



WE/WS 2300 SERIES MAINTENANCE MANUAL



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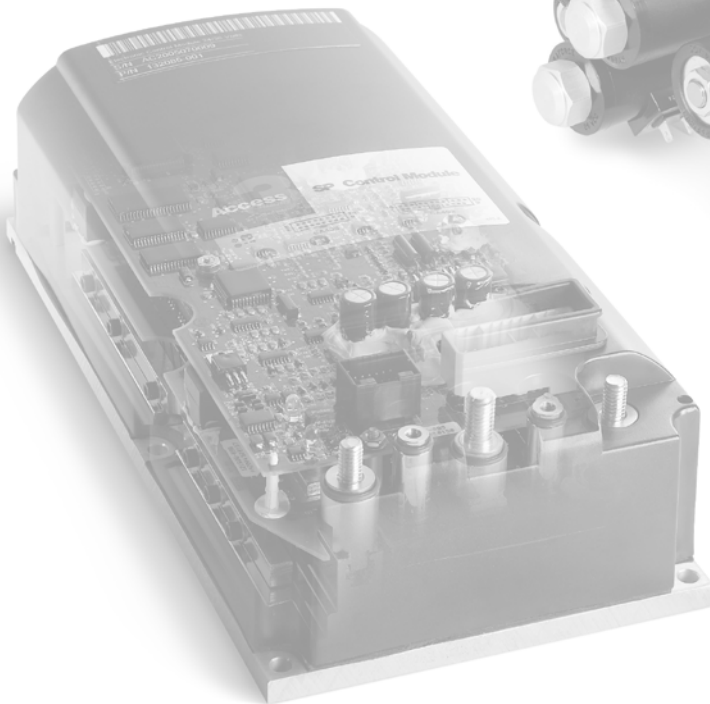
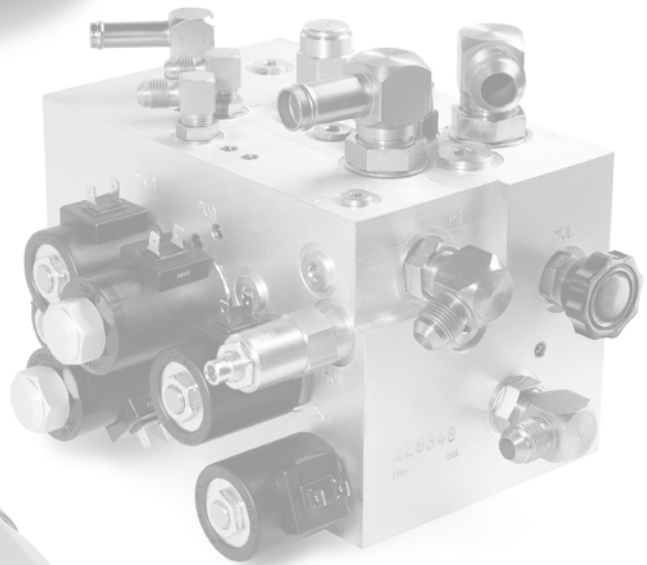


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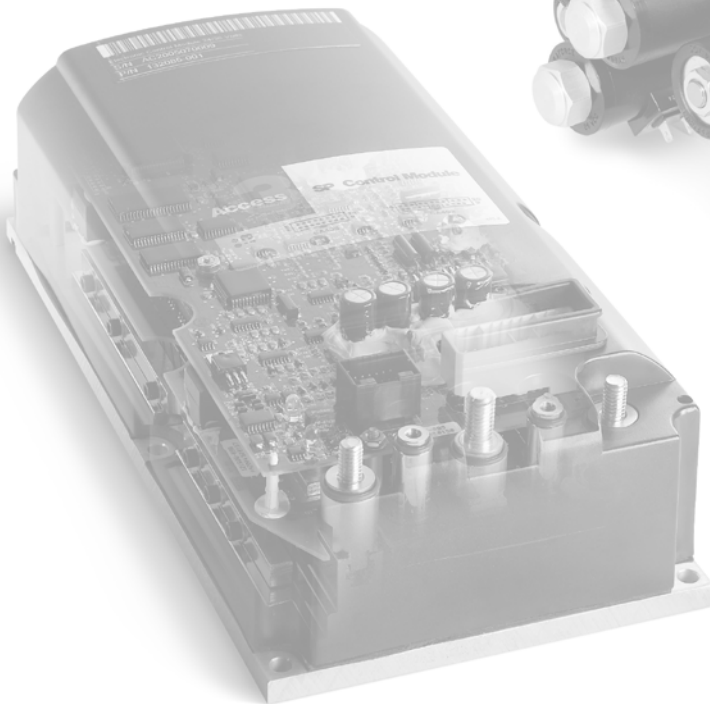
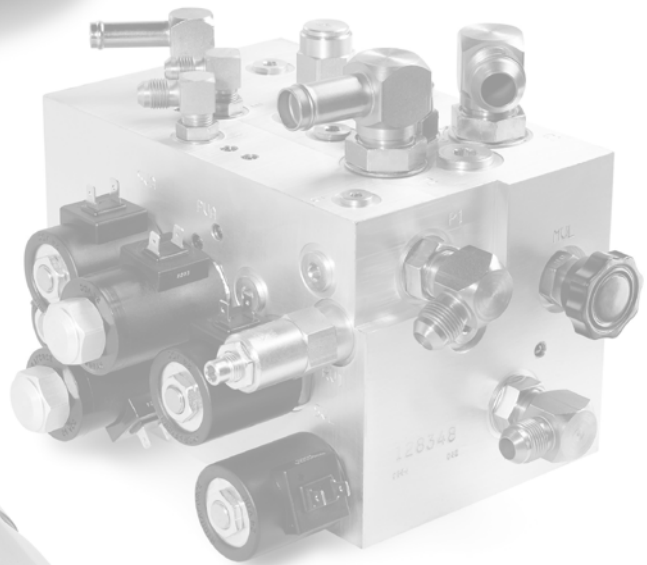
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Notes:



SAFETY



Notes:



SAFETY

Symbols Used

Symbols Used

Safety Symbols

To provide guidance and to identify potential hazards in a clear manner, we have used graphic illustrations in the manual:



DANGER

*This symbol indicates danger to life.
You or other people could be seriously or fatally injured if you fail to comply with this safety instruction.*



WARNING

*This symbol represents risk of injury and/or potentially significant material damage.
You or other people could be seriously injured and/or significant material damage could occur if you fail to comply with this safety instruction.*



CAUTION

*This symbol represents potential minor injuries and/or potential minor material damage.
You or other people could be slightly injured and/or minor material damage could occur if you fail to comply with this safety instruction.*

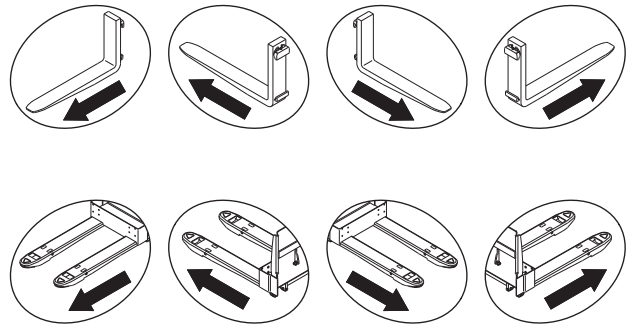
NOTE

This symbol is used with additional information and instructions.

General Symbols

Fork direction

These symbols are used to show the direction of view in an illustration. The direction of the forks is taken as reference:



SAFETY

General Safety Instructions



General Safety Instructions

Maintenance and Repair Instructions



DANGER

*Observe the safety instructions in the maintenance manual and the truck operator manual.
Failure to do so could result in serious or even fatal injuries to maintenance and other personnel.*

Powered trucks can become hazardous if maintenance and service work are neglected. For this reason maintenance and inspections must be performed at sufficiently short intervals. There must be suitably trained personnel and proper guidelines at your place of work.

Maintenance and Repairs

- Always carry out work in accordance with the test and maintenance schedule contained in this manual and any applicable service bulletins.
- Maintenance and repair work must only be performed by qualified and authorized personnel.
- Keep fire protection equipment at hand and do not use a naked flame to check fluid levels or to test for leaks.
- Use groundwater neutral, non-flammable solvents for cleaning. Always perform cleaning work over an oil separator. Protect the electrical system against damp.
- Keep the work place and battery charging station clean, dry and well ventilated.
- Do not allow oils to penetrate the ground or the drainage system. Used oil must be recycled correctly. Oil filters and dehumidifying inserts must be treated as special waste. Observe the local authority regulations.
- Spilled battery fluid must be neutralized immediately and thoroughly rinsed.
- Keep the truck clean. This will facilitate tracing loose or faulty components.
- Maintain the legibility of the data capacity plate and data plate, warning and instruction decals.

- Truck modifications and additions may only be performed with Crown's prior written approval.
- The reliability, safety and suitability of Crown trucks can only be ensured by using original Crown parts.

Before Parking the Truck

- Apply the brake until the truck comes to rest.
- Lower the fork carriage fully.
- Apply the parking brake if applicable.
- Switch off the truck and remove the key.
- When parking on a slope or incline always chock all wheels.

Before Working on the Truck

- Jack up the truck so that the drive wheel is clear of the ground. Apply the Emergency Disconnect and disconnect the battery.
- Prevent the truck from rolling away and lowering.
- When working on the mast, fork carriage or lifting mast always apply a chock to prevent accidental lowering.
- Allow sufficient room for manoeuvre when testing the truck, to avoid endangering yourself and other people.

Before Starting the Truck

- Test the safety mechanisms.
- Get into the travel position.
- Test the lifting mechanism, travel switch, speed control, steering, warning mechanism and brakes.

Warning and Instruction Decals on the Truck

In the course of periodic maintenance work, check that the warning and instruction decals on the truck are complete and legible.

- Clean any dirty decals.



SAFETY

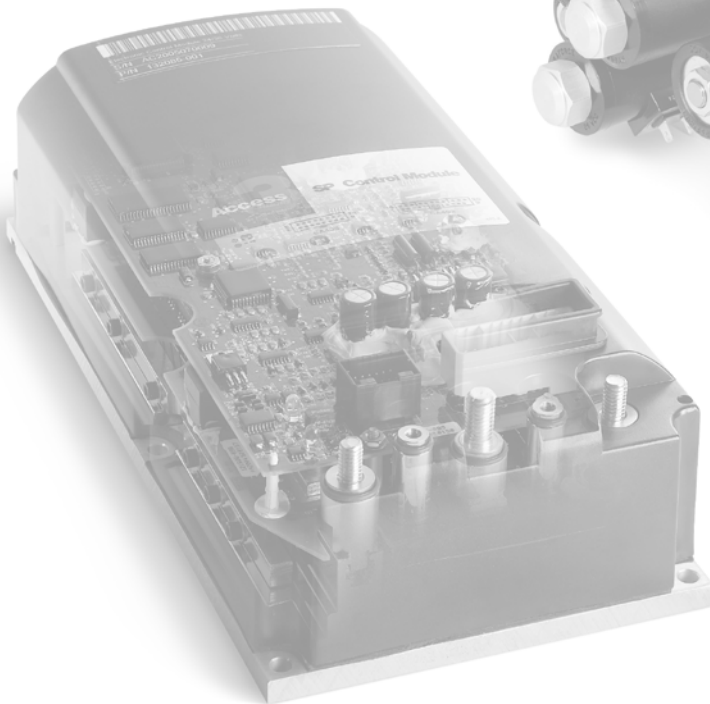
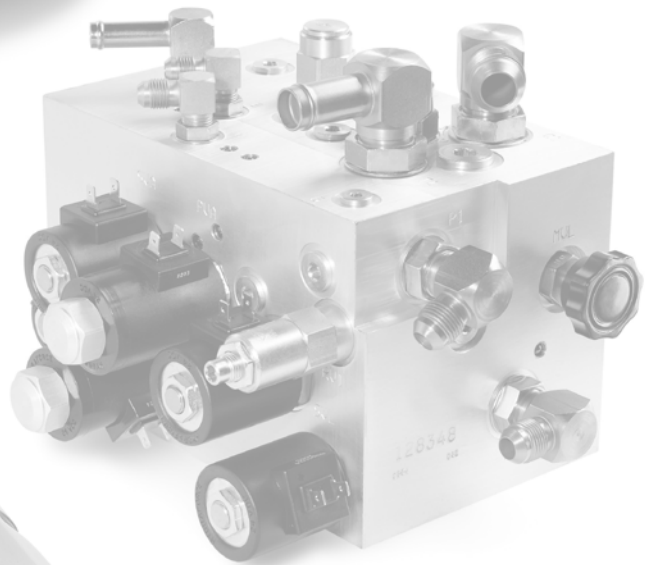
General Safety Instructions

- Replace any faulty or missing decals.

A description of the warning and instruction decals used on the truck and their locations are given in chapter 10.9 of the parts manual.



Notes:



INTRODUCTION



Notes:



INTRODUCTION

General

General

This manual is designed for Customer Service engineers who wish to familiarise themselves with maintenance work required for the various truck components.

It also contains troubleshooting sections which can be used to identify and remedy faults.

INFORMATION

This book is not an operator manual. It is designed solely for specialist personnel who are trained and authorised to carry out the work described in the manual.

Operator Manual

This manual does **not** contain operating instructions. An operator manual is supplied with the truck. Additional copies can be ordered if required.

This manual will help you and your personnel to ensure the long service life, operational safety and error-free functioning of your Crown truck.

Service Training

Crown offers truck-specific training for service personnel. Contact Crown for details.

Ordering Spare Parts

The maintenance manual does not cover spare parts. These are listed in a separate parts manual.

Spare parts can be ordered by quoting the:

- Truck specification number
- Truck model number
- Truck serial number

This information can be found on the truck data plate. Orders can only be processed quickly, correctly and reliably if the above information is supplied.

Refer to the Technical Specifications sheet for the utilisable loads, technical data and dimensions for this

series. Publications can be obtained from your Crown dealer or from the following address:

CROWN Gabelstapler GmbH & Co.KG
Moosacher Str. 52
80809 Munich
GERMANY

Tel.: +49 (0)89 / 93 002 -0

Fax: +49 (0)89 / 93 002 -175 or 133

Using the Manual

The manual is divided into chapters. The following table shows how the manual is structured

Manual structure	
Section	Table of Contents
IDX	Index
MA	Safety
ITD	Introduction
1	Lubrication & Adjustment
2	Hydraulic System
3	Drive Unit
4	Electrical System
5	Brake System
6	Steering
7	Lifting Mechanism
8	Cylinders
9	Platform
10	Glossary

INTRODUCTION

Models



Models

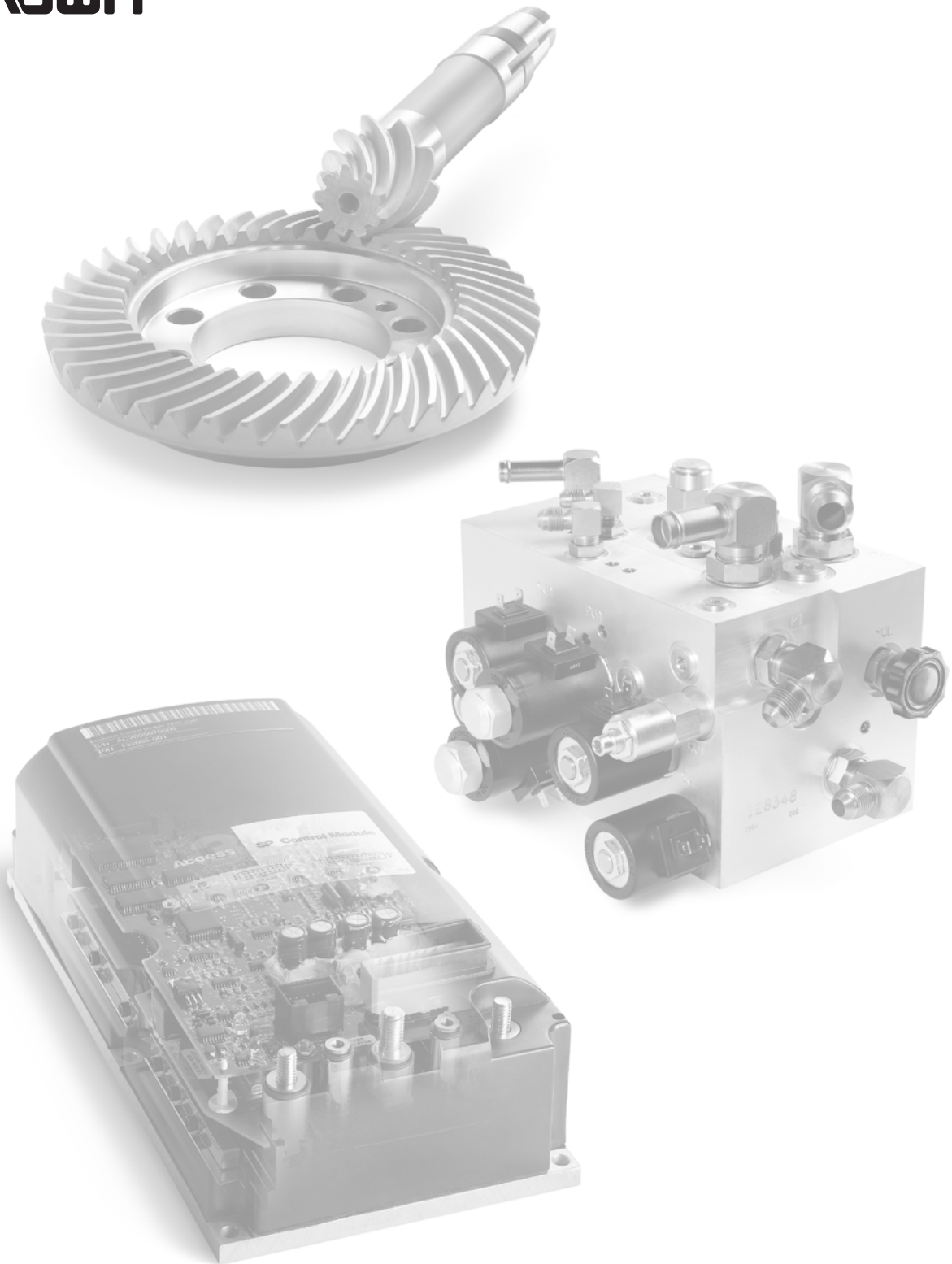
The manual covers maintenance and repair work for the following models:

WE2300

WS2300

WE2300S

WS2300S



LUBRICATION & ADJUSTMENT



Notes:



LUBRICATION & ADJUSTMENT

Component Access

Component Access

Up to serial no. 5A134880

The following is a list of covers, panels etc. which must be removed before carrying out repairs and / or maintenance in order to access the components.



WARNING

Before starting work read the safety notices and instructions in the relevant sections of this manual.

Drive Unit Cover

Provides access to:

- Traction motor (TM)
- Drive unit
- Brake
- Pump motor (PM), lift contactor (P), valves (PV, SVCL, SVH, SVA1, SVA2)
- Hydraulic oil reservoir
- Horn (HN)
- Traction control module (TCM)
- Direction contactor (F / R)
- Fuse FU1 (travel power fuse)
- Fuse FU3 (raise)
- Proportional lift PCB
- Unigage (TT / BDI)
- Key switch (KYS)
- Fuse 2, FU2 (control circuit)
- Fuse 4, FU4 (discharge indicator)
- Fuse 5, FU5 (option F/C)
- Platform module (PLM2)
From serial no. 5A132188
- Distributor PCB
- On-board charger

Control Handle

Provides access to:

- Horn switches (HNS1, HNS2)
- Main Lift – lower switches (LOS1, LOS2)
- Main Lift – lift switch (RAS)
- Fast / slow travel switch (HSS)
- Safety reverse switch (SAS)
- Potentiometer (POT)
- Forward switch (FS)
- Reverse switch (RS)
- Auxiliary hydraulic switches

Control Handle Knuckle

Provides access to:

- Brake switch (BRS)
- Brake override switch⁽¹⁾

Mast

Provides access to mast switches:

- Lift speed reduction switch (LMS)
- Lift switch (LMS2)⁽²⁾

Platform and Side Restraints⁽²⁾

Provides access to:

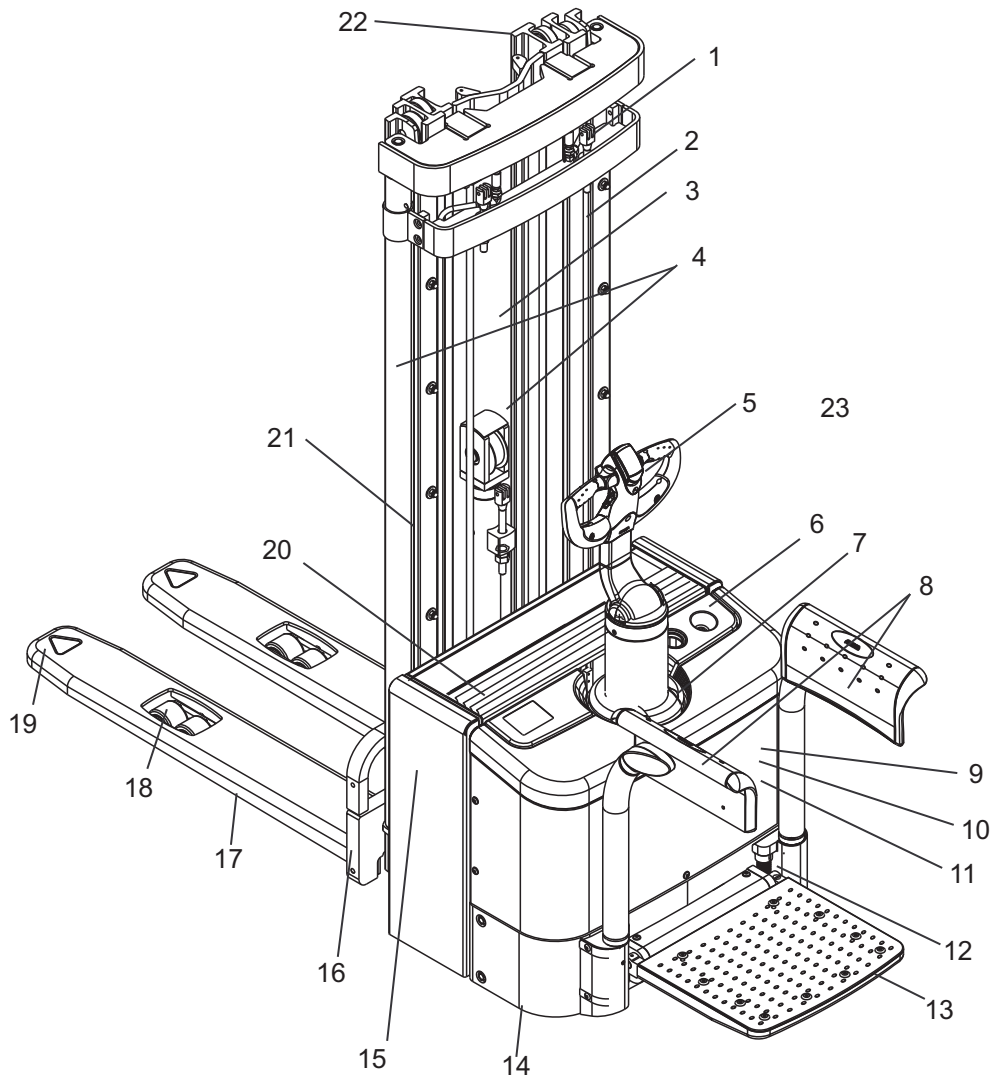
Travel mode switches (GCSL, GCSR, PLS)

⁽¹⁾ Non-platform trucks only

⁽²⁾ Folding platform trucks only

LUBRICATION & ADJUSTMENT

Component Access



MS-4223-042

- | | | | |
|----|--------------------------------------|----|--------------------------------|
| 1 | Lift chain | 2 | Mast limit switch |
| 3 | Safety shield | 4 | Lift cylinders |
| 5 | Control handle | 6 | Display panel |
| 7 | Control handle knuckle | 8 | Side restraints ⁽¹⁾ |
| 9 | Pump unit & hydraulic manifold block | 10 | Controller and contactors |
| 11 | Drive unit / brake | 12 | Castor wheel |
| 13 | Platform ⁽¹⁾ | 14 | Drive wheel |
| 15 | Battery compartment | 16 | Fork carriage |
| 17 | Outrigger | 18 | Load wheel |
| 19 | Fork | 20 | Battery / battery connector |
| 21 | 1st mast stage | 22 | 2nd mast stage |

⁽¹⁾ Folding platform trucks only



LUBRICATION & ADJUSTMENT

Component Access

Component Access

From serial no. 5A134882

The following is a list of covers, panels etc. which must be removed before carrying out repairs and / or maintenance in order to access the components.



WARNING

Before starting work read the safety notices and instructions in the relevant sections of this manual.

Drive Unit Cover

Provides access to:

- Traction motor (TM)
- Drive unit
- Brake
- Pump motor (PM), lift contactor (P), valves (PV, SVCL, SVH, SVA1, SVA2)
- Hydraulic oil reservoir
- Horn (HN)
- Traction control module (TCM)
- Direction contactor (F / R)
- Fuse FU1 (travel power fuse)
- Fuse FU3 (raise)
- Hydraulic control module (HCM)
- Unigage (TT/BDI)
- Key switch (KYS)
- Fuse 2, FU2 (control circuit)
- Fuse 4, FU4 (discharge indicator)
- Fuse 5, FU5 (option F/C cold store)
- Platform module (PLM2)
- Distributor PCB
- On-board charger

Control Handle

Provides access to:

- Horn switches (HNS1, HNS2)
- Main Lift – lower switches (LOS1, LOS2)
- Main Lift – lift switch (RAS)
- Fast / slow travel switch (HSS)
- Safety reverse switch (SAS)
- Potentiometer (POT)
- Forward switch (FS),
- Reverse switch (RS)
- Auxiliary hydraulic switches

Control Handle Knuckle

Provides access to:

- Brake switch (BRS)
- Brake override switch⁽¹⁾

Mast

Provides access to mast switches:

- Lift speed reduction switch (LMS)
- Lift switch (LMS2)⁽²⁾

Platform and side restraints⁽²⁾

Provides access to:

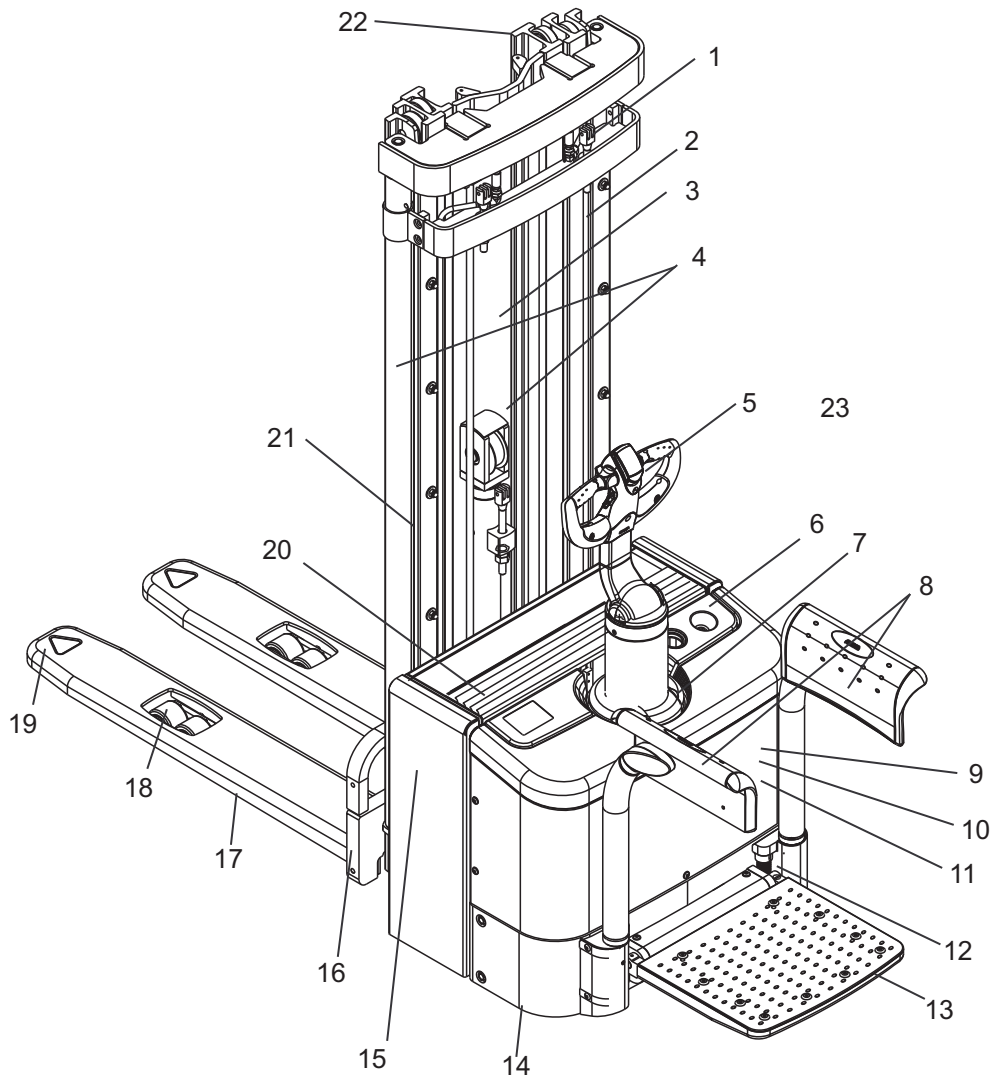
Travel mode switches (GCSL, GCSR, PLS)

⁽¹⁾ Non-platform trucks only

⁽²⁾ Folding platform trucks only

LUBRICATION & ADJUSTMENT

Component Access



- | | | | |
|----|--------------------------------------|----|--------------------------------|
| 1 | Lift chain | 2 | Mast limit switch |
| 3 | Safety shield | 4 | Lift cylinders |
| 5 | Control handle | 6 | Display panel |
| 7 | Control handle knuckle | 8 | Side restraints ⁽¹⁾ |
| 9 | Pump unit & hydraulic manifold block | 10 | Controller and contactors |
| 11 | Drive unit / brake | 12 | Castor wheel |
| 13 | Platform ⁽¹⁾ | 14 | Drive wheel |
| 15 | Battery compartment | 16 | Fork carriage |
| 17 | Outrigger | 18 | Load wheel |
| 19 | Fork | 20 | Battery / battery connector |
| 21 | 1st mast stage | 22 | 2nd mast stage |

⁽¹⁾ Folding platform trucks only



LUBRICATION & ADJUSTMENT

Lifting the Truck



DANGER

Fatal injuries can result from a falling crane or lift truck. Make sure the crane, truck and the lifting gear have the required capacity.

Minimum capacity required (truck without battery): see data plate

The forks must be fully lowered.

Lifting with a Crane

The forks must be fully lowered. Attach lifting gear as shown in the following diagram and prevent the truck from slipping (see arrow).



MO-4223-014

LUBRICATION & ADJUSTMENT

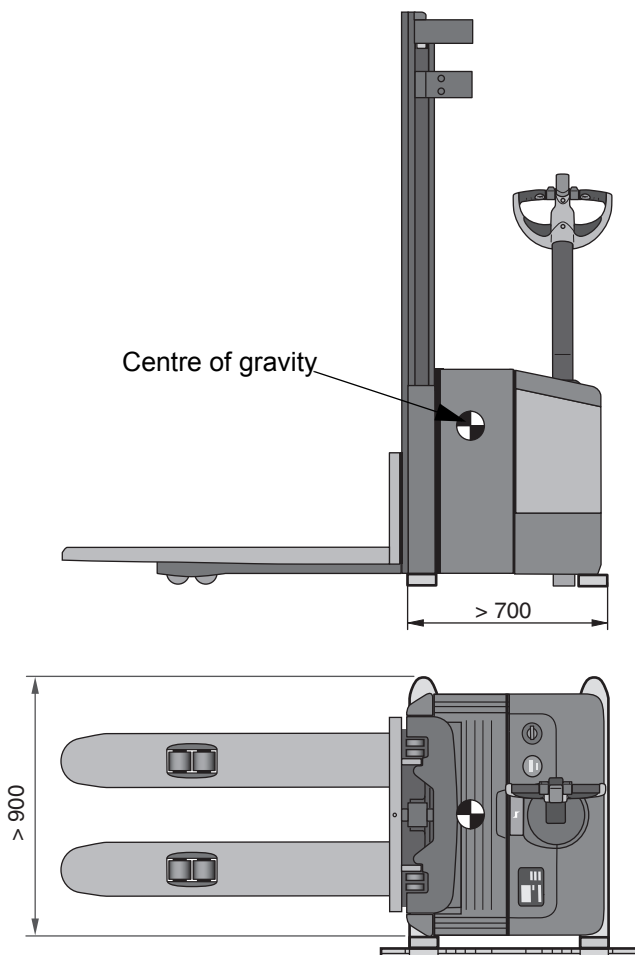
Lifting with a Forklift Truck



DANGER

Failure to comply with the instructions can cause the truck to tip over or drop off the forks.

- *Fatal accidents may result.*
- *Position the forks of the truck which is doing the lifting as shown in the diagram below.*
- *The truck's centre of gravity, with or without the battery, lies near the battery compartment. It should always lie between the forks of the truck doing the lifting.*
- *Attach the truck securely to the forks of the truck which is doing the lifting (e.g. with tensioning belts).*



G_WEWS23-lifted



LUBRICATION & ADJUSTMENT

Towing the Truck

Towing the Truck

When the truck is de-energised, the brake (acting on the drive wheel) is applied. In order to remove the truck from an aisle for example, it can be raised and pulled by a forklift truck. Capacity required = truck weight, see data plate. The load wheels remain on the ground when the truck is towed.

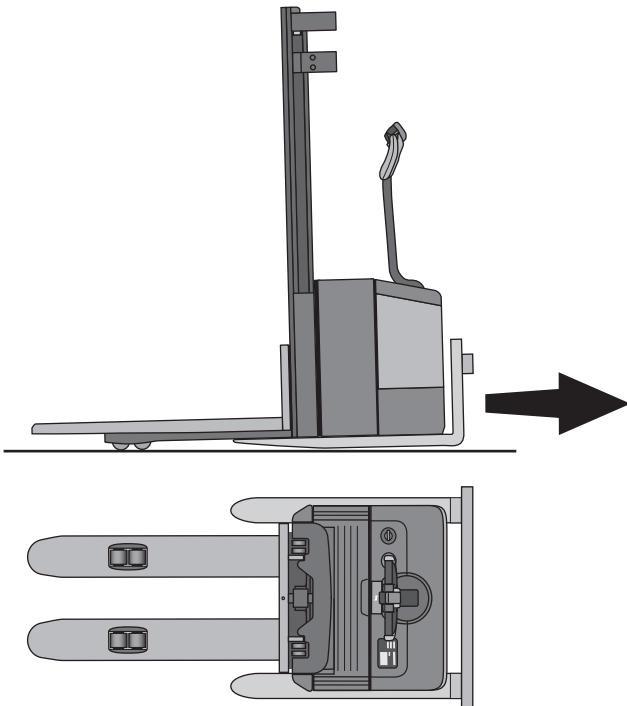
- Position the forks as shown in the diagram.
- Raise the truck (at the front) approx. 20 mm.



CAUTION

The drive wheel should no longer be touching the ground.

- *Otherwise the truck could be damaged.*
- *Pull the truck forward slowly and straight ahead (as indicated by the black arrow).*



G_WEWS23-tow

LUBRICATION & ADJUSTMENT

Jacking up the Truck



Jacking up the Truck



DANGER

Risk of serious injury.

Failure to handle the truck and/or the equipment correctly could result in fatal injury.

Never reach with your hands or other parts of your body under the truck before it has been supported, or when jacking up the truck.

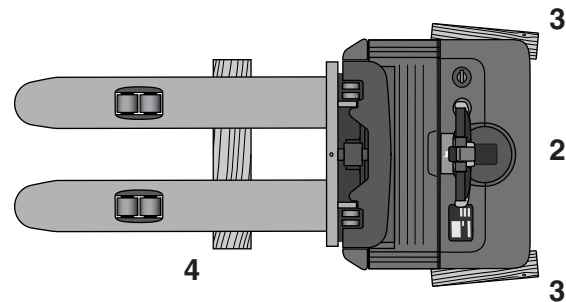
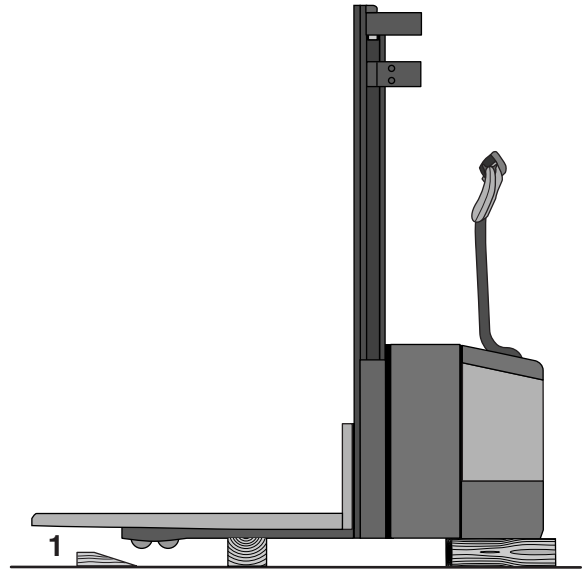
Always support a raised truck with hard wooden blocks or other appropriate equipment to relieve the jack.

- *Improper handling of the truck or the tools can result in fatal accidents.*

To jack up the truck proceed as follows:

The forks must be lowered and must not be carrying any load.

1. Place wedges (1) in front of both load wheels.
2. Open the panel.
3. Place a jack with sufficient capacity (> 1000 kg) in the centre of the articulated axle (2) and raise the truck a maximum of 20 mm.
4. Place sufficiently sized wooden blocks (hard wood) on the left and right-hand sides underneath the chassis and lower the truck onto them (3).
5. Now raise the outriggers with the jack.
6. Slide a hard wooden block underneath and lower the truck onto it (4).



G_WEWS23-jack-up



LUBRICATION & ADJUSTMENT

Service

Service

Recommended Lubricants

The next page shows typical lubricants used by Crown itself in its facilities. However, you can use any lubricants provided they meet the same technical criteria.

Cold Store Trucks

Special hydraulic oil, lubrication oil and grease must be used for cold store trucks operating in low temperature conditions (see table on following page). An anti-corrosion fluid (Crown no. 805236-004) must be applied to all screws, washers, nuts, pins, retaining rings etc. Take care to protect all electrical connections and components from corrosion. For detailed information, refer to chapter 4.

Service intervals must be adapted to the conditions of use. This means they must be reduced as far as possible to prevent excessive wear.

Taking the Truck out of Service

- If the truck is to be out of service for 3 months or more, proceed as follows:
- Disconnect the battery.
- De-commission the battery in accordance with the manufacturer's instructions.
- Clean the truck. Carry out lubrication in accordance with the maintenance manual.
- If the truck is to be stored in hostile conditions (e.g. saline atmosphere) treat the surface of the truck with a suitable preservative to prevent corrosion.
- Do not park the truck in the open air or in a humid environment. The ideal place is a dry room where the temperature and air humidity are reasonably constant. If the truck has to be covered, use an air-permeable material. Do not use plastic sheets. Otherwise, condensation may form.
- Jack up the truck. Lower the chassis onto suitable wooden blocks so that the wheels clear the ground (prevents the wheels from flattening under constant pressure).

- Every 3 months connect the battery, carry out a daily inspection and activate all the truck functions. Finally, disconnect the battery again.

Returning the Truck to Service

To return the truck to service, proceed as follows:

- Remove any anti-corrosion agents which have been applied additionally (apart from the cold store agents)⁽⁴⁾.
- Jack up the truck, remove the wooden blocks and lower the truck.
- Charge the battery or fit a charged battery.
- Connect the battery.
- Carry out the daily inspection.

Do not use pressure jets and/or solvents with the truck. Do not use metal brushes. Do not wet-clean the electrical system and do not use flammable cleaning agents.

LUBRICATION & ADJUSTMENT

Recommended Lubricants and Consumables



Recommended Lubricants and Consumables

Lubricant Type	Product	Manufacturer	Crown Part Number	Type
Grease (Multi-Purpose)	Aralube HLP2 LM Grease Regulus A2 Beacon EP2 EP2 Mobiluxe EP2 Retinax LX LGWMI	Aral Castrol Century Esso Maxol Mobil Shell SKF	053002-005	B
Grease (Low Temperature)	Aralube SKL2 Unirex Lotemp EP	Aral Mobil	053002-005	BB
Hydraulic Oil	Vitam GF 32 Hyspin AWS-32 Nuto H32 DTE 24 Tellus 32 Hydran LZ 32 B110	Aral Castrol Esso Mobil Shell Finol Fuchs Mineralölwerke GmbH	053001-009	D
Hydraulic Oil (Low Temperature)	Deutz Oel HVI 32	Klöckner	053001-009	DD
Transmission oil	Hyp 85W90 GX-D 85W90 Mobilube HD85W90 Spirax MB90	Aral Esso Mobil Shell	053002-004	A
Transmission oil (Low Temperature)	Mobil SHC 624	Mobil	053002-009	AA
Lubrication oil	Kowal 40 Essolube HDX + 40 Delvac 1240	Aral Esso Mobil	053002-008	G
Lubrication oil (Low Temperature)	SHC 626	Mobil	053002-008	GG
Rubber & Vinyl Dressing	---	---	---	H

Lubricants	Product	Application	Crown Part No.
Anti-corrosive agent	Tectyl	Corrosion inhibitor for cold store trucks	805236-004



LUBRICATION & ADJUSTMENT

Recommended Lubricants and Consumables

Lubricants	Product	Application	Crown Part No.
Clearseal paint	2K clearseal paint	Acid-resistant clearseal paint for traction controllers used in cold stores.	805236-003

LUBRICATION & ADJUSTMENT

Inspection and Maintenance Schedule



Inspection and Maintenance Schedule

The following inspection and maintenance schedules assume single-shift operation under normal conditions. The frequency of maintenance intervals must however be constantly adapted to the prevailing operating conditions.

In dusty or otherwise extreme operating conditions including cold store application, the maintenance intervals specified must be reduced. Exact details should be discussed with a Crown service engineer.

When carrying out maintenance routinely check for wear, corrosion, damage, component operation and safety. Always replace a component if in doubt.



LUBRICATION & ADJUSTMENT

Inspection and Maintenance Schedule

Daily or Every 8 Service Hours

Index	Location	Action
I01	Battery	Ensure battery connector is tight and check for damage. Check contacts for signs of burning. Check battery compartment for spilled acid. Both the battery left and right-hand side panels must be properly engaged. Check/charge battery in accordance with manufacturer's instructions if necessary.
I02	Gear Unit	Check for leaks: Dark oil at the bottom near the drive wheel? If leakage is found, take the truck out of service.
I03	Hydraulics	Check for leaks: Traces of light oil on the ground beneath the truck? If leakage is found, take the truck out of service.
I04	Steering	Check operation, ensure there is zero backlash.
	WE / WS 2300 S: Platform and Side Restraints	Test freedom of movement, automatic reset and check for any damage. The platform must not be slippery (no oil, loose leaves, sheets etc.). Clean if necessary. The platform should always fold up automatically when the driver exits.
I05	Forks, Fork Carriage	Check for possible damage, cracks and excessive wear. Raise and lower forks. Check operation. Check that the chain, inner mast and mast rollers are running correctly. WS: The fork latches should be firmly engaged.
	Load Backrest (if applicable)	Ensure it is fitted securely and check for damage.
I06	Lift Chains, Chain Anchor	Check for possible corrosion, cracks and any other damage.
I07	Wheels, Load Wheels	Check tyres for wear and foreign bodies. Remove all foreign bodies.
I08	Safety Shield	Securely attached, not cracked and still visible?
	Labels, Decals	Check that they are all present, clean and legible. See spare parts manual.
I09	Key Switch	Switch on and test battery discharge indicator operation.
I10	Emergency Power Disconnect Switch	Check operation.
	Horn	Check operation.
I11	Travel Functions	Move the truck in both directions, first slowly and then at full speed. Test rabbit / turtle switch operation (fast / slow). Check speed reduction when forks are raised.
I12	WE / WS 2300 S: Brake override zone	Test speed reduction and brakes in brake override zone (not on platform truck)

LUBRICATION & ADJUSTMENT

Inspection and Maintenance Schedule



Index	Location	Action
I13	WE / WS 2300 S: Platform Logic From serial no. 5A132188	Test "rabbit" speed setting (fast) - Platform folded up (top): - Maximum speed 6.0 km/h if both side restraints are folded in. - Travel block if one or both side restraints are folded out. Platform folded out (bottom): - Maximum speed 6.0 km/h if both side restraints are folded in. - Maximum speed 8.3 km/h if both side restraints are folded out. Travel block if forks > 1800 mm - Travel block if just one side restraint is folded out.
I14	Brake	Test brakes in both directions: - by changing direction - by moving the control handle to the braking position (has the stopping distance increased since the last check?) The control handle should automatically revert to the upright position when you release it from the travel position.
I15	"Auto Reverse" Switch	Test operation - see following page for details.
I16	Lift / Lower	Raise and lower the forks. Check operation. Check the mast, chains, hoses and hose reels while the forks are being raised and lowered to ensure they are working correctly.
	If applicable: Sideshift	Check operation.



LUBRICATION & ADJUSTMENT

Inspection and Maintenance Schedule

Safety Reverse Switch Test

NOTE

For platform trucks this test can only be performed in pedestrian (walkie) mode.



DANGER

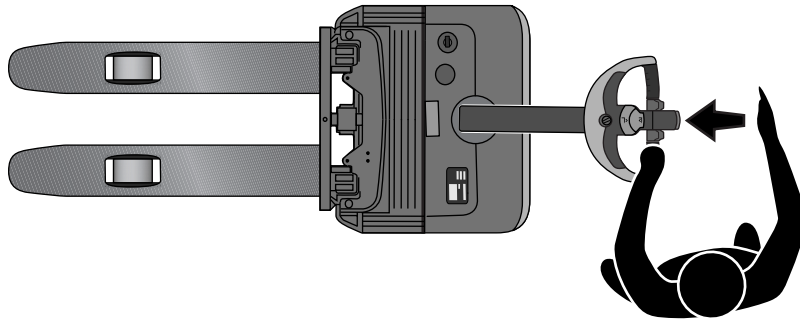
Risk of injury to third parties!

Always test the safety reverse switch in a secure environment with no other people around and sufficiently far away from obstacles.

1. Set the control handle straight so that the truck can only travel in a forward direction.
2. Stand to the side at a sufficient distance from the control handle.
3. Travel slowly in the direction of the control handle.
4. Make sure there is no one else in the vicinity.
5. Apply the safety reverse switch.

The truck should stop immediately and then, after a few seconds or for however long the switch is held down, move off in the opposite direction.

If the test does not work, the fault must be rectified before using the truck again.



G_WEWS23-ARS-test

LUBRICATION & ADJUSTMENT

Test and Maintenance Interval Chart



Test and Maintenance Interval Chart

Abbreviations

M Months

I Inspection

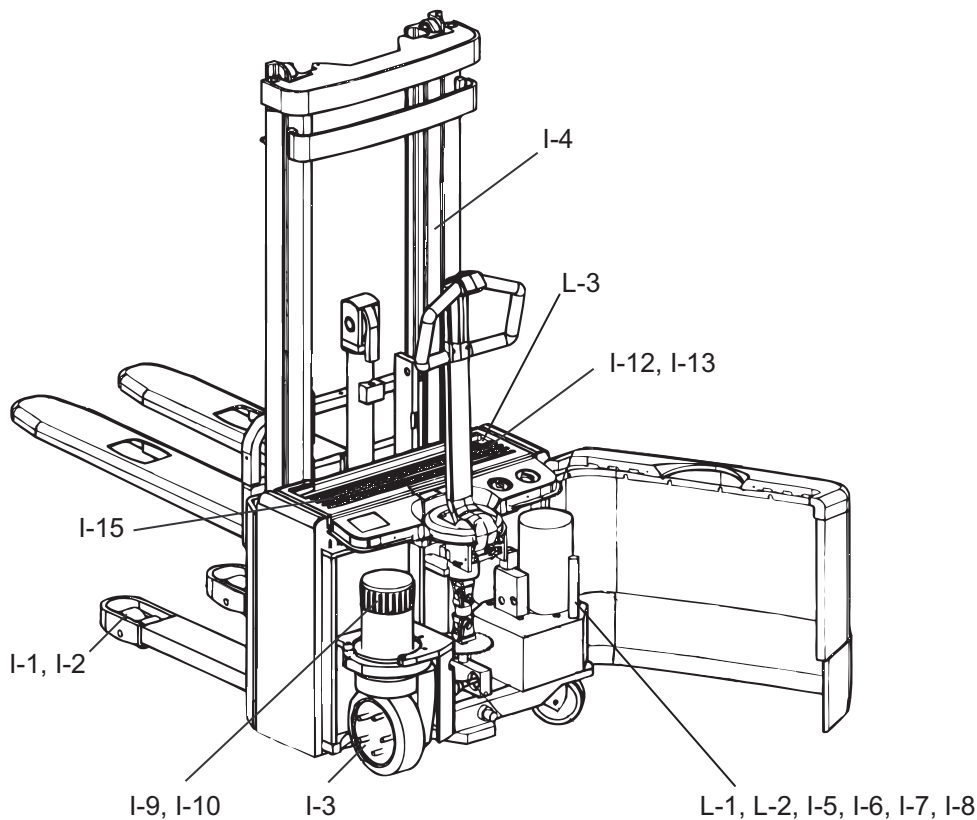
X Standard

B - H, BB - GG see lubricant table on page 22

h Service hours

L Lubrication

C Cold Store



MS-4223-045

Position	Lubri- cant	Action	3 M	6 M	12 M	24 M
			100 h	250 h	500 h	1000 h
I-01		Check the clearance and wear levels on the load wheel and castor wheel supports	X / C			
I-02		Check the tyres of the load wheels, caster wheels and drive wheel for wear.		X / C		



LUBRICATION & ADJUSTMENT

Test and Maintenance Interval Chart

Position	Lubri- cant	Action	3 M	6 M	12 M	24 M
			100 h	250 h	500 h	1000 h
I-03		Tighten the drive wheel nuts after 50 hours on a new truck or after removal/assembly. Thereafter every 500 hours or every 12 months.		X / C		
I-04		Check hydraulic lines and hoses for damage, and check connections are tight.		X / C		
L-01	D / DD	Check hydraulic oil level, replenish if necessary.		X / C		
L-02	D / DD	Replace hydraulic oil.				X / C
I-05		Check relief valve setting.			X / C	
I-06		Check attachment clamp, pump motor.				X / C
I-07		Check carbon brushes and commutator of pump and traction motors for wear.			X / C	
I-08		Check pump motor coupling for damage and wear.				X / C
I-09		Tighten the traction motor attachments.				X / C
I-10		Torque the gear unit attachment, check gear unit oil level.				X / C
I-11		Torque all power cable connections.			X / C	
I-12		Clean battery connector contacts and check contact springs.		X / C		
I-13		Clean battery connector contacts. Check connector housing, contact springs and cables.		X / C		
I-15		Check charger connecting cable for damage.	X / C			
I-16		Check all electrical lines for damage to insulation, and ensure switches and connections are secure and check for corrosion.			X / C	
L-3	B / BB	Lubricate hinges and battery panel lock.		X / C		

LUBRICATION & ADJUSTMENT

Test and Maintenance Interval Chart



Abbreviations

M Months

I Inspection

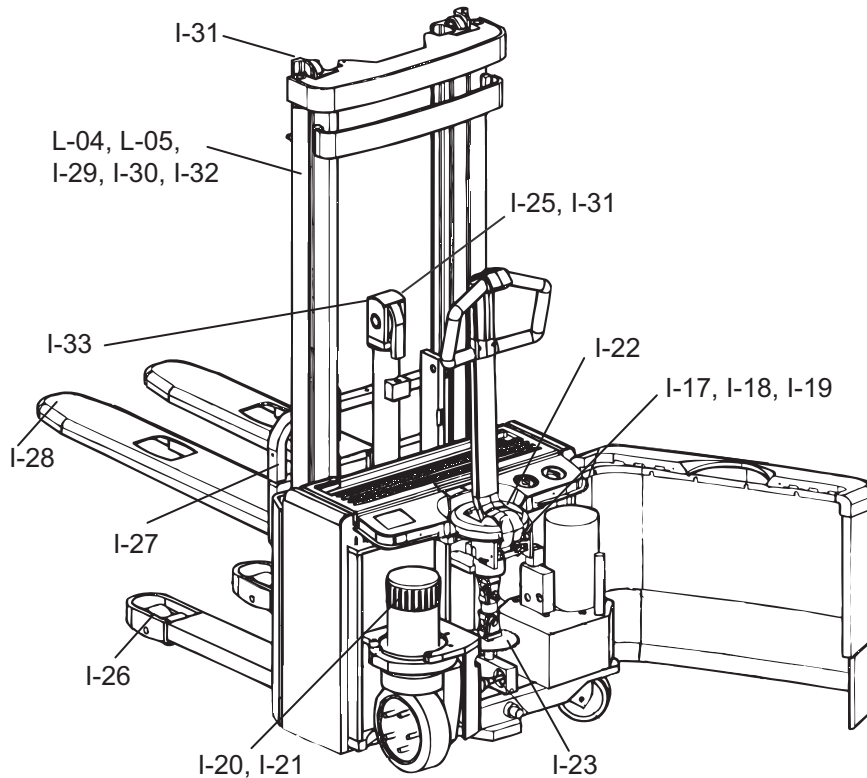
X Standard

B - H, BB - GG see lubricant table on page 22

h Service hours

L Lubrication

C Cold Store



MS-4223-046

Position	Lubri- cant	Action	3 M	6 M	12 M	24 M
			100 h	250 h	500 h	1000 h
I-17		Clean pump contactor contacts and check for wear.		X / C		
I-18		Clean main contactor contacts and check for wear.		X / C		
I-19		Read traction controller error log. Torque traction controller attachment.			X / C	
I-20		Apply pressurised air to abrasion in brake. Check the conical nipple for damage. Check air gap.	X / C			



LUBRICATION & ADJUSTMENT

Test and Maintenance Interval Chart

Position	Lubri- cant	Action	3 M	6 M	12 M	24 M
			100 h	250 h	500 h	1000 h
I-21		Dismantle the brake. Clean all components and check for wear and damage. Replace any worn or damaged components.			X / C	
I-22		Check the restoring force of the control handle springs.			X / C	
I-23		Check the steering chain tension.		X / C		
I-25		Check the alignment of the mast to the truck (lowering plumb test).		X / C		
I-26		Check fork carriage for cracks, and check rollers for slack.		X / C		
I-27		Check slack between forks and fork carriage.			X / C	
I-28		Check forks for damage and wear.			X / C	
I-29		Clean mast contact surfaces and check for wear.			X / C	
L-04	B / BB	Lubricate mast contact surfaces.			X / C	
I-30		Clean all lift chains, check for damage, corrosion and wear (elongation).		X / C		
L-05	G / GG	Lubricate lift chains.		X / C		
I-31		Check chain anchors for damage, corrosion and cracks.		X / C		
I-32		Check mast rollers for wear and slack.		X / C		
I-33		Check load backrest for damage and ensure it is securely fitted.		X / C		

LUBRICATION & ADJUSTMENT

Test and Maintenance Interval Chart



Abbreviations

M Months

I Inspection

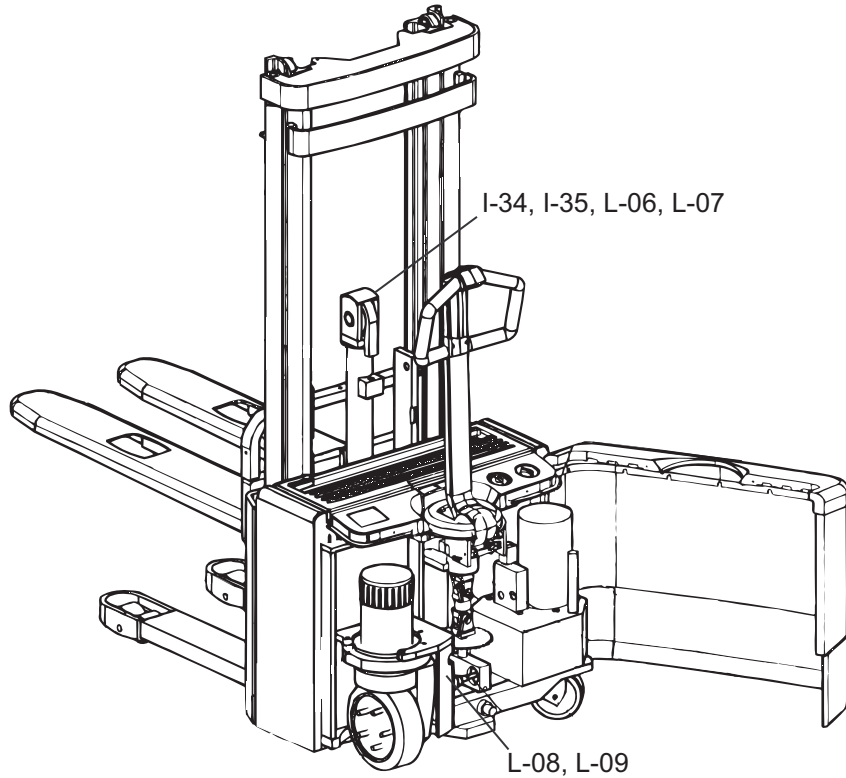
X Standard

B - H, BB - GG see lubricant table on page 22

h Service hours

L Lubrication

C Cold Store



MS-4223-047

Position	Lubri- cant	Action	3 M	6 M	12 M	24 M
			100 h	500 h	1000 h	1000 h
I-34		Check pulleys, pulley yoke, hose rollers and mast limit cushioning for wear, damage and slack.		X / C		
L-06	H	Lubricate hose rollers.		X / C		
L-07	G / GG	Lubricate chain pulleys.		X / C		
L-08	A / AA	Check transmission oil level, replenish if necessary.		X / C		
L-09	A / AA	Replace transmission oil				X / C
I-35		Check hydraulic cylinder piston rods for damage and ensure cylinder is sealed. Check cylinder attachment fuses.		X / C		



LUBRICATION & ADJUSTMENT

Test and Maintenance Interval Chart

Position	Lubri- cant	Action	3 M	6 M	12 M	24 M
			100 h	500 h	1000 h	1000 h
		Carry out the UVV inspection (Germany only. For other countries, refer to national regulations).			Annually	
		PMT test (traction controller safety test, see chapter 4).			Annually	

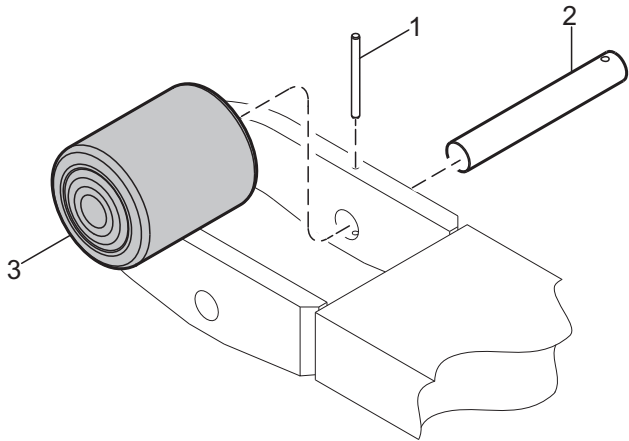
LUBRICATION & ADJUSTMENT

Load Wheels and Castors



Load Wheels and Castors

Single Load Wheel Replacement (WE)



MS-4423-002



WARNING

Risk of serious injury!

Avoid accidents by:

- Switching off the truck
- Disconnecting the battery
- Preventing the truck from being switched on again.
- Jacking up the truck and preventing it from rolling away

For further details refer to the Safety chapter.

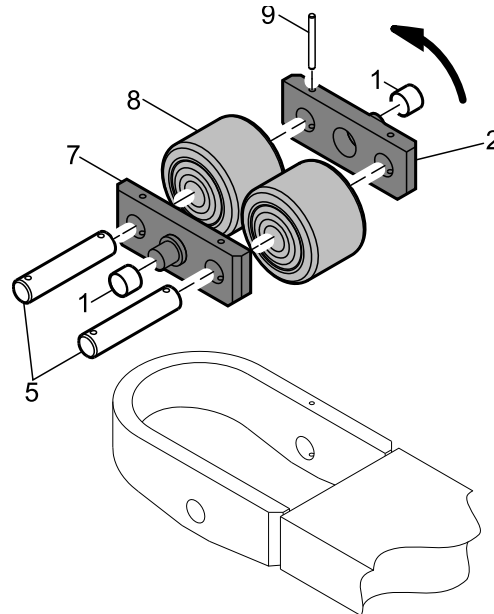
Removal

1. Drive the dowel pin (1) out of the axle (2).
2. Remove the axle and take off the load wheel (3).

Assembly

Assembly is the reverse order of removal.

Tandem Load Wheel Replacement (WE)



MS-4423-004



WARNING

Risk of serious injury!

Avoid accidents by:

- Switching off the truck
- Disconnecting the battery
- Preventing the truck from being switched on again.
- Jacking up the truck and preventing it from rolling away

For further details refer to the Safety chapter.

Removal

1. Drive the dowel pins (9) out of the axles (5).
2. Raise the outrigger.
3. Turn / flip the rocker switch up.
4. Remove the axles and take off the load wheels (8).
5. Remove the rocker switches (2).
6. Drive out the bearing bushing (1).



LUBRICATION & ADJUSTMENT

Load Wheels and Castors

Assembly

Prior to assembling:

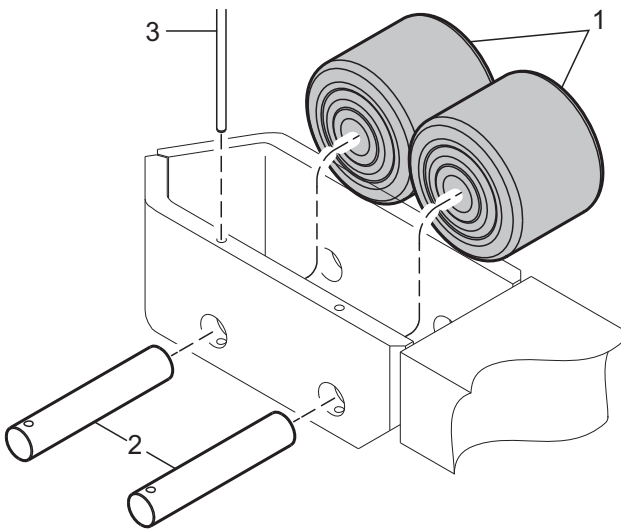
1. Check the bearing bushing (1) for wear. Replace if necessary.

Assembly is the reverse order of removal.

Assembly

Assembly is the reverse order of removal.

Tandem Load Wheel Replacement (WS)



MS-4423-003



WARNING

Risk of serious injury!

Avoid accidents by:

- Switching off the truck
- Disconnecting the battery
- Preventing the truck from being switched on again.
- Jacking up the truck and preventing it from rolling away

For further details refer to the Safety chapter.

Removal

1. Drive the dowel pins (3) out of the axles (2).
2. Pull off the axles and remove the load wheels (1).

LUBRICATION & ADJUSTMENT

Load Wheels and Castors



Castor (WE/WS)



WARNING

Risk of serious injury!

Avoid accidents by:

- *Switching off the truck*
- *Disconnecting the battery*
- *Preventing the truck from being switched on again.*
- *Jacking up the truck and preventing it from rolling away*

For further details refer to the Safety chapter.

Removal

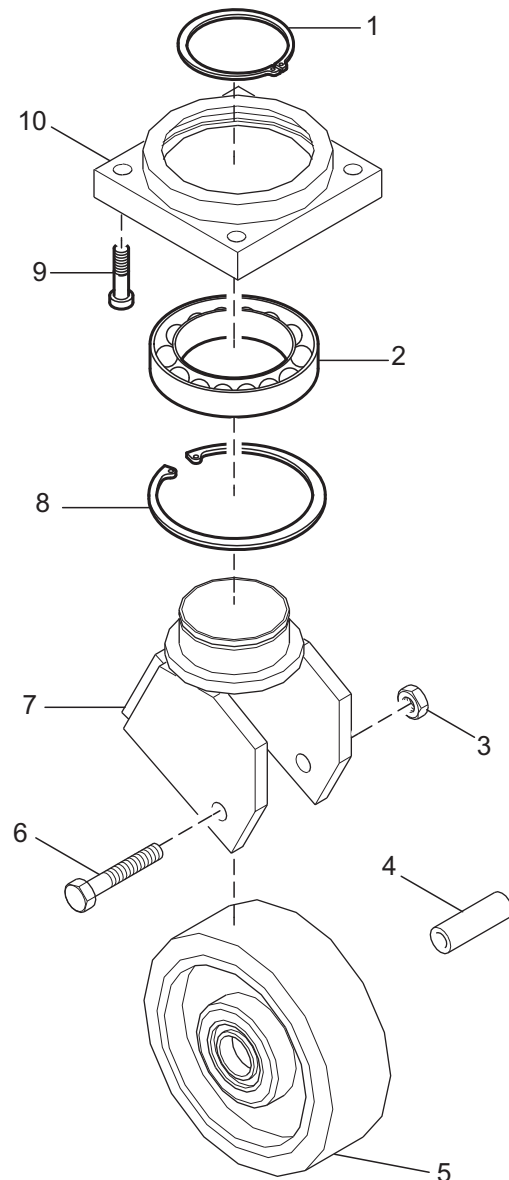
1. Unscrew the self-locking nut (3).
2. Pull out the mounting screw (6) and remove the castor (5).
3. Press out the axle (4).

Assembly

NOTE

Use new self-locking nuts.

Assembly is the reverse order of removal.



MS-4423-005



LUBRICATION & ADJUSTMENT

Load Wheels and Castors

Castor (WE-S/WS-S)



WARNING

Risk of serious injury!

Avoid accidents by:

- Switching off the truck
- Disconnecting the battery
- Preventing the truck from being switched on again.
- Jacking up the truck and preventing it from rolling away

For further details refer to the Safety chapter.

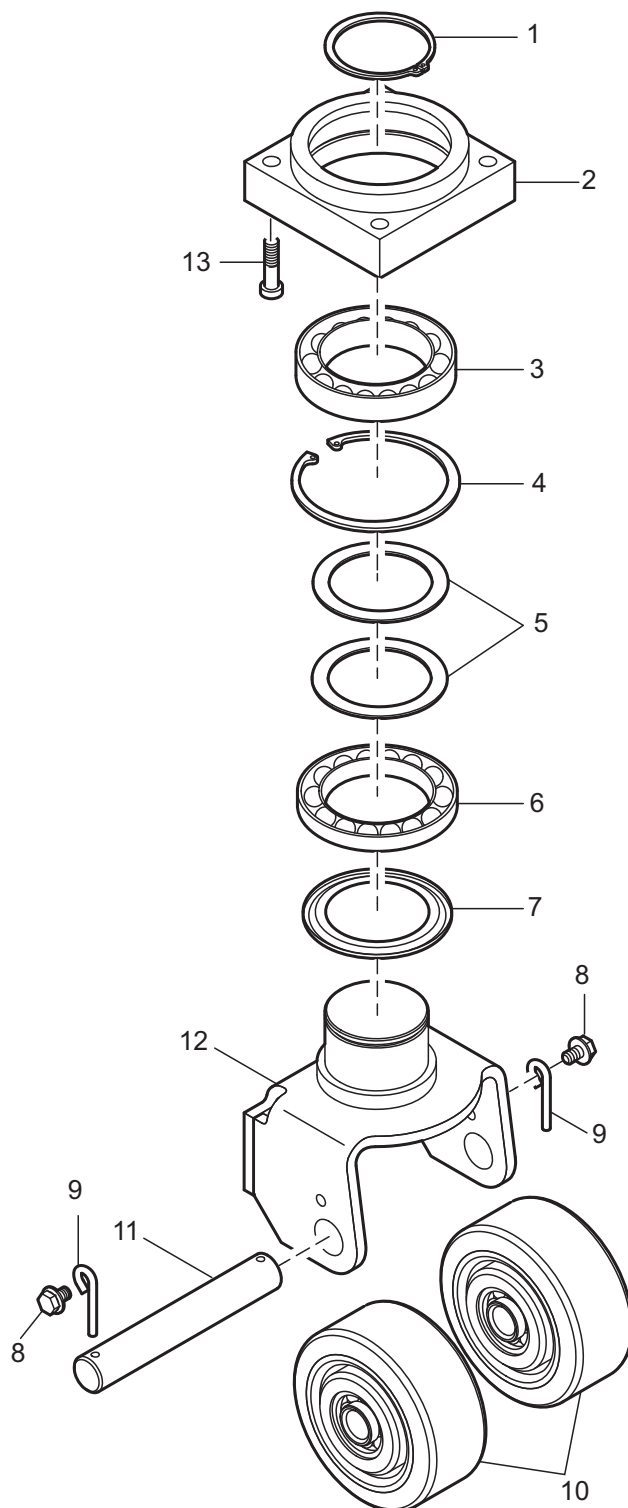
Removal

1. Remove retaining screws (8).
2. Pull the retaining pins (9) out of the axle (11).
3. Press out the axle (11).

Assembly

1. Screw in the retaining screws (8) with threadlocker order no. 053050-006 and tighten them.

Assembly is the reverse order of removal.



MS-4423-005

LUBRICATION & ADJUSTMENT

Load Wheels and Castors



Castor Suspension (WE/WS)



WARNING

Risk of serious injury!

Avoid accidents by:

- Switching off the truck
- Disconnecting the battery
- Preventing the truck from being switched on again.
- Jacking up the truck and preventing it from rolling away

For further details refer to the Safety chapter.

Removal

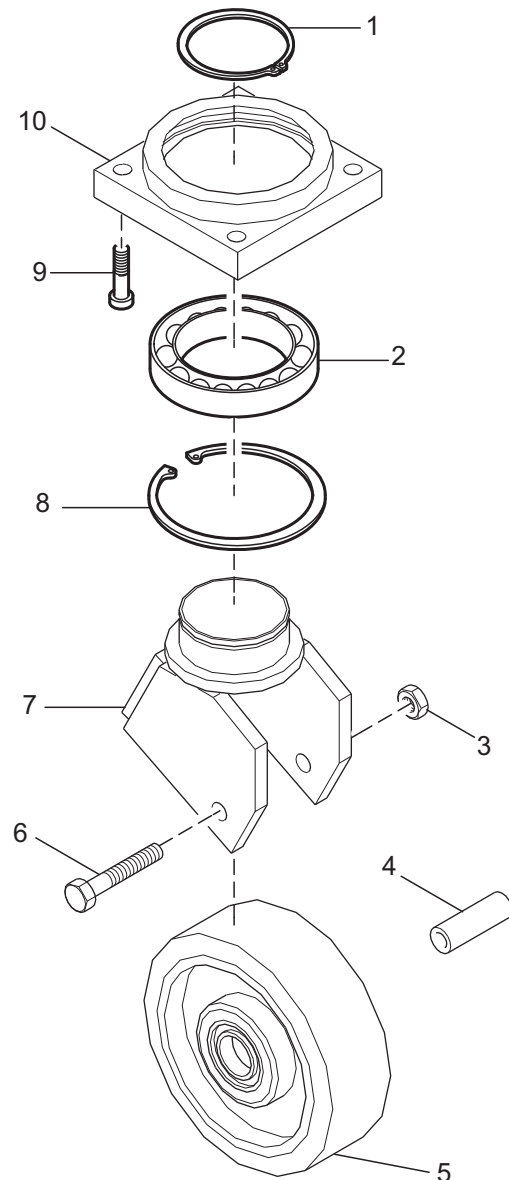
1. Unscrew the four mounting screws (9) and remove the complete caster from the truck.
2. Remove the retaining ring (1) and press the castor out of the bearing (2).
3. Loosen the retaining ring (8) and press the bearing (2) out of the bearing housing (10).

Assembly

NOTE

Screw in the retaining screws (9) with threadlocker order no. 053050-006 and tighten them.

Assembly is the reverse order of removal.



MS-4423-005



LUBRICATION & ADJUSTMENT

Load Wheels and Castors

Castor Suspension (WE-S/WS-S)



WARNING

Risk of serious injury!

Avoid accidents by:

- Switching off the truck
- Disconnecting the battery
- Preventing the truck from being switched on again.
- Jacking up the truck and preventing it from rolling away

For further details refer to the Safety chapter.

Removal

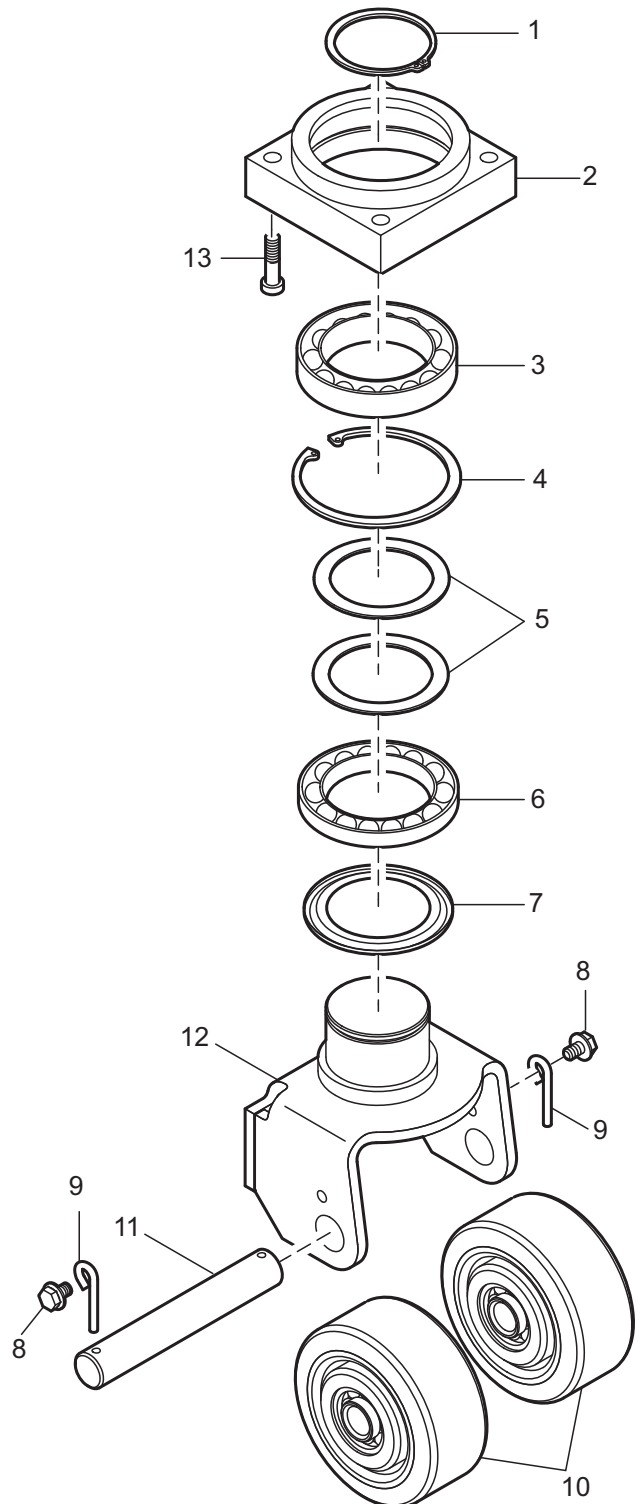
1. Unscrew the four mounting screws (13) and remove the complete caster from the truck.
2. Remove the retaining ring (1) and press the castor out of the bearing housing (2).
3. Remove seal (7), bearing (6) and spacer washers (5).
4. Loosen the retaining ring (4) and press the bearing (3) out of the bearing housing (9).

Assembly

Prior to assembling:

1. Lubricate the open bearing (6) with grease order no. 053002-001. For cold store trucks use grease order no. 053002-005.
2. Screw in the retaining screws (10) with thread-locker order no. 053050-006 and tighten them.

Otherwise, assembly is the reverse order of removal.



MS-4423-005

LUBRICATION & ADJUSTMENT

Torques



Torques

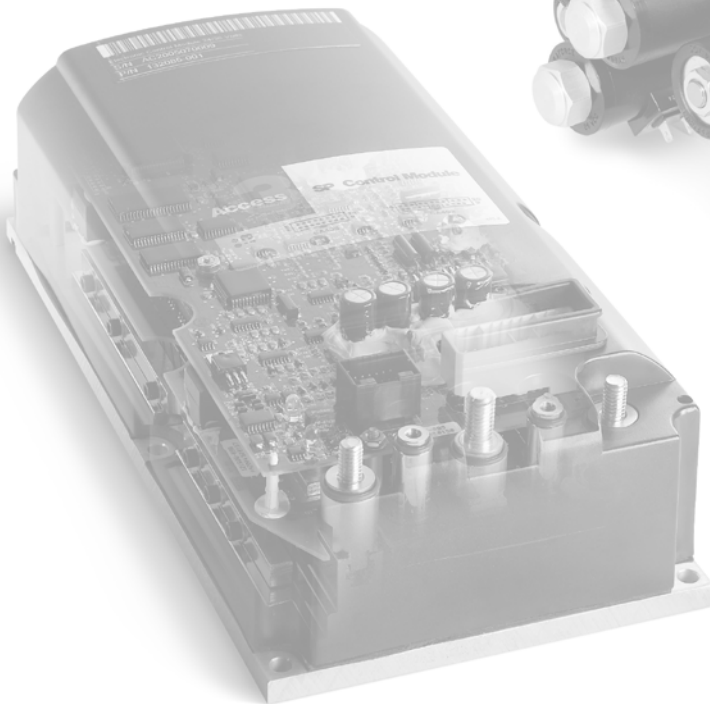
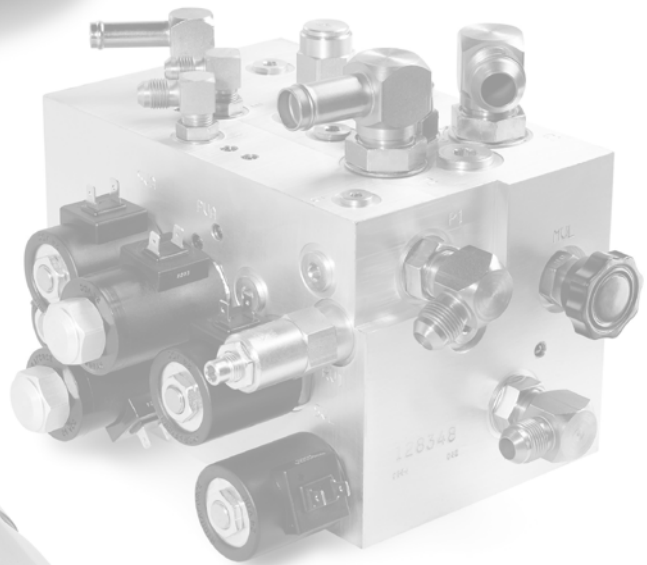
Standard Torques

NOTE

The torques listed in the manual always take precedence over standard torques.

Standard Screws and Nuts			
Grade:	8 and 8.87	10 and 10.9	12 and 12.9
Thread Size	Torque (Nm)		
M5 x 0.8	5 - 6	7 - 8	8 - 10
M6 x 1	8 - 10	12 - 14	14 - 16
M8 x 1.25	20 - 25	30 - 35	34 - 40
M10 x 1.5	40 - 45	60 - 65	70 - 75
M12 x 1.75	70 - 80	100 - 110	115 - 130
M16 x 2	170 - 190	240 - 270	280 - 320
M20 x 2.5	340 - 380	450 - 500	550 - 600
M24 x 3	580 - 650	800 - 900	900 - 1050
M30 x 3.5	1150 - 1300	1600 - 1800	1850 - 2100

Umbrako screws and nuts		
Grade	10 and 10.9	12 and 12.9
Thread Size	Torque (Nm)	
M5 x 0.8	8	11
M6 x 1	14	19
M8 x 1.25	33	45
M10 x 1.5	63	86
M12 x 1.75	111	152
M16 x 2	270	372
M20 x 2.5	521	717



HYDRAULIC SYSTEM



Notes:



HYDRAULIC SYSTEM

Hydraulic Schematic Symbols

Hydraulic Schematic Symbols

Icon	Meaning	Icon	Meaning
	Vented reservoir with lines above the fluid level		Electric motor unidirectional single speed
	Vented reservoir with lines above the fluid level		Hydraulic pump fixed displacement unidirectional
	Filter or strainer		Spring, (bias to normal de-energised position)
	Hydraulic line with full flow		Solenoid single coil or winding
	Control line or drainage with restricted flow		Component enclosure manifold block
	Lines crossing; not connected		Resistor orifice throttle (adjustable)
	Lines crossing and connected		Throttle, fixed
	Plugged port		Relief valve adjustable
	Accumulator gas charged diaphragm type		Check valve

HYDRAULIC SYSTEM

Hydraulic Schematic Symbols



Icon	Meaning	Icon	Meaning
	2/2 way valve (2 ways, 2 connections)		Hydraulic steer unit
	3/2 way valve (3 ways, 2 connections)		Torque generator
	3/2 way valve (3 ways, 2 connections); Spring bias solenoid control		Shut-off valve, manual
	4/2 way valve (4 ways, 2 connections)		PRF= Priority Flow Regulator Bypass flow control with controlled flow, pressure-regulated
	4/3 way valve (4 ways, 3 connections)		Flow divider/combiner
	4/3 way valve (4 ways, 3 connections); manual activation and spring centred		Single pre-tension valve assembly in manifold
	Flow meter		Electric motor unidirectional variable speed



HYDRAULIC SYSTEM

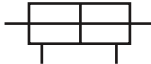
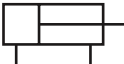
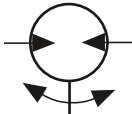
Hydraulic Schematic Symbols

Icon	Meaning	Icon	Meaning
	Valve block with 3 operating units		Proportional solenoid
	Shuttle valve		Dual solenoid
	Relief valve, fixed setting		Solenoid valve, pilot operated
	Velocity fuse		Hydraulic pilot operated valve
	Pressure-compensated flow control with reverse flow bypass; fixed.		Manual actuator
	Pressure-compensated flow control with reverse flow bypass; fixed.		Single-acting cylinder, with cushion
	Pilot check valve (pilot to open)		Single-acting cylinder ram type
	Manual lever actuator		Single-acting cylinder with spring returned (rod end vented)

HYDRAULIC SYSTEM

Hydraulic Schematic Symbols



Icon	Meaning	Icon	Meaning
	Double-acting cylinder; equal area		Thermometer
	Double-acting cylinder; unequal area		Pressure gauge
	Pressure switch		Hydraulic motor, bi- directional



General Principles

Hydraulic Lines and Ports

- Apply pressurised air to all hoses and lines before assembling them, to remove any loose particles.
- Once a steel or plastic line has been bent, it is permanently damaged. It must be replaced even if the damage is not externally visible.
- Any hose which bends during operation in its normal assembly position must also be replaced.
- All hoses and lines must have sufficient clearance from other surfaces or edges that could result in wear or cuts or where the hoses or lines could get caught.
- All connections must be tight and free of leaks.

Bleeding the Hydraulic System

Whenever work has been performed on hydraulic components, the hydraulic system must be flushed and bled (see *Cylinders chapter*).

Drift Test

Always perform a drift test after carrying out any work on hydraulic components (see *Cylinders chapter*).

Lifting:

NOTE

Ensure the load can lift and lower smoothly (subjective test).

- Whenever maintenance work has been performed on the hydraulic system.
- The HCM (hydraulic control module) may have to be calibrated (see *Electrical System chapter*).

HYDRAULIC SYSTEM

Pump Unit



Pump Unit

(Up to serial no. 5A134880)

The pump unit consists of the following:

- Motor
- Pump
- Valve block
- Filter

The pump unit is mounted on the reservoir.



WARNING

AVOID HIGH PRESSURE FLUIDS-Escaping fluids under pressure can penetrate the skin causing serious injury. Relieve pressure before disconnecting hydraulic lines. Tighten all connections before applying pressure. Keep hands and body away from pin holes which eject fluids under high pressure. Use a piece of cardboard or paper to search for leaks. Do not use your hand.

Any fluid injected into the skin under high pressure should be considered as a serious medical emergency despite an initial normal appearance of the skin. There is a delayed onset of pain, and serious tissue damage may occur. Medical attention should be sought immediately by a specialist who has had experience with this type of injury.

Removal

- Fully lower forks and mast.

NOTE

Depress and hold down “Lower” button for 10 seconds to relieve the hydraulic pressure.



WARNING

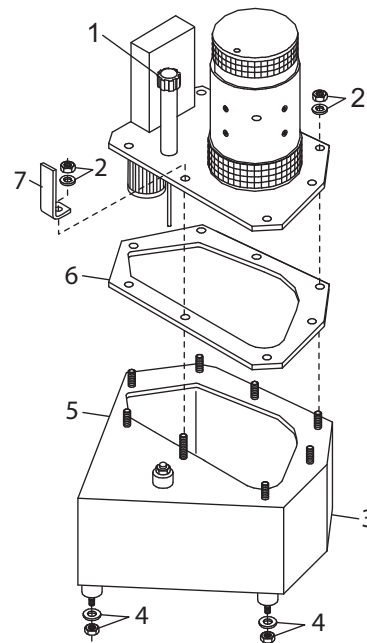
Risk of serious injury

Avoid accidents by:

- Switching off the truck
- Disconnecting the battery
- Preventing the truck from being switched on again.
- Jacking up the truck and preventing it from rolling away

For further details refer to the Safety chapter.

1. Open the panel.
2. Disconnect hydraulic lines from manifold.
3. Seal ports with filler plugs.
4. Disconnect electric wires.
5. Remove nuts from electrical panel and take out panel.



M0410



HYDRAULIC SYSTEM

Pump Unit

6. Unscrew nuts (2) (8 off).
7. Remove bracket (7).
8. Remove the pump unit.

Assembly

Assembly is the reverse order of removal. Replace seal (6) during assembly.

NOTE

Torque nuts (2) to 12 Nm (9 lbs.ft.).

HYDRAULIC SYSTEM

Reservoir



Reservoir

(Up to serial no. 5A134880)

The capacity is 9.5 L.

Removal

(see Fig. M0410)

Remove the pump unit. Pump unit section (see page 48).

1. Place a container under the oil drain plug (3).
2. Unscrew oil drain plug (3).
3. Remove nuts (4).
4. Remove reservoir.



WARNING

Health risk. Observe the manufacturer's safety instructions when handling cleaning agents and solvents.

5. Clean the reservoir with a suitable solvent.

Assembly

Assembly is the reverse order of removal. Replace the seals on the oil drain plug and the dipstick (1).

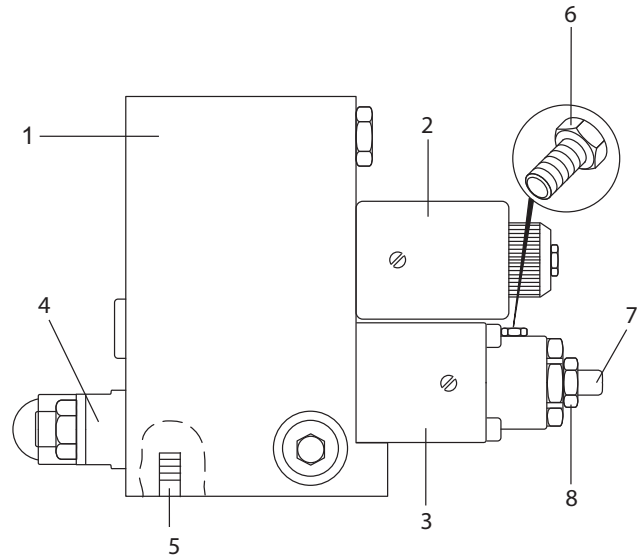
1. Add hydraulic oil.
2. Bleed the hydraulic system (see *Cylinders* chapter)
3. Check the hydraulic oil level.

NOTE

The oil must lie between the top and bottom markings on the dipstick.

Bleeding the Manifold

(see Fig. M0439)



M0439

1. Extend the mast as far as the stop.
2. Unscrew the bolt (6).
3. Fully lower the forks.
4. Screw in the bolt (6).

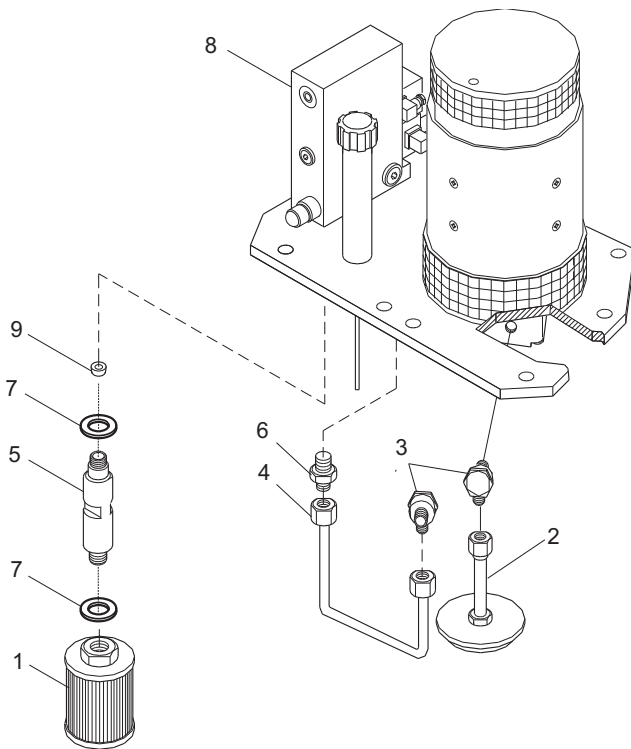
NOTE

Repeat the process until only hydraulic oil emerges.

Replacing the Filter

(Up to serial no. 5A134880)

(see Fig. M0607)



M0607

Removal

Remove the pump unit. Pump unit section (see page 48).



WARNING

Health risk Observe the manufacturer's safety instructions when handling cleaning agents and solvents.

1. Clean return line filter (1) with a suitable solvent.
2. Replace metallic mesh filter.
3. Clean suction filter (2) with a suitable solvent.

Assembly

Assembly is the reverse order of removal.

HYDRAULIC SYSTEM

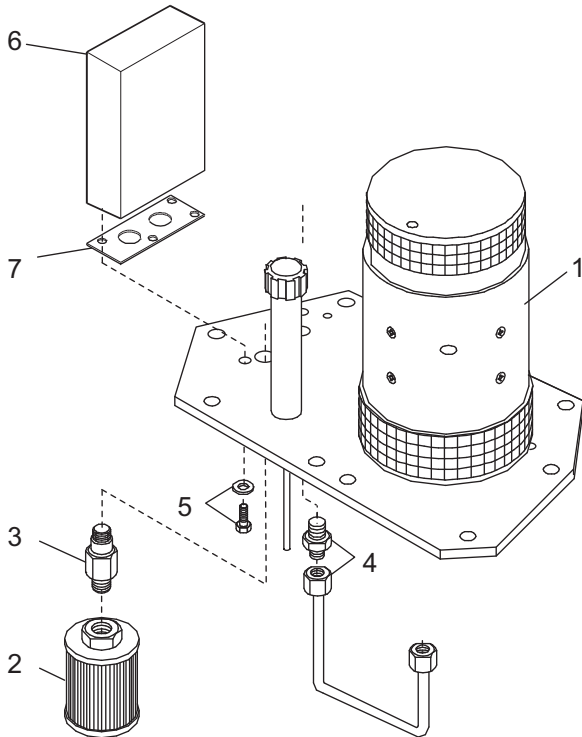
Valve Block



Valve Block

(Up to serial no. 5A134880)

(see Fig. M0412)



M0412

Removal

Remove the pump unit (see page 48).

1. Remove return line filter (2).
2. Remove adapter (3).
3. Unscrew pipe line (4) and union (4).
4. Remove screw (5).
5. Remove manifold (6) and seal (7).

Assembly

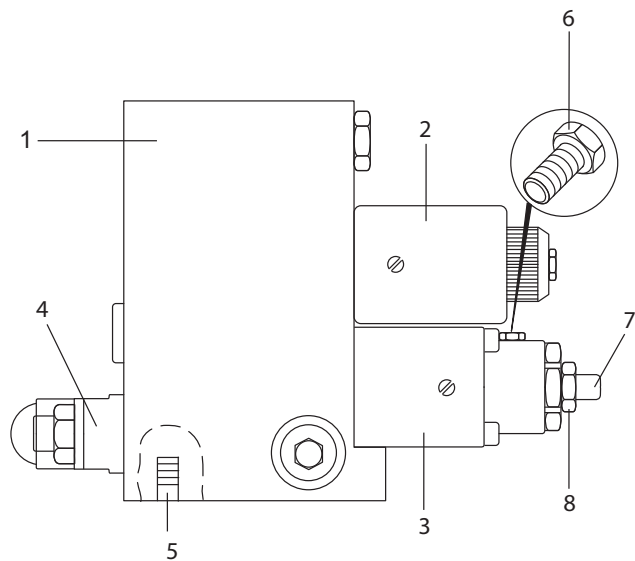
Assembly is the reverse order of removal. Replace the manifold seal (7).

NOTE

Apply threadlocker order no. 053050-006 to screws (5) and torque them to 6 Nm (4.5 lbs.ft.).

Valve Block

(see Fig. M0439)



M0439

- 1 Valve block
- 2 Solenoid SV2
- 3 Proportional valve SV3
- 4 Relief valve RV1
- 5 Reduction
- 6 Bleed screw
- 7 Adjusting screw
- 8 Jam nut



HYDRAULIC SYSTEM

Relief Valve

Relief Valve

(Up to serial no. 5A134880)

Removal

(see Fig. M0439)

1. Remove entire relief valve assembly, unscrew nut and relief valve (4).
2. Remove O ring and strainer

Assembly

1. Apply a thin layer of hydraulic oil to O ring.
2. Position O ring and strainer in valve seat.
3. Apply hydraulic oil to the relief valve (4), insert it into the valve seat and tighten.

4. Tighten the relief valve.

5. Insert hydraulic unit and adjust relief valve (4).

Relief Valve Setting

NOTE

The relief valve (4) protects the hydraulic system and the lifting mechanism from overloading.



WARNING

Never operate the hydraulic unit unless it is properly attached.

The amount of torque will twist the unit. This can result in short circuits and damage.

Model	Capacity	Minimum test weight	Maximum test weight	Setting
WE2300 1.25 t	1250 kg (2756 lbs.)	1350 kg (2976 lbs.)	1450 kg (3197 lbs.)	170 MPa (2465 psi)
WE2300 1.35 t	1350 kg (2976 lbs.)	1450 kg (3197 lbs.)	1550 kg (3417 lbs.)	170 MPa (2465 psi)
WE2300 1.4 t	1400 kg (3086 lbs.)	1500 kg (3307 lbs.)	1600 kg (3527 lbs.)	180 MPa (2610 psi)
WE2300 1.6 t	1600 kg (3527 lbs.)	1700 kg (3748 lbs.)	1800 kg (3968 lbs.)	180 MPa (2610 psi)
WE2300 1.8 t	1800 kg (3968 lbs.)	1900 kg (4189 lbs.)	2000 kg (4409 lbs.)	180 MPa (2610 psi)

Relief Valve Test and Setting

1. With the hydraulic system at operating temperature, place a test load corresponding to 110% of rated capacity (= minimum load) in the centre of the forks.
The load should lift easily.
2. Raise a test load corresponding to 110% of the rated capacity +100 kg (220 lbs.) [=maximum load].
It should not be possible to raise this load (relief valve opens).

If necessary, adjust the relief valve:

1. Hold the relief valve with a screwdriver and undo the counter nut.
2. Turn the relief valve clockwise to increase the pressure at which the valve opens.
3. Turn the relief valve anticlockwise to reduce the pressure.

4. Counter-fix the relief valve again with the nut.



HYDRAULIC SYSTEM

Hydraulic System Troubleshooting

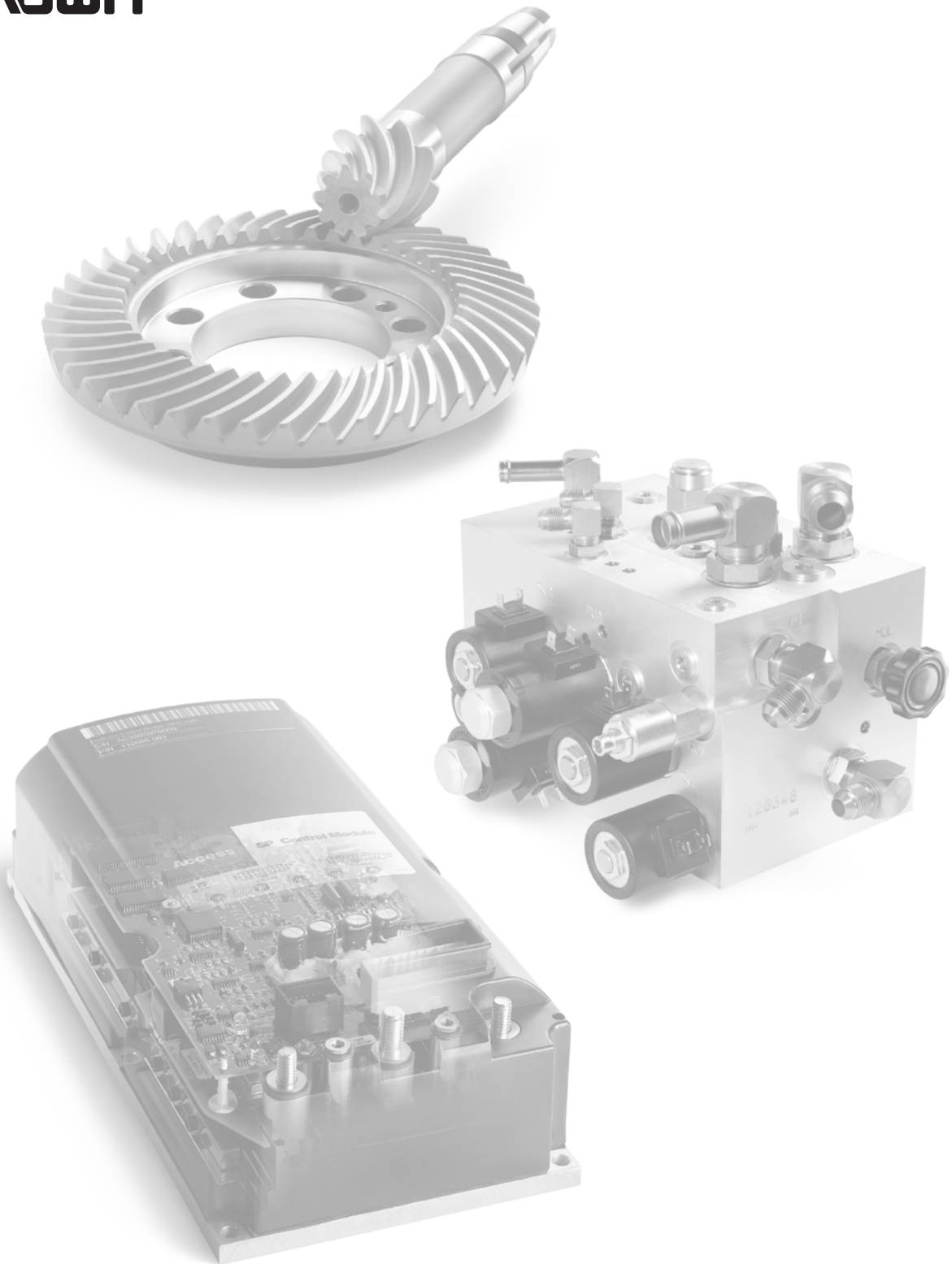
Hydraulic System Troubleshooting

Symptom	Probable Cause	Remedy
Pump noisy	- Oil level too low. - Incorrect oil viscosity (e.g. standard oil used in cold store environment). - Leak in suction pipe union (pump suctions air). - Filter in suction pipe partly clogged.	- Check oil level. - Use correct hydraulic oil. - Check suction pipe connection to pump. - Replace filter.
Foaming hydraulic oil	- Air in system. - Water in oil.	- Check oil level. - Check suction pipe connection to pump. - Clean reservoir and replace hydraulic oil.
Pump or oil over-heating	- Incorrect oil viscosity (e.g. cold store oil used at normal temperature). - Oil contaminated with water. - Pressure relief valve permanently open	- Drain oil completely and add new oil depending on the application conditions. - Drain oil completely, clean reservoir and fill with clean oil. - Check oil level. - Check suction pipe - pump connection (see "Foaming Hydraulic Oil" symptom). - Test setting and operation of relief valve (see page 53).
Low flow rate	- Air in system. - Pressure relief valve leaky or set too low. - Oil too hot.	- See "Foaming hydraulic oil" symptom. - See "Pump or oil overheating" symptom. - Test operation and setting of relief valve (see page 53), replace if faulty.
No build up of pressure	- Faulty pressure relief valve. - Oil level too low.	- Test relief valve (see page 53), replace if faulty. - Add hydraulic oil.
Lifting delay	Air in manifold	Bleed manifold (see page 50)
Sudden lowering	Air in manifold	Bleed manifold (see page 50)



Notes:

CROWN



DRIVE UNIT



Notes:

Drive Wheel

Removal



WARNING

Risk of serious injury

Avoid accidents by:

- Switching off the truck
- Disconnecting the battery
- Preventing the truck from being switched on again.
- Jacking up the truck and preventing it from rolling away

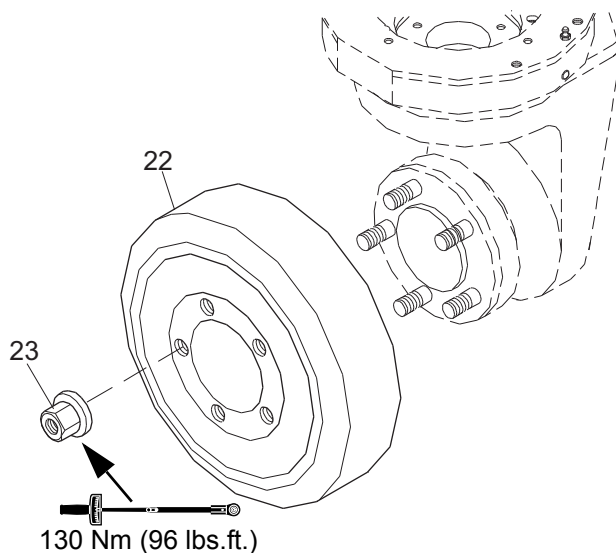
For further details refer to the Safety chapter.

Assembly

Assembly is the reverse of disassembly.

NOTE

Torque wheel nuts to **130 Nm (96 lbs.ft.)**.



M0419

1. Turn the drive unit until the wheel nuts are accessible.
2. Loosen wheel nuts (23), jack up the truck and unscrew the wheel nuts.
3. Pull the wheel (22) off the stay bolts.
4. Replace tyres if worn.

DRIVE UNIT

Drive Unit Removal and Assembly



Drive Unit Removal and Assembly

The drive unit is located on the left hand side of the truck behind the cover. It comprises the drive motor, steering bearing, gear unit and drive wheel.



WARNING

Trapping hazard. The drive unit is heavy. When assembling, removing and handling the drive unit always secure it with a suitable device to prevent injury.

Removal



WARNING

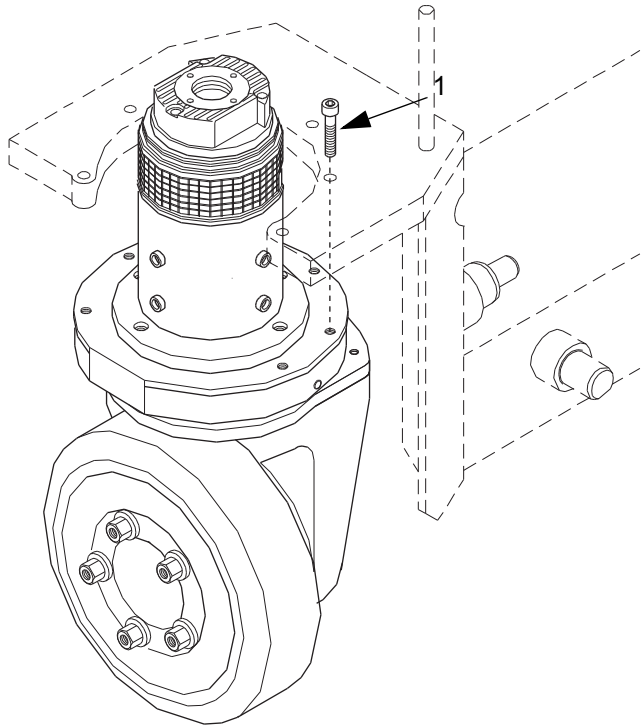
Risk of serious injury

Avoid accidents by:

- Switching off the truck
- Disconnecting the battery
- Preventing the truck from being switched on again.
- Jacking up the truck and preventing it from rolling away

For further details refer to the Safety chapter.

1. Open the panel.
2. Remove the steering chain (see *Steering* chapter).
3. Disconnect the brake connector.
4. Unscrew the electrical wires from the drive motor.
5. Position a suitable device under the gear unit to collect the drive unit.
6. Remove the mounting screws (1, Fig. M0414).
7. Remove the drive unit from the truck.



M0414

Assembly

Assembly is the reverse order of removal.

1. Insert the mounting screws (1, Fig. M0414) applying threadlocker 053050-006 and tighten them.
2. Attach the steering chain and adjust the steering (see *Steering* chapter).

Gear Unit

Unless otherwise stated, the item numbers in this section refer to diagram M0415 (see page 62).

Removal



WARNING

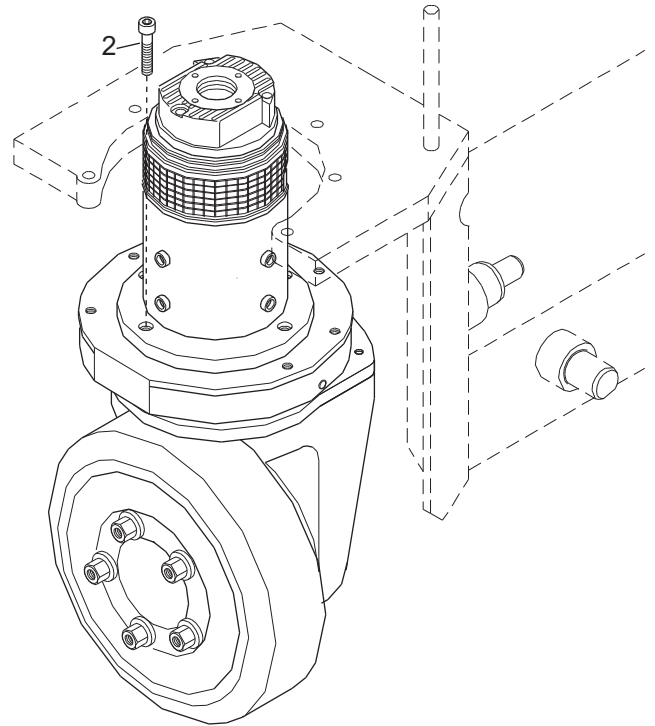
Risk of serious injury

Avoid accidents by:

- Switching off the truck
- Disconnecting the battery
- Preventing the truck from being switched on again.
- Jacking up the truck and preventing it from rolling away

For further details refer to the Safety chapter.

1. Open the cover.
2. Disassemble the drive wheel (see page 59).
3. Drain the oil (see page 67)
4. Remove the drive unit (see page 60).
5. Use a suitable device to place the drive unit securely on a workbench.
6. Unscrew the four mounting screws (2, Fig. M1154) and remove the drive motor from the rest of the unit.
7. Unscrew the mounting screws (30) and remove the steering bearing (29).
8. Remove the chain wheel (28).



M1154

Assembly



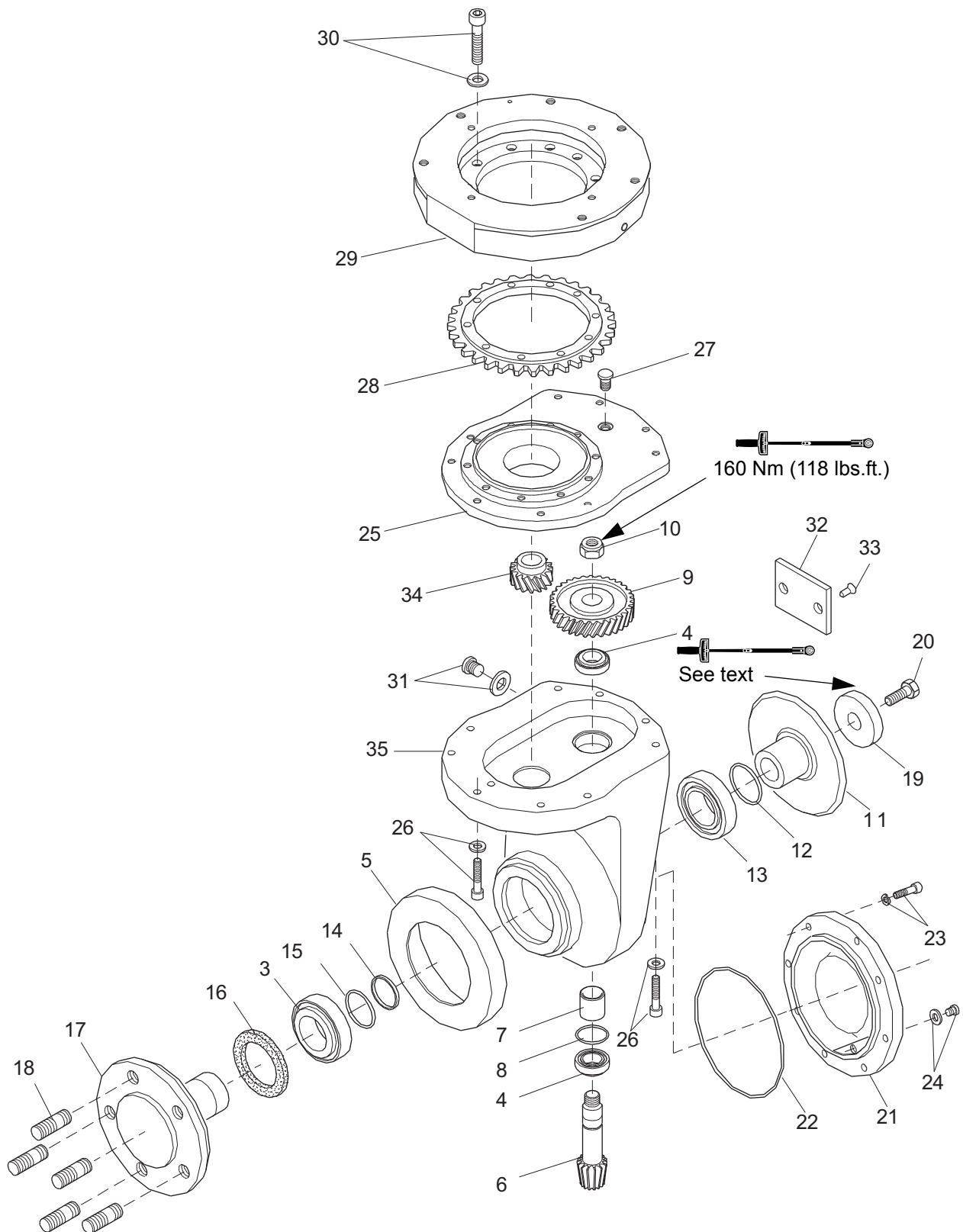
CAUTION

*New gear units are supplied without oil.
Remember to add oil (see page 67)!*

1. Assembly is the reverse of disassembly.
2. Add oil (see page 67)
3. Attach the drive motor and reinstall the drive unit (see page 60).

DRIVE UNIT

Gear Unit



M0415



DRIVE UNIT

Repairing the Gear Unit

Repairing the Gear Unit

We recommend a replacement of the gear unit. In emergencies repairs can be carried out by a specialist company licensed by Crown.



WARNING

Health risk. Observe the manufacturer's safety instructions when handling solvents and lubricants.

Preparation

1. Remove the drive wheel (see page 59)
2. Remove the drive unit (see page 60)

Dismantling

(see Fig. M0415)

1. Remove the screws (30) and the live ring bearing (29).
2. Remove the chain wheel (28).
3. Remove the screws (26) and the gear unit cover (25).
4. When the live ring bearing and gear unit cover have been removed:
5. Remove the screws (23) and the cover (21).
6. Remove the screw (20) and the washer (19).
7. Press out the flange shaft (17) with an appropriate tool.
8. Remove the bevel gear (11).
9. Remove the nut (10).
10. Press out the bevel pinion shaft (6) with an appropriate tool.
11. Press out the ball races (3, 4, 13) using an appropriate tool.
12. Remove the rotary shaft seal (16).

Thoroughly clean all components. Check for wear and damage. Replace if necessary.

Assembly

NOTE

All seals must be replaced.

1. Press in the outer rings of the taper bearings (3), (4), (13) using an appropriate tool.
2. Attach and calk the thread shield ring (5).
3. Insert the oil drain plug (24) with a new seal in the cover and tighten it.
4. Attach a new O ring (22) to the cover.
5. The housing is now ready to receive the bearings and pinion shaft.
6. Apply a thin layer of Loctite 307 to where the taper bearing (4) sits on the pinion shaft (6) and press on the taper bearing (4) using an appropriate tool.
7. Fit the shim (8) and spacer sleeve (7) onto the pinion shaft (6).
8. Insert the pinion shaft (6) into the housing (35) from below.
9. Insert the second taper bearing (4) and spur wheel (9).
10. Screw on the locknut (10) and torque to 160 Nm (118 lbs.ft.).

The follow stages cover the assembly of the flange shaft with bearings and gear wheels.

1. Insert the wheel bolts (18) into the flange shaft.
2. Place the taper bearing (3) in its respective ball race.
3. Apply a thin layer of Loctite 307 to the outside diameter of the rotary shaft seal (16) and install the seal.
4. Apply a thin coat of oil to the sealing lip of the rotary shaft seal (16).
5. Press the shim (12) onto the bevel gear (11) and press on the taper bearing (13) using an appropriate tool.
6. Place the shim (15) and the spacer bushing (14) onto the flange shaft (17).
7. Insert the flange shaft (17) from below into the housing (35).
8. Fit the bevel gear (11) and washer (19).
9. Screw in the bolt (20).

You are now ready to adjust the bevel gear set.

DRIVE UNIT

Repairing the Gear Unit

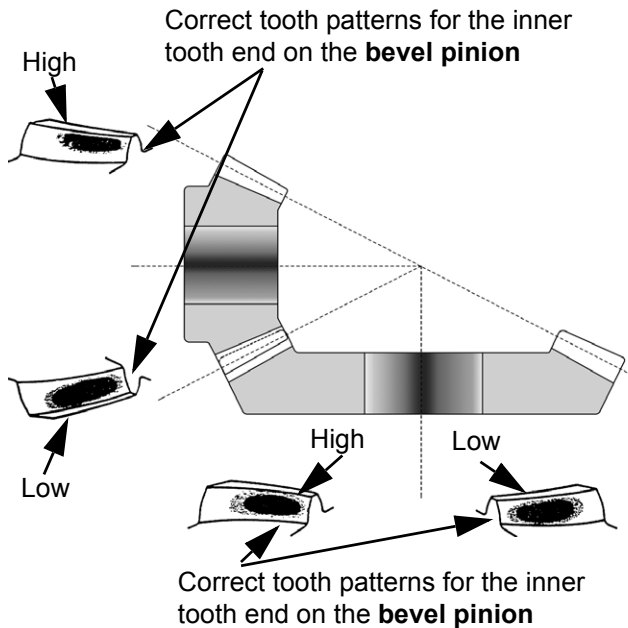


Adjusting the bevel gear set



CAUTION

Adjust with care. Pre-tensioning the bearings and shims will affect the tooth pattern. Do not set the pre-tension too low. It will automatically reduce during normal operation.



M1565-2

The correct setting can be calculated from the tooth profile pattern (see Fig. M1565-2).

Basic Rules:

- Always adjust the bevel wheel set to the correct flank position. The tooth ends should *not* form a straight line.
- The tooth pattern must always be aligned with the inner tooth end.
- The tooth pattern must range from high (top of tooth) to low (bottom of tooth).

Fig. M1565-2 shows the limits of the permissible tooth patterns on the bevel pinion and bevel gear.

Checking the flank tooth bearing

1. Colour the tooth profiles of the bevel gear (11) with touch-up paste (striking colour).

2. Turn the bevel gear several times in one direction. The tooth bearing will appear as a bright point (marked black in Fig. M1565-2) on the tooth flanks.
3. Check the pattern and bring it within the tolerance levels:
 - by removing and/or adding shims (15, 12, 8)
 - by adjusting the screw (20) torque by up to **max. 300 Nm**. The gear unit must be able to turn freely without backlash. **Note the torque reading when the tooth pattern is correct.**
4. Remove the screw (20) again when the bevel gear set is adjusted. Apply a layer of Delo 187 thread-locker and torque to the previously recorded level.

DRIVE UNIT

Repairing the Gear Unit



5. Replace the nut (10) and torque to 160 Nm (118 lbs.ft.).
6. The bevel gear set is now fully adjusted.
7. Final tasks:
8. Apply a thin layer of oil to the O ring (22) of the cover (21) and insert it in the cover.
9. Apply a thin layer of Loctite 307 to the contact surfaces of the housing (35) and the gear unit cover (25).
10. Screw on the gear unit cover. Torque the screws to the standard rating crosswise.
11. Fit the ring gear (28) and the live ring bearing (29).



CAUTION

*Leave the surface and thread sealants to dry for at least 2 hours at room temperature.
Then fill with oil.*

- Add gear oil (order no. 053051-017). The oil must reach up to the thread of the oil filler port.

NOTE

Use oil order no. 53002-009 for cold store trucks.

1. Fit the bleed cap (27).
2. Insert the oil filler plug (31) with a new seal and tighten it.

Oil Change



WARNING

Risk of serious injury

Avoid accidents by:

- *Switching off the truck*
- *Disconnecting the battery*
- *Preventing the truck from being switched on again.*
- *Jacking up the truck and preventing it from rolling away*

For further details refer to the Safety chapter.



WARNING

Health risk. *Observe the manufacturer's safety instructions when handling lubricants.*

Draining Oil

1. Open the cover.
2. Turn the control handle as far to the left as it will go.
3. Unscrew the oil refill plug (31).
4. Turn the control handle as far to the right as it will go.
5. Place a suitable container under the drain plug.
6. Unscrew the drain plug (24) and collect the used oil.
7. Dispose of the used oil in accordance with national disposal regulations.

Adding Oil

1. Wipe the drain plug (24) with a clean cloth.
2. Insert the drain plug (24) with a new seal and tighten it.
3. Add oil (see table S. 14) up to the filler port of the gear unit (approx. quantity 1.5 litres (1 quart)).

NOTE

Use a particular type of oil for cold store trucks! (see table S. 14)

DRIVE UNIT

Live Ring Bearing



Live Ring Bearing

Removal

1. Remove the drive unit (see page 60).
2. Remove the gear unit (see page 61).
3. Unscrew the mounting screws (30) of the live ring bearing and remove the live ring bearing (29).

Assembly

Assembly is the reverse of disassembly.



WARNING

The steering may jam.

*For cold store trucks replace the entire live ring bearing grease filling with grease order (see table S. 22)
Other greases may solidify through the cold and jam the steering.*

After assembly:

1. Thoroughly grease the live ring bearing (see table S. 22).
2. For cold store trucks use grease (see table S. 22) only:
 - Grease and pack the bearings before assembly.
 - Remove the emerged grease and wipe the area with a cloth.
 - Dispose of the grease and cloth in accordance with national environmental disposal regulations.



DRIVE UNIT

Pivoting Carriage

Pivoting Carriage

(Up to serial number 5A134880)

General

On WS trucks the pivoting carriage is able to move, thereby compensating for ground unevenness. This improves the drive wheel traction. If a moving pivoting carriage is not required on the WS model, it can be fixed in the same way as on the WE model.

Removal



WARNING

Risk of serious injury

Avoid accidents by:

- Switching off the truck
- Disconnecting the battery
- Preventing the truck from being switched on again.
- Jacking up the truck and preventing it from rolling away

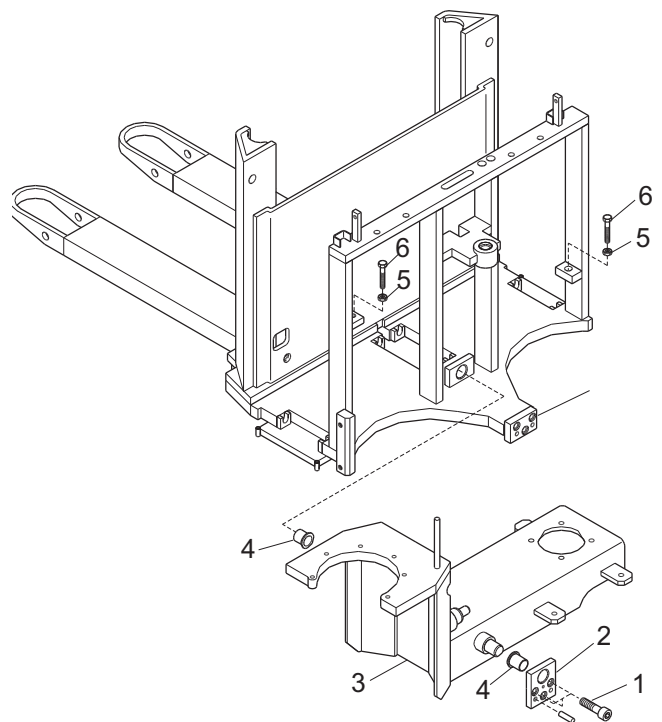
For further details refer to the Safety chapter.

1. Remove the drive unit.
2. Remove the hydraulic reservoir.
3. Remove the electric panel.
4. Unscrew the three mounting screws (1) and remove the bracket (2).
5. Take off the pivoting carriage (3).

4. Screw in both screws until they contact the pivoting carriage evenly.
5. Tighten the counter nuts.

WS Trucks

1. Park the truck on a level surface.
2. Loosen the counter nut (5).
3. Set a 12 mm gap on either side between the pivoting carriage and the screws.
4. Tighten the counter nuts.



MP4420-300

Assembly

Prior to assembling:

1. Check bearing (4). Replace if faulty.
2. Further assembly is the reverse of disassembly.

Adjusting the pivoting carriage

WE Trucks

1. Park the truck on a level surface.
2. Loosen the counter nut (5).
3. Unscrew both screws (6) until they are no longer contacting the pivoting carriage.

DRIVE UNIT

Pivoting Carriage



Pivoting Carriage

(From serial no. 5A134882)

General

On WS trucks the pivoting carriage is able to move, thereby compensating for ground unevenness. This improves the drive wheel traction. If a moving pivoting carriage is not required on the WS model, it can be fixed in the same way as on the WE model.

Removal



WARNING

Risk of serious injury!

Avoid accidents by:

- switching off the truck
- disconnecting the battery
- preventing the truck from being switched on again.
- jacking up the truck and preventing it from rolling away

For further details refer to the Safety chapter.

1. Remove the drive unit.
2. Unscrew the three mounting screws (2) and remove the bracket (1).
3. Take off the pivoting carriage (4).

Assembly

Prior to assembling:

1. Check bearing (3). Replace if faulty.
2. Further assembly is the reverse of disassembly.

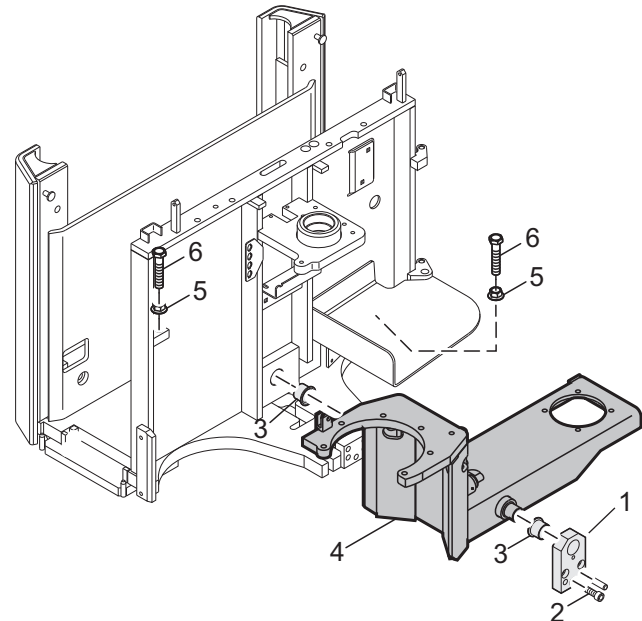
Adjusting the pivoting carriage

WE Trucks

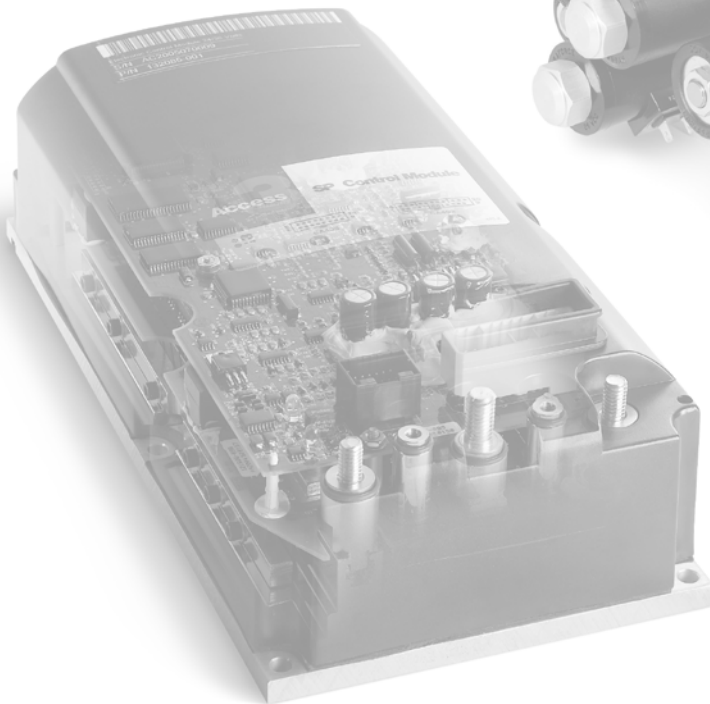
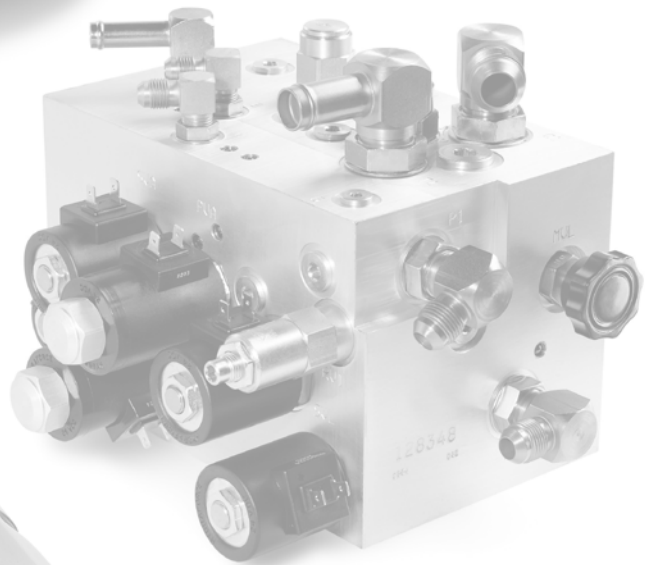
1. Park the truck on a level surface.
2. Loosen the counternut (5).
3. Unscrew both screws (6) until they no longer contact the pivoting carriage.
4. Screw in both screws until they are contacting the pivoting carriage evenly.
5. Tighten the counternuts.

WS Trucks

1. Park the truck on a level surface.
2. Loosen the counternut (5).
3. Set a 12 mm gap on either side between the pivoting carriage and the screws.
4. Tighten the counternuts.



MS-4223-301



ELECTRICAL SYSTEM



Notes:



ELECTRICAL SYSTEM

General

General

first two digits indicate the wire colour while the last two digits are counter numbers.

Wire colour code

Third party component lines may pose an exception to this rule (see *Schematic Diagrams* chapter):

The wires used in the truck are colour-coded and numbered according to their function. The first digit or the

Abbreviation	Colour	Colour number	Function
BLK	Black	0 **	Digital signal
BRN	Brown	1 **	Analog signal
RED	Red	2 **	Positive not connected
ORG	Orange	3 **	+12 VDC - transformer
YEL	Yellow	4 **	Third DC - transformer
GRN	Green	5 **	Negative not connected
BLU	Blue	6 **	Negative, insulated
VIO	Violet	7 **	+5 VDC - transformer
GREY	Gray	8 **	Fourth DC - transformer
WHT	White	9 **	Various
RED/WHT	Red/White	29 **	Positive connected
GRN/WHT	Green/White	59 **	Negative connected
** Numbers 01 to 99			

ELECTRICAL SYSTEM

Contact Symbol Abbreviations



Contact Symbol Abbreviations

Abbrevia- tion	Description	Abbreviation	Description (Sheet 1 of 2)
K*	Relays	LMS	Limit switch
ACS	Travel switch	LOS	Lower Switch
ARS	Armrest switch	ORS	Override switch
AXS	Auxiliary function switch	POT	Potentiometer
BRS	Brake switch	RA	Raise potentiometer
DIS	Travel direction switch	RAS	Raise switch
DRS	Door switch	REA	Reach potentiometer
EMS/EDS	Emergency power disconnect	RS	Reverse switch
EM	Encoder module	SAS	Safety reverse switch
ENC	Encoders	SES	Seat switch
FS	Forward switch	SSS	Sideshifter switch
HBS	Handbrake switch	THS	Thermo switch
HNS	Horn switch	TLT	Tilt switch
HSS	"Rabbit/Turtle" toggle switch (fast/slow)	WAS	Walk-along / pedestrian mode switch
HSS1-3	Platform switch	M2 (PM)	Pump motor
KYS	Key switch	MRC	Control module
LGS	Light switch	OHGD	Overhead guard display
BV (AK)	Battery voltage after the key switch	P	Pump contactor
BDI	Battery discharge indicator	PC	Female connector
BR	Brake	PCB	Printed circuit board
BWI	Brush wear display	SF	Shunt field
CA	Cable connection	STI	Steering wheel indicator
F	Shunt field connection	SV	Solenoid valve
FAN	Fan	TB	Terminal block
FU	Fuse	TMM	Truck management module
HN	Horn	TT	Hourmeter
IFD	Information display	VMN	Motor driver (volt motor negative)
JC	Male connector	GCSR	Safety switch - RH side restraint
LINE	Main contactor	GCSL	Safety switch - LH side restraint
M1 (TM)	Traction motor	SLS	Sideshift left switch
PS	Pressure switch	SRS	Sideshift right switch
PLS	Platform switch	TCM	Traction motor



ELECTRICAL SYSTEM

Contact Symbol Abbreviations

Abbrevia- tion	Description	Abbreviation	Description (Sheet 2 of 2)
HCM	Hydraulic control module	HR	Heating
RECEIVER	Receiver	ALM	Travel alarm
BDI/TT	Unigage, discharge indicator and hour-meter	TRANSMITTER	Transmitter
BRK	Electromagnetic brake	CHARGER	On-board charger
ECS	Lift control switch	DR	Driver
SSS	Sideshift switch		

* If one of the above abbreviations is used more than once, a number extension will be used, e.g. SV1, SV2 etc.

ELECTRICAL SYSTEM

Electrical wiring diagrams



Electrical wiring diagrams

Europe	USA	Description	Europe	USA	Description
		Wires joining			Switch applied manually
		Wires crossing			Solenoid valve
		Wire connection			Throttle / coil
		Plug / socket			Resistor
		Wire strap			Capacitor
		Terminal board			Potentiometer
		Fuse			Varistor
		Assembly			Thermal protector
		Contact, normally open			Lamp
		Contact, normally closed			Horn
		Selective switch			Battery
		Contactors/relays			Diode
		Slow release contactor / relay			Breakdown diode
		Time delay contactor / relay			LED
		Switch, normally open			Transistor



ELECTRICAL SYSTEM

Electrical wiring diagrams

Europe	USA	Description	Europe	USA	Description
		Push button, mechanically actuated			MOSFET
		Pushbutton, hydraulically actuated			Thyristor
		Emergency power disconnect			Comparator
		Motor armature	---		

ELECTRICAL SYSTEM

Electrical Components



Electrical Components



WARNING

Risk of serious injury

Avoid accidents by:

- Switching off the truck
- Disconnecting the battery
- Preventing the truck from being switched on again.
- Jacking up the truck and preventing it from rolling away

For further details refer to the *Safety* chapter.

Switch

(ALM) Travel alarm

Alarm transmitter. Activated by the travel alarm driver (DR) when the travel switch is pressed.

(BBD) Battery connector

Pulling the battery connector disconnects the power supply to the truck.

(BDI) Unigage

Battery discharge indicator with hourmeter and lift cut-out when battery voltage is low. Optional on some models.

For adjustment see the *Electrical System* chapter.

(BRK) Brake

The override switch (ORS) or brake switch (BRS) transmit a positive signal to the traction controller. The traction controller then releases the brake.

(BRS) Brake switch

The brake switch (BRS) is immediately below the control handle knuckle. As soon as the control handle reaches the upper or lower braking zone (see Fig. MS-4223-010) the brake switch is activated. The traction controller disconnects the power supply to the traction motor (TM) and the brake (BR). The brake drops and the truck brakes.

(Charger) On-board charger

Up to serial no. 5A134880

Charger (see *Schematic Diagrams*).

(Charger) On-board charger

From serial no. 5A134882

The charger disconnects the truck control circuit when connected to the mains (see *Schematic Diagrams*).

(EDS) Emergency Power Disconnect Switch

Pushing the Emergency Disconnect disconnects vehicle power.

(F/R Contactor) Direction contactor

Changes the polarity of the power circuit current to the traction motor anchor coil. Governed by the traction control module.

(DR) Travel alarm driver

Supplies current for the travel alarm. Governed by the traction control module. See *Schematic Diagrams* (travel alarm option).

(FU) Fuses

The entire truck circuit is protected by fuses:

- FU1 protects the traction motor power circuit
- FU3 protects the control circuit and options
- FU3 protects the pump power circuit
- FU4 protects the unigage (BDI)
- FU5 protects the option F/C

(GCSR) Gate closed switch right

Up to serial no. 5A132186

Folded platform only. GCSR, GCSL and PLS are in series. When all the switches are closed, the traction controller changes to the higher travel speed.



ELECTRICAL SYSTEM

Electrical Components

(GCSR) Gate closed switch right

From serial no. 5A134882

Folded platform only. When all the switches are closed, the traction controller changes to the higher travel speed.

(GCSL) Gate closed switch left

Up to serial no. 5A132186

Folded platform only. GCSR, GCSL and PLS are in series. When all the switches are closed, the traction controller changes to the higher travel speed.

(GCSL) Gate closed switch left

From serial no. 5A134882

Folded platform only. When all the switches are closed, the traction controller changes to the higher travel speed.

(HCM) Hydraulic control module

From serial no. 5A134882

Controls the lift contactor P and the valves SVCL & PV as a function of the raise/lower switches RAS /LOS1/ LOS2. A curve for the proportional control of the valves is stored internally.

(HM) Horn

Activated via horn switches HNS1 / HNS2 via the drivers on the main circuit board.

(HNS) Horn switch

A buzzer sounds when the horn button is pressed.

(HSS) "Rabbit/Turtle" toggle switch

Rotary switch (rabbit/turtle symbol) on the control handle. The switch signal to the traction controller is used to change between the high and slow speed ranges.

The switch is connected in series to the limit switch (LMS).

(HYD PCB) Hydraulic printed circuit board

Carrier for the raise / lower switches. Also acts as a distributor for the positive power supply to the heating unit / thermostat resistors.

Equipped with heating resistors for cold store trucks.

(KYS) Key switch

The key switch directs the battery supply to the traction controller and the battery discharge indicator (BDI).

(LMS) Limit switch

On reaching a preset height (approx. 50 cm), the limit switch (LMS) interrupts a signal to the traction controller. This causes the traction controller to change between the high and slow speed ranges. The switch is connected in series to the Fast/Slow Travel (HSS) switch.

(LMS2) Limit switch

From serial no. 5A132188

NOTE

Rider trucks only.

Switches the "lift height" control signal above or below 1,800 mm to the platform logic.

(MAIN PCB) Main circuit board

Contains driver connections for switches SAS/FS/RS/POT/HNS1 and HNS2 and a thermostat switch (THS). With the cold store option, THS switches the heaters on if the temperature is below 5°C and switches the control handle heating off if the temperature is above 15°C.

(M2) Pump motor

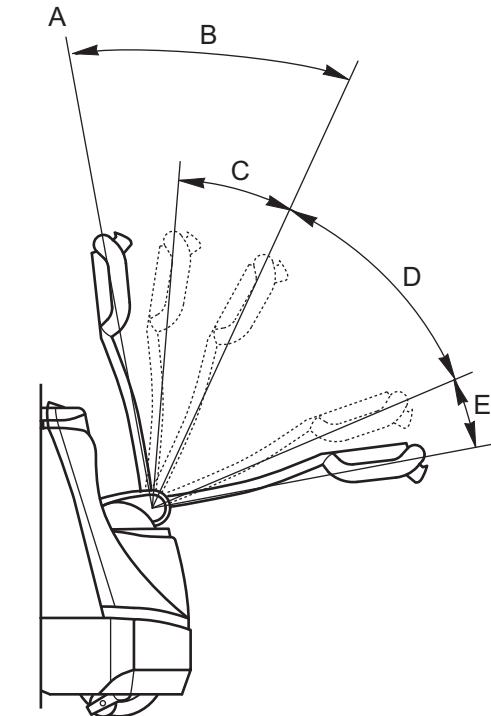
Drives the hydraulic pump. Controlled by the hydraulic control module (HCM) via the pump contactor (P).

(ORS) Override switch

Pedestrian trucks only: the override switch (ORS) is directly below the control handle knuckle. As soon as the control handle enters the brake override zone (see Fig. MS-4223-010) the override switch (ORS) sends a signal to the traction controller with the result that the truck can now only travel slowly (by pressing the traction pod). This provides better shunt operation in restricted conditions.

ELECTRICAL SYSTEM

Electrical Components



MS-4223-010

(P) Pump contactor

Connects positive power supply to the truck's pump motor. Governed by the hydraulic control module (HCM).

(PC) Plug holder

Up to serial no. 5A134880

Accommodates the mains connector while the truck is in operation.

If the connector is removed the truck key switch circuit is interrupted.

(PC) Plug holder

From serial no. 5A134882

Accommodates the mains connector while the truck is in operation.

No electrical function.

(PCB) Distributor PCB

The distributor PCBs all receive control signals which are either used to control drivers on the PCB (horn,

pump, brake and lowering valve) or which are transmitted directly to the control module.

(PLM) Platform logic

From serial no. 5A132188

This module detects and analyses the connection status of the platform switch (PLS) and the side gate switch (GCSR & GCSL).

Depending on the connection status an output signal is sent to the traction controller which either enables the higher travel speed or only permits the lower pedestrian speed.

The SAS and BRS signals are also connected via this module, depending on the platform switch and the side gate switch, as well as the respective function switch.

The RAS signal (main lift) is deactivated from a main lift height above 1800 as well as in platform mode.

(PLS) Platform switch

Up to serial no. 5A132186

Folded platform only. GCSR, GCSL and PLS are in series. When all the switches are closed, the traction controller changes to the higher travel speed.

(PLS) Platform switch

From serial no. 5A132188

Folded platform only. When GCSR, GCSL and PLS are closed, the traction controller changes to the higher travel speed.

(PM / M2) Hydraulic motor

Drives the hydraulic pump (compound motor), indirectly via the hydraulic control module, directly via the pump contactor.

(POT, FS, RS) Traction pod

The travel switches are activated via the thumb-switches on the control handle. The traction pod comprises a switch (FS) for forward travel, a switch (RS) for reverse travel, and a potentiometer (POT) which governs the travel speed. On cold store versions the potentiometer is heated.



ELECTRICAL SYSTEM

Electrical Components

(PV) Proportional valve

Opens temporarily on lifting to reduce overpressure (soft lift). Opens half-way or fully on lowering, depending on the lowering speed selected (LOS1, LOS2).

(RAS, LOS1, LOS2) Raise / lower switches

The raise (RAS) and lower (LOS1, LOS2) switches are activated via rocker switches in the control handle. The rocker switches act on switches assembled on the circuit board of the control handle. The switches are electrically interlocked.

The raise (RAS) switch activates the pump contactor (P) which is connected via the hydraulic control module (HCM), whereby the signal is issued several times via the platform logic to prevent lifting beyond 1800 mm in rider mode: The pump starts.

Up to serial no. 5A132186

The lower switches (LOS1, LOS2) apply voltage to the hydraulic control module (HCM), the solenoid (SVCL) and the proportional valve (PV). The solenoid opens.

Safety reverse switch (SAS)

The safety reverse switch (SAS) is activated via the switch cap on top of the control handle. When this is applied, the truck changes from forward to reverse travel. The signal for normal travel to the traction controller is simultaneously interrupted. Depending on the traction controller setting the truck either travels for a given time, or travels in reverse for as long as SAS is applied. (SAS is not activated in rider mode on platform trucks.)

(SLS / SRS) Aux. hydraulics switch

Enables the auxiliary hydraulics to be controlled from the control handle.

SVH Toggle valve

Auxiliary hydraulics only

Interrupts the hydraulic connection between the mast lift cylinder and the remaining hydraulic system when the auxiliary hydraulics are applied.

(SVA1 / SVA2) Aux. hydraulics valves

Control the auxiliary hydraulics as a function of the aux. hydraulics switch.

(THS) Motor thermal switch

From serial no. 5A134882

Interrupts lifting if a maximum temperature is exceeded (motor protection).

Only on trucks with a capacity of 1.4 t or higher

This switch is an electronic thermostat for cold store trucks. Located on the main PCB of the control handle and applies the heaters at temperatures below 5°C and switches them off at 15°C.

(TM / M1) Traction motor

Drive motor for the truck (compound motor), governed by the traction controller.

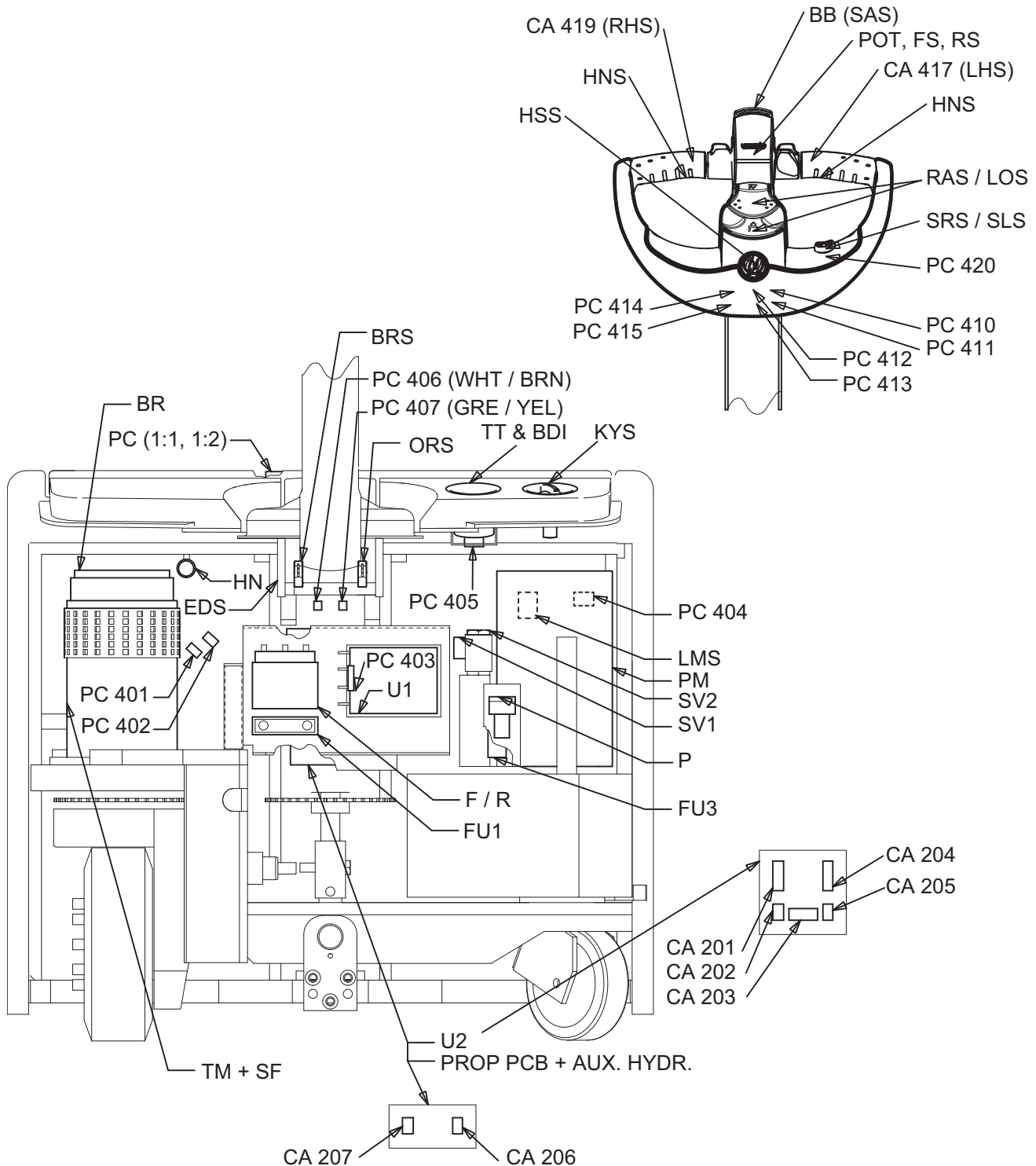
ELECTRICAL SYSTEM

Component Assembly Locations



Component Assembly Locations

Up to serial no. 5A134880



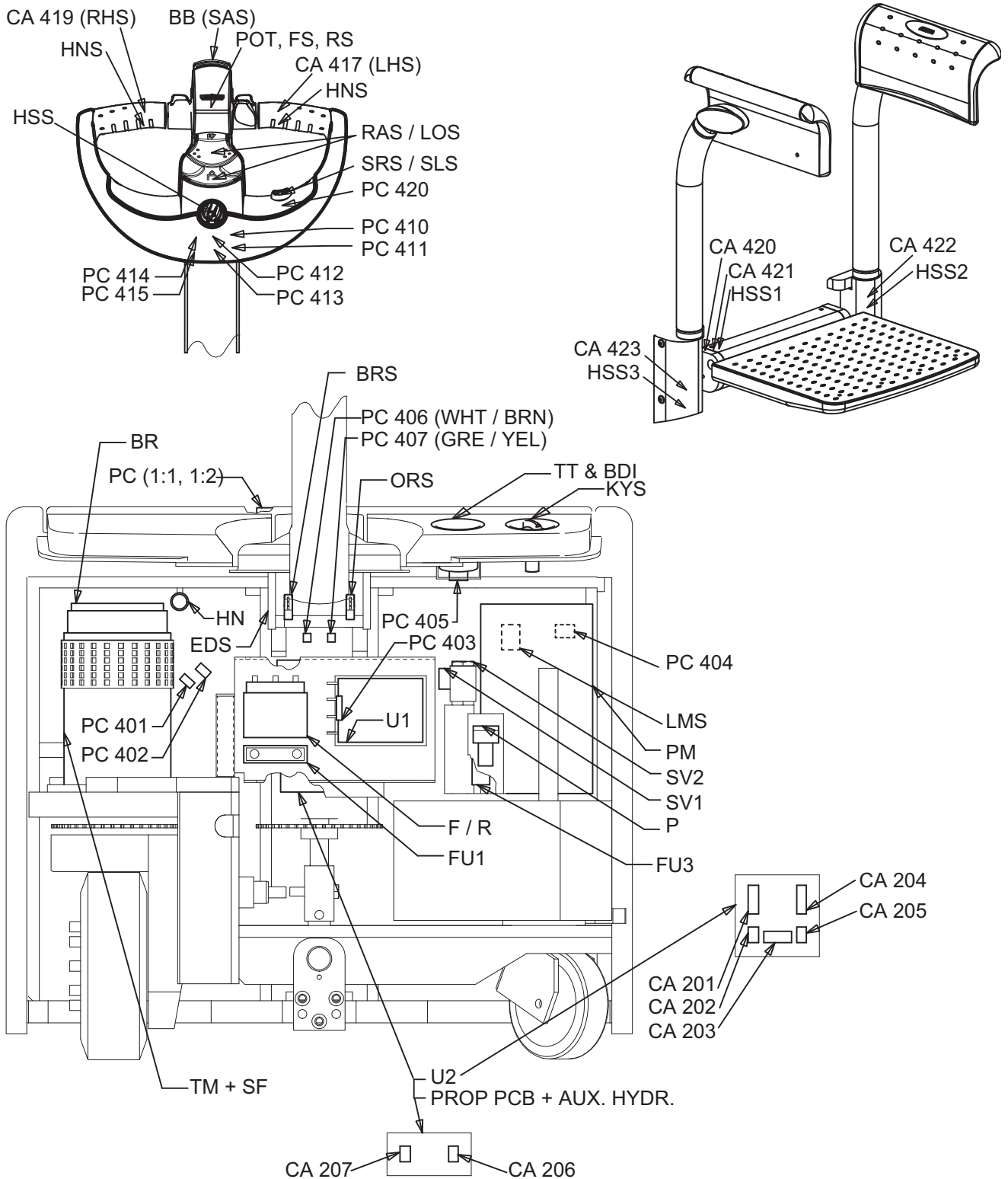
MS-4223-040



ELECTRICAL SYSTEM

Component Assembly Locations

Up to serial no. 5A134880



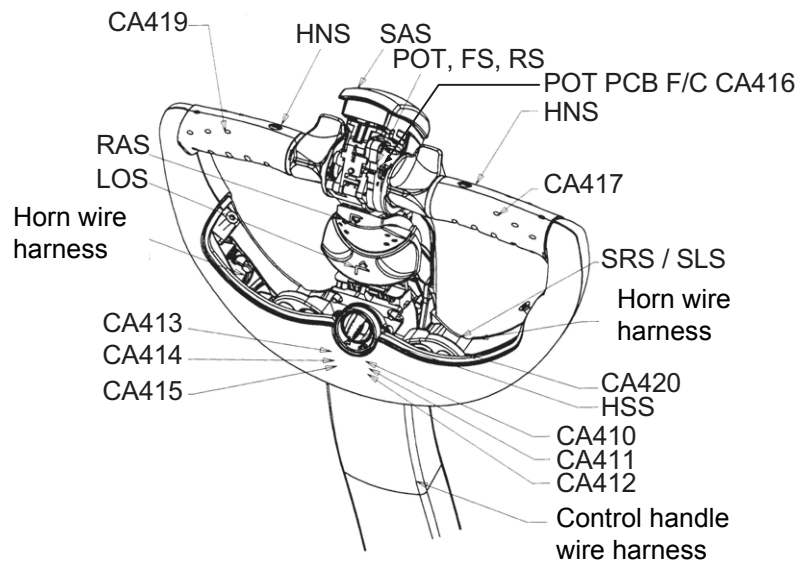
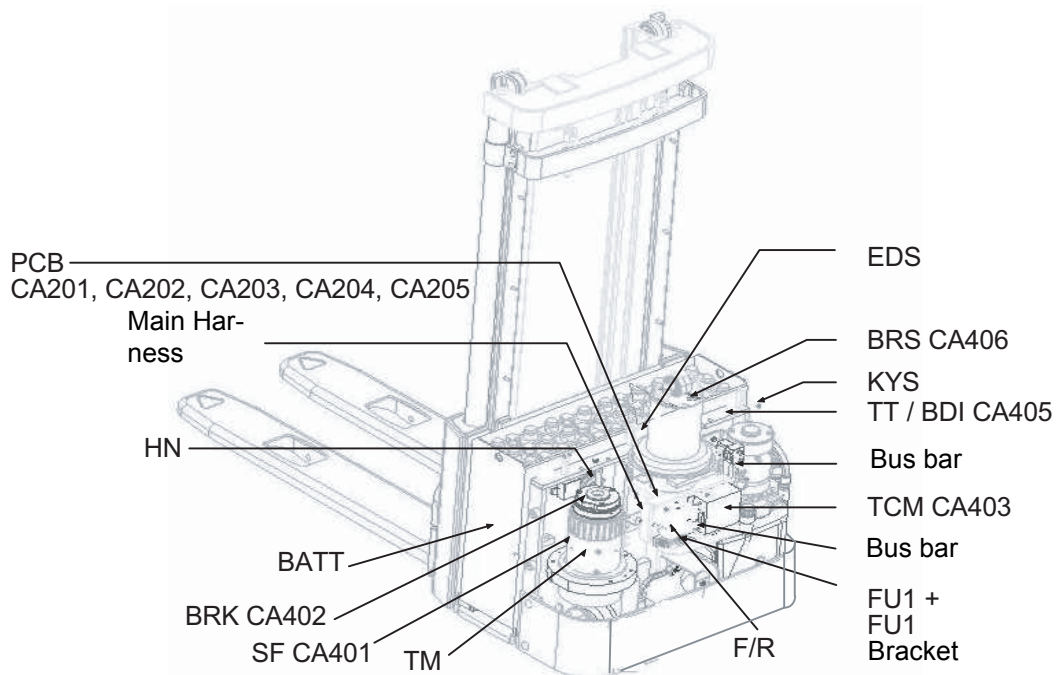
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ELECTRICAL SYSTEM

Component Assembly Locations



From serial no. 5A134882



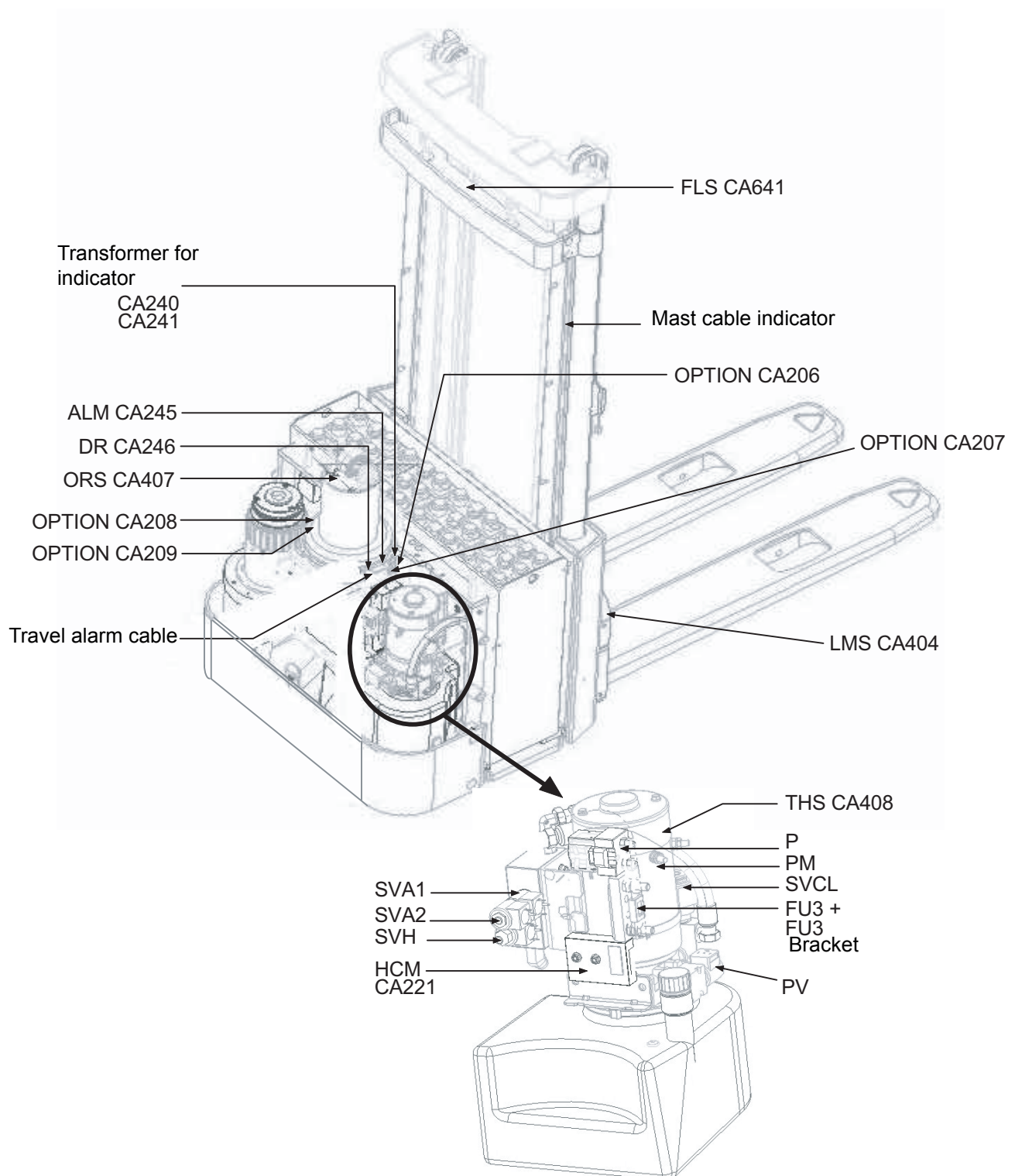
MS-4223-014



ELECTRICAL SYSTEM

Component Assembly Locations

From serial no. 5A134882



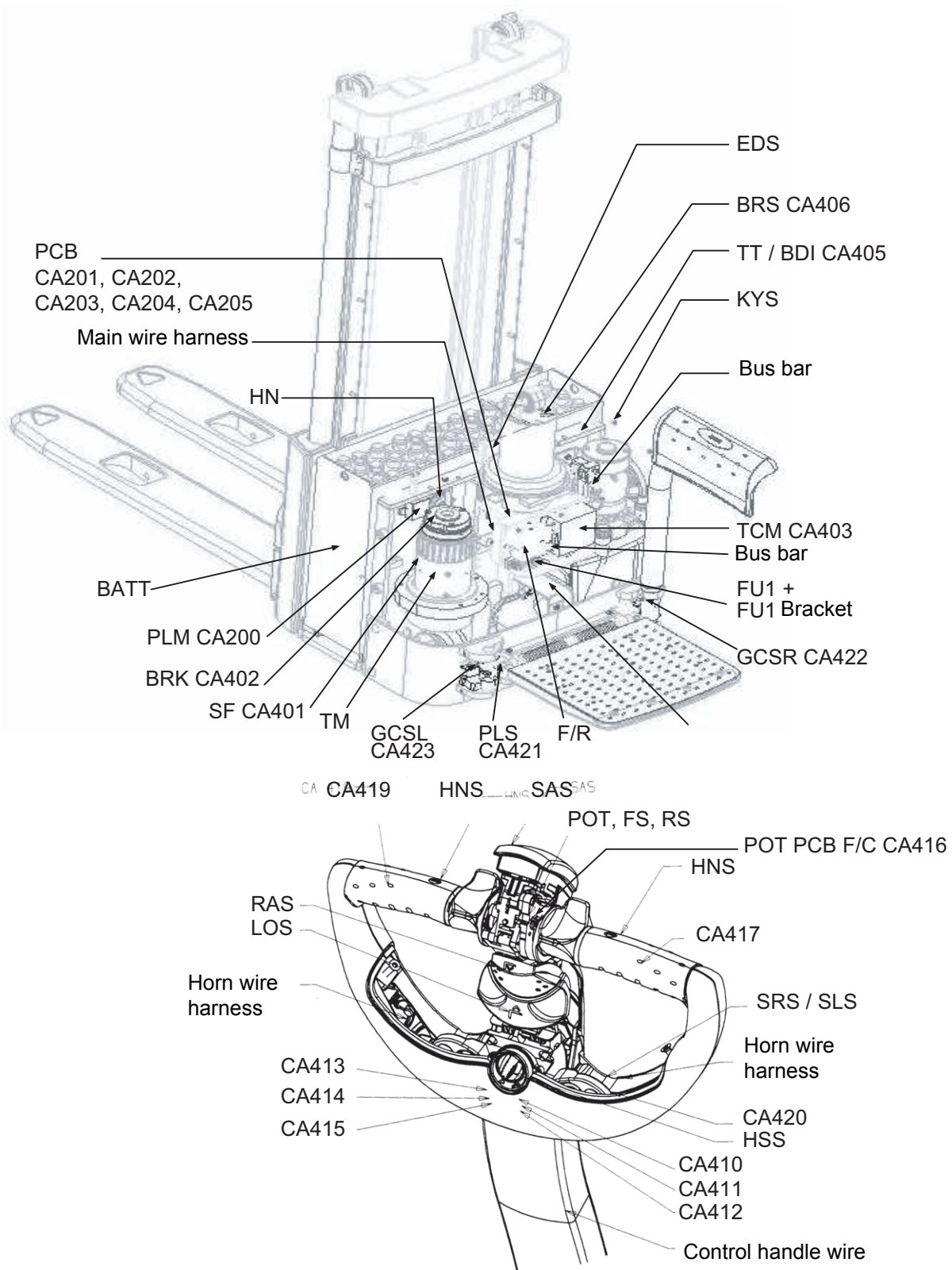
MS-4223-015

ELECTRICAL SYSTEM

Component Assembly Locations



From serial no. 5A134882



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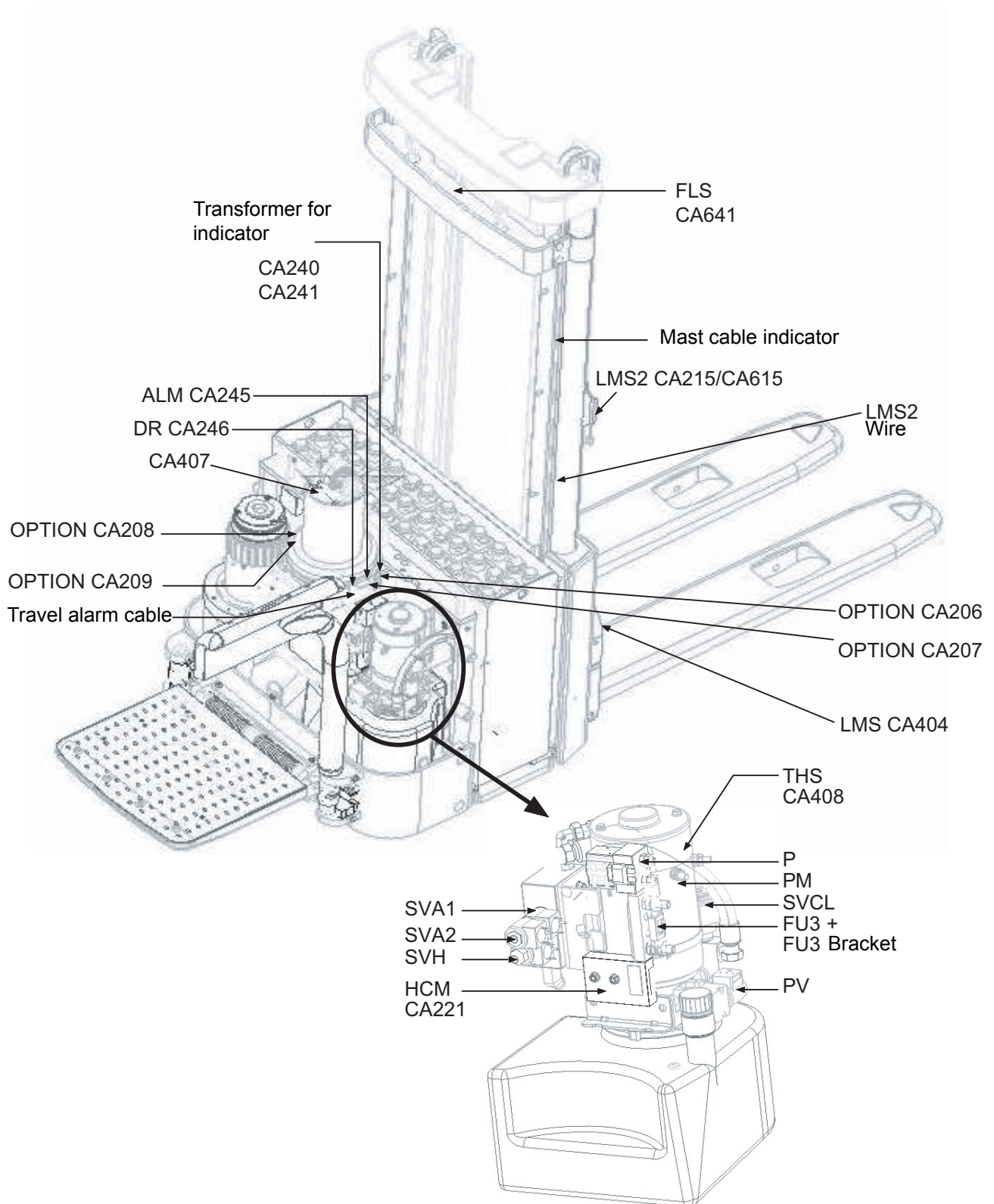
WE/WS 2300



ELECTRICAL SYSTEM

Component Assembly Locations

From serial no. 5A134882



MS-4223-017

ELECTRICAL SYSTEM

Traction Controller 1207



Traction Controller 1207

Functions

In this section we shall outline only the most important functions of the controller insofar as they are necessary to understand for service purposes.

Key switch

The key switch input energises the logic part of the controller and starts the power-up diagnostics. In conjunction with the brake input the key switch input releases all the logic functions of the controller.

Current limit

The current limit function reduces the PWM signal to the controller power part until the motor current falls below the value of the current limit.

Overvoltage protection

In the event of overvoltage the PWM cuts out and opens the contactors. When the permissible voltage has been reached the controller resumes operation.

Overtemperature protection

From a power stage temperature of 85°C the output current is linearly reduced until is zero at 95°C.

Performance reduction for low voltage

If the battery voltage drops below a defined level, the controller proportionally reduces the output current. This reduces the maximum speed (which is current-dependent).

If the battery voltage rises back over the defined low voltage level, the controller proportionally increases the output current. This ensures that the output, as a produce of current and voltage, remains constant.

Fault identification

The internal microprocessor monitors the controller. When a fault is identified, the status LED on the controller flashes a fault code.

If it is a critical error, the controller cuts out. For transient errors such as a low voltage error, the error message automatically goes out when the error no longer applies.

Error log

Errors are logged in the controller memory. It contains all the errors that have occurred since the last time the diagnostic history was cleared. Multiple occurrences of an individual error are recorded as a single event.

The content of the error log can be loaded into the programmer. The SPECIAL DIAGNOSTICS menu contains the error list.

Service



WARNING

Short circuits can cause fires! The traction controller operates with high currents. Particular safety measures are therefore required when handling the controller.

- You must be trained to carry out this work.
- Use fatigue-free eye protection.
- Wear close-fitting clothing.
- Do not wear jewelry.
- Always use insulated tools.

Service work on the traction controller is restricted to:

- External cleaning
- Checking any errors logged using the programmer.



WARNING

Risk of serious injury

Avoid accidents by:

- Switching the truck off
- Disconnecting the battery.
- Preventing the truck from being switched on again.
- Jacking up the truck and preventing it from rolling away

For further details refer to the Safety chapter.

The truck must be de-energised and secured, see safety notice. Once this has been done:

1. Discharge the capacitors: short-circuit the positive and negative terminals of the traction control module over a resistor (10 - 100 Ohm, min. 5 W) for a few seconds.
2. Remove the power cable.
3. Remove any dirt and corrosion from the contact surfaces.
4. Wipe down the traction controller with a clean, damp cloth.
5. When everything is dry, re-connect the cables.

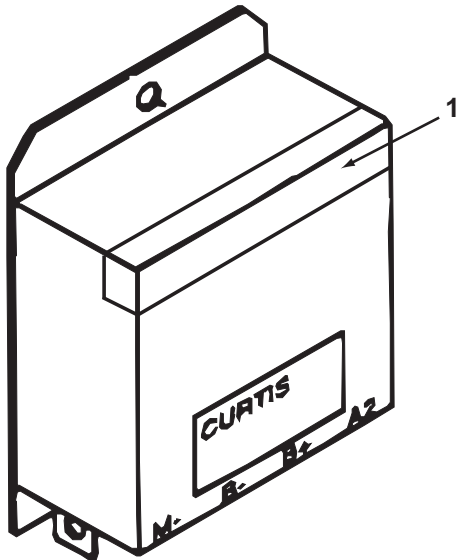
ELECTRICAL SYSTEM

Traction Controller 1207

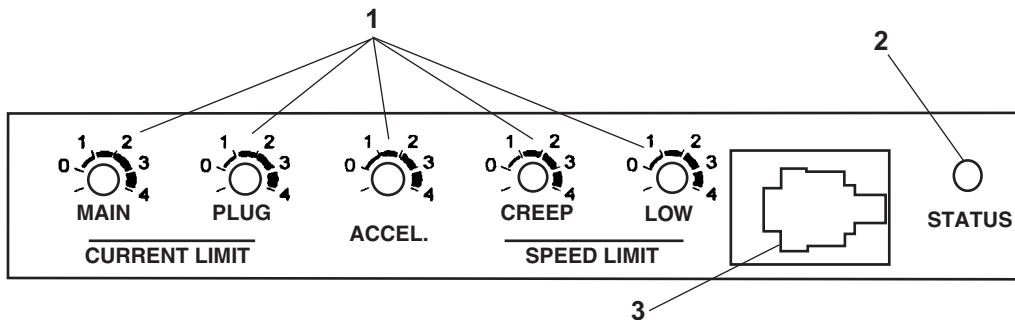


Control Panel

The control panel is located below a sliding cover (1, Fig. MS-4223-048) on top of the traction control module.



MS-4223-048



MS-4223-049

NOTE

The potentiometers must be set to "OFF" to change the settings with the programmer.

Programmer connection

A socket (3, Fig. MS-4223-049) is provided to connect the programmer. The connecting lead is included with the programmer.

Adjusting potentiometer

Five potentiometers allow the following to be set manually:

- Maximum travel current (MAIN)
- Maximum plugging current (PLUG)
- Acceleration time (ACCEL)
- Maximum creep speed (CREEP)
- Maximum slow travel speed (LOW).

Status LED

The LED uses a flashing code to indicate the most recent error.

Diagnostics with the status LED

During normal operation the status LED (2, Fig. MS-4223-049) flashes approximately every second. If an error is detected, the status LED continues to flash a 2-digit code followed by an interval until the error is rectified. See LED codes table.



ELECTRICAL SYSTEM

Traction Controller Error Messages

Traction Controller Error Messages

Status LED

If the self-test is positive and there are no errors with the externally monitored components, the status LED flashes (*—*) at regular intervals. When an error occurs, the status LED indicates a code (see following table). The code remains displayed until either the error is rectified or another error overwrites the first one. The

programmer can be used to define the error more exactly.

The following symbols are used in the table:

- ⊗ LED off.
- LED permanently lit.
- * LED flashes once.
- Flashing signal interval.

LED code	Programmer LCD display	Comments	Possible Causes
⊗	None	Traction controller not active.	Power supply interrupted or traction controller faulty.
○	Unspecified	Traction controller faulty.	—
*—**	HW FAILSAFE	Hardware failure	Controller faulty.
*—***	M- FAULT	M- output shorted.	M- output frame leakage. Short circuit in motor. Direction contactor not closed. Direction contactor not closed fast enough. Short circuit between motor and housing.
*—****	SRO	Power-up sequence error.	Incorrect power-up sequence of key switch, brake and direction switch. Wrong SRO type selected. Brake or wiring of travel direction switch disconnected. Sequencing delay too short.
**—*	THROTTLE FAULT 1	Traction potentiometer error.	Potentiometer wire disconnected. Potentiometer input shorted to B -. Travel switch potentiometer faulty. Incorrect travel switch type selected.
—	BB WIRING CHECK	Safety reverse switch circuit check failed.	Safety reverse switch (SAS) wiring faulty.
—*	HPD	Travel switch applied when truck switched on.	Incorrect starting sequence. Incorrect HPD type selected.
—**	THROTTLE FAULT 2	Traction potentiometer error.	Earth wire shorted. Potentiometer wiring disconnected. Incorrect travel switch type selected.

ELECTRICAL SYSTEM

Traction Controller Error Messages



LED code	Programmer LCD display	Comments	Possible Causes
***_**	CONT DRVR OC	Overcurrent in contactor driver.	Short circuit in direction contactor coil. Short circuit in motor shunt coil or wiring.
_	DIR CONT WELDED	Direction contacts are welded.	Direction contactor contacts are welded or jamming.
_**	MISSING CONTACTOR	Wiring to direction contactor or shunt field open.	Direction contactor coil is open. Direction contactor coil missing. Shunt coil connection is open. Direction contactor wiring disconnected.
****_**	LOW BATTERY VOLTAGE	Battery voltage too low.	Battery voltage below 16 V
****_***	OVERVOLTAGE	Overvoltage	Battery voltage above 16 V
****_****	THERMAL CUTBACK	Reduction in travel speed due to traction controller high or low temperature.	Traction controller temperature above +85 °C or below -25 °C. Truck overloaded. Controller fitted incorrectly. Extreme ambient conditions.

NOTE

Only one error - the most recent - is displayed.



ELECTRICAL SYSTEM

Traction Controller Error Messages

Error Reset

The only exceptions are:

Almost all errors require the key switch or the brake switch input to be turned off / on again to reset the controller and resume operation.

Error	Reset by:
Contacting coil overvoltage	Automatic as soon as the current drops to normal levels.
Collision protection	Apply safety reverse switch or brake.
Travel switch collision protection	Pull back the travel switch until it is below the limit.
Overvoltage	Automatic as soon as the battery voltage drops below the limit.
Travel direction switch start-up protection	Keep the correct power-up sequence.
Overtemperature	Automatic when the temperature drops again.
Travel switch error	On attaining the normal travel switch signal.
Low voltage	Automatic as soon as the battery voltage rises above the limit.
All other errors	Turn the key switch off / on or apply the brake.

ELECTRICAL SYSTEM

Test Procedure



Test Procedure

Replace the traction controller and then repeat the test.

- Switch the truck off and jack it up.

Pulse Monitor Trip Test (PMT)

This test must be performed at least annually in accordance with EU regulations.

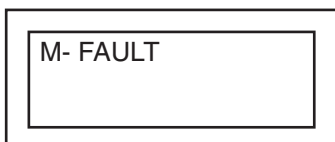
The test is used to check the safety circuit of the traction controller.

Equipment

A test wire > 1.5 mm², protected by a 10A fuse and one insulated crocodile clip on each end of the wire.

Test

- Switch off the truck.
- Jack up the truck so that the drive wheel is clear of the ground (see chapter 1).
- Attach the test wire to B- and M- of the traction controller (see Fig. M0460-de).
- Connect the programmer to the controller.
- Power up the truck.
- Apply the brake switch.
- LED - Code * *** (1_3) appears and the display shows: ALARM



M0461

- Select forward or reverse. The traction motor should not start up.

This means the test has been carried out successfully, and the safety circuit of the traction controller is working normally.



DANGER

A faulty traction controller safety circuit can result in fatal injuries.

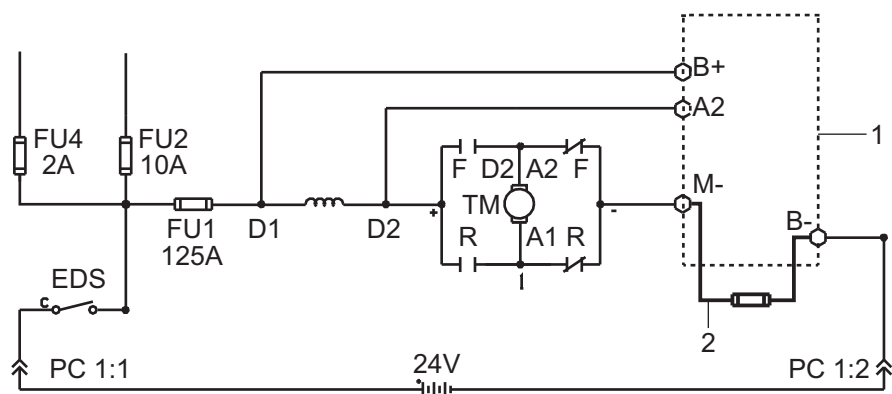
If the circuit fails the test, take the truck out of service immediately.



ELECTRICAL SYSTEM

Test Procedure

PMT Test Wiring Diagram



MS-4223-050

- 1 Impulse controller
- 2 Test wire

ELECTRICAL SYSTEM

1307 Programmer



1307 Programmer

General

The 1307 programmer enables the following to be carried out:

- Traction controller programming.
- Traction controller testing.
- Traction controller diagnostics.

The programmer is connected to the traction controller via a cable. The programmer is powered via the traction controller (Fig. M0031).

Connection



DANGER

You or other people could be fatally injured.

If the drive wheel is in contact with the ground, the truck can roll away accidentally.

The truck must be jacked up before operating on the truck or troubleshooting the control module. The drive wheel must not be in contact with the ground.

NOTE

Make sure the brake switch is not applied when you connect the programmer to the control module.

When all the data has been read from the controller, the programmer will show the model number of the controller, the manufacturing date and the software version. After this display the programmer will request further entries.

Operation

(see Fig. MS-4223-043)

NOTE

The display module contains a 4-row LCD display. The display contrast can be adjust in the SPECIAL PROGRAM MODE menu.

- *The display (7) shows four lines of a menu at the same time. Use the SCROLL DISPLAY keys to display the other lines.*

- *If you wish to select a specific menu item it must be displayed in the top line. The menu item selected is highlighted in programming mode by a flashing arrow (= cursor). Only in this position can a parameter be changed or information relating to the parameter retrieved.*

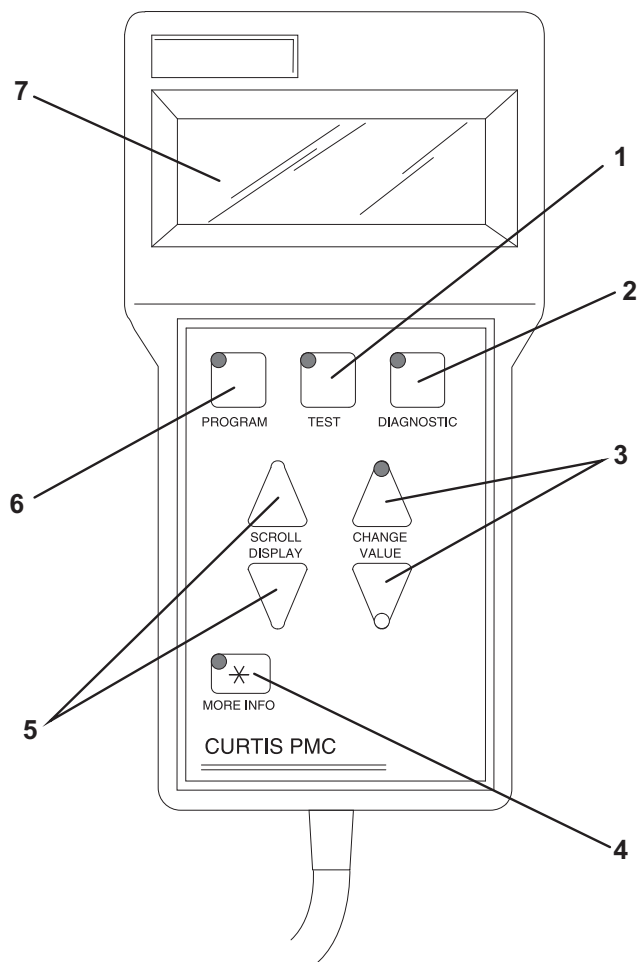
General

The programmer is controlled via a keypad with 8 keys. Three keys are used to select a function menu: (PROGRAM, TEST, DIAGNOSTICS). Two keys are used to scroll the display up and down in the window, and two keys are used to change the parameter selected.

The MORE INFO key provides further information on the line selected in the three menus. Pressing the MORE INFO key and the PROGRAM or DIAGNOSTICS key simultaneously brings you to the Special Program menu or the Special Diagnostics menu (Fig. M0045-1).

All keys, with the exception of the SCROLL DISPLAY keys, contain an LED. When the key is pressed the LED illuminates and shows the menu being used.

The LED in the CHANGE VALUE keys has a special function. It is permanently lit when you reach the limit and cannot be further adjusted in this direction.



MS-4223-043

- | | | | |
|---|---------------------|---|----------------|
| 1 | TEST key | 2 | DIAGNOSTIC key |
| 3 | CHANGE VALUE keys | 4 | MORE INFO key |
| 5 | SCROLL DISPLAY keys | 6 | PROGRAM key |
| 7 | Display screen | | |

ELECTRICAL SYSTEM

1307 Programmer



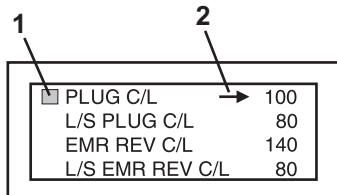
Key Functions

SCROLL DISPLAY keys

Use the SCROLL DISPLAY keys (5) to scroll up and down the menu. The keys can be pressed repeatedly or held down.

If one of the keys is held down, the display will scroll with increasing speed until you let go of the key.

A small scroll bar (1, Fig. MS-4223-043) on the left border of the display window shows the current position in the four menu items displayed. When the scroll bar is at the top border the start of the menu is displayed. As you scroll through the menu the scroll bar moves down. When the scroll bar is at the bottom border you have reached the end of the menu. The example shown is taken from the PROGRAM menu.



MS-4223-044

CHANGE VALUE keys

Use the CHANGE VALUE keys to increase or reduce the value of the parameter selected in the menu. The keys can be pressed repeatedly or held down. The longer a key is pressed, the faster the parameter setting will change. An LED on the top of each key indicates the activity status of that key. When a parameter is changed the LED on the key remains illuminated until the maximum setting for this parameter is reached. If the LED goes out this indicates that the parameter cannot be adjusted any further in this direction.

MORE INFO key

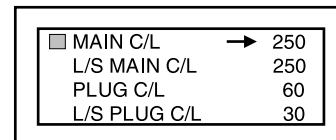
The MORE INFO key has three functions:

- To display more information about the menu item selected.
- To start a special function (e.g. self test).
- To select the SPECIAL-PROGRAM or SPECIAL-DIAGNOSTIC menus (when pressed in conjunction with the PROGRAM or DIAGNOSTICS keys).

More information on the various parameters is available in all the programmer menus. To regain access to the list, press the MORE INFO key again.

PROGRAM key

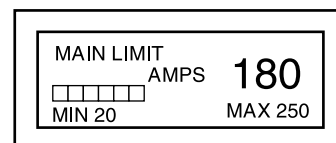
The PROGRAM key switches programming mode on (see Fig. M0607).



M0607

The display screen shows a menu in list form for all the adjustable parameters and functions of the controller, with the current settings. Use the SCROLL DISPLAY keys to scroll through the list.

The MORE INFO key provides an extended display (see Fig. M0033) of the selected parameter with a bar graph, the current setting as well as the minimum and maximum settings for this parameter.



M0033

Parameters can be changed either directly in the list or, after pressing the MORE INFO key, in the extended display.

To restore all the original settings, see "Resetting to Defaults", page 99.

NOTE

The possible settings for some parameters will depend on the settings of other parameters. In other words, the possible setting range for one parameter depends on the current setting of another.

For example the controller will not permit the traction current limit to be set less than the present setting for the collision protection current limit. The controller therefore blocks any logical errors.

If you try to set the traction current limit less than the present setting for the collision protection current limit, a message on the display screen will refer you to the dependency.



ELECTRICAL SYSTEM

1307 Programmer

TEST key

Pressing the TEST key activates Test mode. The test menu is used for testing after installation and for troubleshooting. The display provides information in real time on the status of the inputs and outputs as well as the controller temperature.

The required menu item does not have to be in the top line of the display in the test menu list. It only has to be in the 4 lines shown in the display in order to be read. The SCROLL DISPLAY keys can also be used here to scroll.

Pressing the MORE INFO key while the programmer is in test mode provides more information and abbreviations are detailed. The parameter in question must be selected, i.e. must be in the top line.

DIAGNOSTIC key

Pressing the DIAGNOSTIC key brings up current errors.

Pressing the MORE INFO key in the DIAGNOSTICS menu mode brings up details on abbreviations.

Key Combinations

Some modes can be reached by key combinations.

SPECIAL DIAGNOSTIC menu

This mode shows the controller's error history. It contains all the errors that have occurred since the last time the error history was cleared. If the same error has occurred several times, only the last occurrence is logged. *The controller's maximum and minimum temperatures can be seen in the TEST menu.*

To switch to the SPECIAL DIAGNOSTIC menu:

1. Hold down the MORE INFO key.
2. Press the LED on the DIAGNOSTICS key.

The LED on the DIAGNOSTICS key illuminates as if the programmer were in diagnostic mode. More information on the item selected (the first line is always the one selected) can be viewed by pressing the MORE INFO key.

NOTE

The error history can only be cleared in the SPECIAL PROGRAM menu.

SPECIAL PROGRAM menu

A number of tasks can be performed in the SPECIAL PROGRAM menu. Most of them are self-explanatory. The Special Program menu also allows you to:

- Restore settings to defaults after adjustment.
- Copy controller settings and then load them into a new controller and clear the diagnostic history.

Switch on the SPECIAL PROGRAM:

1. Press and hold down the MORE INFO key.
2. Press the PROGRAM key.

The LED on the PROGRAM key illuminates as if the programmer were in programming mode. You can distinguish between the two operating modes by looking at the menu items.

Selecting a menu item (the first line is always the one selected) with the SCROLL DISPLAY keys and pressing the MORE INFO key again opens up a sub-menu. Here you can change the function selected. Pressing the MORE INFO key again returns you to the selection menu.

Clearing the error history

Set the programmer to the SPECIAL-PROGRAM mode. Select the *Clear Diagnostic History* menu item and press the MORE INFO key for further instructions.

Clearing the diagnostic history also deletes the maximum and minimum temperature settings in the test menu.

Copying (cloning) controller settings

The menu items of the special program - *Save Controller Settings in Programmer* and *Load Programmer Settings into Controller* - allow you to copy controllers.

To do this simply program a controller with the required parameters and store the settings in the programmer (*Save Controller Settings in Programmer*). Now transfer the program to another controller with the same model number (*Load Programmer Settings into Controller*).

Resetting to defaults

Immediately after the programmer is connected to a controller the controller's program is read and stored in the programmer's memory.

ELECTRICAL SYSTEM

1307 Programmer



NOTE

While the truck is switched on and the programmer connected to the controller, you can access the initial settings at any time during programming via the Special-Program menu.

To restore the initial settings in the *Revert to Previous Settings* line, press the MORE INFO key and follow the instructions. All the previous settings will be overwritten.

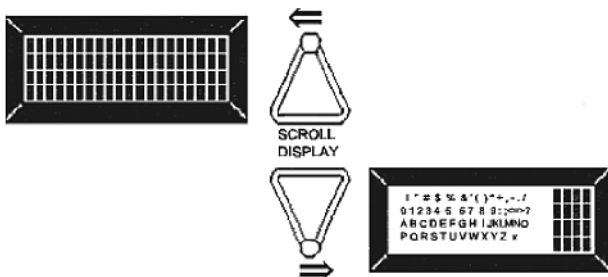
Programmer self-test

The programmer is checked via two special test screens.

To carry out the self-test, connect the programmer to the controller when the truck is switched off. Now press the MORE INFO key as you turn the key switch on.

Use the SCROLL DISPLAY keys to change the test display. In the first display each LCD segment is switched on, the second display shows all the characters of the various menus.

To test the keys, the LEDs in the respective keys should illuminate. To end the self-test turn the key switch off.



M0046

1311 Programmer

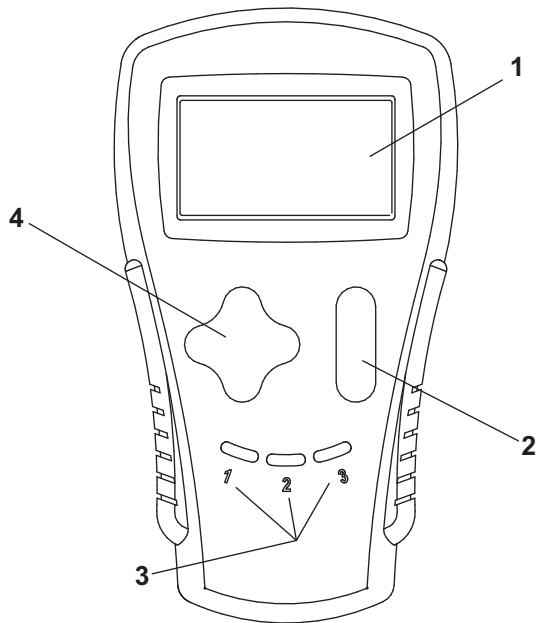
Operation

NOTE

We shall now explain how to operate the programmer using the example of the programmer menu. The following steps apply broadly to all sub-menus.

When the programmer is connected it shows the controller's model number, manufacturing date and software version. The display then shows the main menu (see Fig. 10468).

If there are no entries for a particular menu, the title of this menu will not be displayed.



10466

- 1 Display screen
- 2 Data +/- key
- 3 Highlighter keys 1 to 3
- 4 Navigation key

General

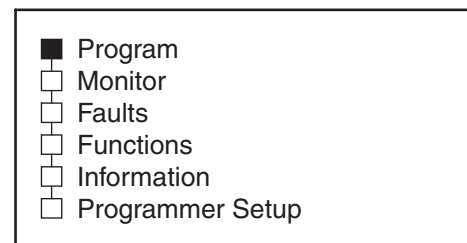
The 1311 programmer is the successor to the 1307 model.

It can be ordered through part no. 130475. It comes with connection lead part no. 130480 (4 pin Molex connector) and part no. 130481 (RJ11 connector).

The 1311 programmer can be used for the following Curtis traction controllers:

- Model 1207
- Model 1214
- Model 1703.

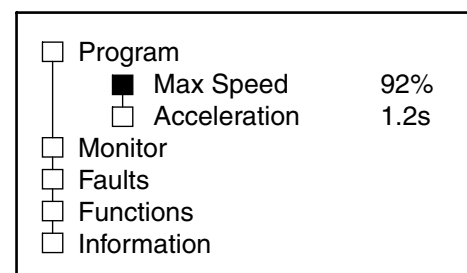
The programmer is powered via the traction controller.



10468

A flashing rectangle on the left border shows the cursor position. You are at the highest menu level, in the main menu. The *navigation key arrow keys facing up and down* move the cursor in the main menu.

The *navigation key right arrow key* opens an entry in the main menu. A right-indented sub-menu is displayed (see Fig. 10532).

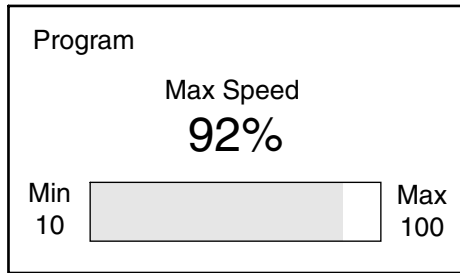


10532

Details can be viewed in a sub-menu of the programmer menu. Press the *navigation key right arrow key* to bring up a screen with more information and a bar chart (see Fig. 10533).

ELECTRICAL SYSTEM

1311 Programmer



10533

Use the *data* +/- key to change the setting of the parameter displayed. Press the *navigation key left arrow* key to switch back to the next highest menu level.

To highlight an item in the menu, press down on one of the *highlighter keys 1 to 3*. After 3 seconds the highlighter feature will be confirmed on the display screen. To move to a set highlighted item, press the appropriate highlighter key. The highlights are not stored permanently.

The highlights are deleted if:

- The programmer is disconnected from the controller.
- The truck is switched off.

Menus

Main menu

The main menu is the starting point. All the main functions can be easily reached from the main menu.

Program menu

The programming menu can contain several sub-menus with parameters. This menu is used to adapt the truck to the operating conditions and the application.

Monitor menu

The monitor menu contains a list of all the variables that can be read and displayed.

Error menu

The error menu shows current errors. It can also be used to clear the error history. It contains the sub-items:

- SYSTEM FAULTS
- FAULT HISTORY

- CLEAR FAULT HISTORY

Functions

The 1311 programmer can also be used to copy data between similar models, to reset data and for other model-specific functions.

SETTINGS

- GET SETTINGS FROM CONTROLLER
- WRITE SETTINGS TO CONTROLLER
- RESET ALL SETTINGS

Hand Held Unit Settings

Various setup options and information can be accessed in this menu.

PROGRAM

- LCD CONTRAST
- LANGUAGE
- INFORMATION
- OEM INFO
- RECONFIGURED
- MODEL NUMBER
- SERIAL NUMBER
- MANUFACTURING DATE
- SOFTWARE VERSION
- HARDWARE VERSION
- MC-PROTOCOL VER
- ES-PROTOCOL VER
- S-PROTOCOL VER
- DEVICE TYPE



ELECTRICAL SYSTEM

Traction Controller Settings

Traction Controller Settings

WE 1.25t/WS 1.35t

Traction Controller Type 1207-1115 Setting

Program Menu			
Menu item	Setting range	Setting	Description
MAIN C / L	20 - 250 A	180	Traction current limit
PLUG C / L	20 - 250 A	110	Plugging current limit
ACELL RATE	0 - 3 s	1.0	Acceleration
CREEP SPEED	0 - 25 %	0	Creep speed
LOW SPEED	40 - 100 %	40	Reduced travel speed

WE 1.25t/WS 1.35t Platform

Traction Controller Type 1207-1144 Setting

Program Menu			
Menu item	Setting range	Setting	Description
MAIN C / L	20 - 250 A	180	Traction current limit
PLUG C / L	20 - 250 A	110	Plugging current limit
ACELL RATE	0 - 3 s	1.0	Acceleration
CREEP SPEED	0 - 25 %	0	Creep speed
LOW SPEED	40 - 100 %	55	Reduced travel speed

ELECTRICAL SYSTEM

Traction Controller Settings



WE 1.6t/WS 1.8t/WS 1.4 t

Traction Controller Type 1207-1115 Setting

Program Menu			
Menu item	Setting range	Setting	Description
MAIN C / L	20 - 250 A	180	Traction current limit
PLUG C / L	20 - 250 A	110	Plugging current limit
ACELL RATE	0 - 3 s	1,0	Acceleration
CREEP SPEED	0 - 25 %	0	Creep speed
LOW SPEED	40 - 100 %	55	Reduced travel speed

WE 1.4t Platform / WS 1.4t Platform

Traction Controller Type 1207-1144 Setting

Program Menu			
Menu item	Setting range	Setting	Description
MAIN C / L	20 - 250 A	220	Traction current limit
PLUG C / L	20 - 250 A	120	Plugging current limit
ACELL RATE	0 - 3 s	1,0	Acceleration
CREEP SPEED	0 - 25 %	0	Creep speed
LOW SPEED	40 - 100 %	55	Reduced travel speed



ELECTRICAL SYSTEM

Programmer Menus

Programmer Menus

"Program" Menu

Display	Meaning
MAIN C / L	Traction current limit
L / S MAIN C / L	Traction current limit, in reduced speed travel
PLUG C / L	Plugging current limit
L / PLUG C / L	Plugging current limit, in reduced speed travel
EMR REV C / L	Safety reverse switch current limit
L / S EMR REV C / L	Safety reverse switch current limit, in reduced speed travel
RAMP C / L	Ramp start current limit
L / S RAMP C / L	Ramp start current limit, in reduced speed travel
ACCEL RATE	Acceleration rate in seconds
THROTTLE TYPE	Travel switch type
RAMPE SHAPE	Ramp shape
CREEP SPEED	Creep speed, as a % of maximum speed
LOW SPEED	Reduced travel speed, as a % of maximum speed
EMR REV SPEED	Safety reverse switch speed, as a % of maximum speed
SEQUENCING DLY	Delay in checking the power-up sequence
VARIABLE PLUG	Varying the brake current with the travel switch
HIGH PEDAL DIS	Travel switch start up protection (potentiometer)
SRO	Direction switch start up protection (SRO)
ANTI - TIEDOWN	Anti-tie down: on or off
QUICK START	Rapid start rate

ELECTRICAL SYSTEM

Programmer Menus



“Test” Menu

Display	Description
FORWARD INPUT	Forward switch: on / off
REVERSE INPUT	Reverse switch on / off
BRAKE INPUT	Brake switch: on / off
THROTTLE %	Travel switch signal, as a % of maximum speed
SPEED IN	Rapid travel switch: on / off
EMR. REV INPUT	Safety reverse switch: on / off
MAIN CONTACTOR	Main contactor: on / off
FWD CONTACTOR	Forward contactor: on / off
REV CONTACTOR	Reverse contactor: on / off
BATT VOLTAGE	Battery voltage
HEATSINK °C	Heatsink temperature
MAX TEMP °C	Max. recorded heatsink temperature (cannot be used)
MIN TEMP °C	Minimum recorded heatsink temperature



ELECTRICAL SYSTEM

Programmer Menus

“Diagnostics” and “Special Diagnostics” Menus

Display	Description
WIRING CHECK	BB error checking the safety reverse switch
CONT DRVR OC	Current through contactor driver too high
DIR CONT WELDED	Direction contactor contacts jammed
HPD	Travel switch start up protection activated
HW FAILSAFE	Hardware safety device activated
LOW BATTERY VOLTAGE	Battery voltage too low (< 16 V)
M - SHORTED	Short circuit on M- output to B-
MISSING CONTACTOR	Contactor control circuit cutout
NO KNOW FAULTS	Controller has not detected any errors
OVERVOLTAGE	Battery voltage too high (> 45 V)
SRO	Direction switch start up protection activated
THERMAL CUTBACK	Reduction due to overtemperature or low temperature
THROTTLE FAULT 1	Travel switch error, incorrect value
THROTTLE FAULT 2	Travel switch error, wire disconnected

ELECTRICAL SYSTEM

Programmer Menus



“Special Program” Menu

Special Program menu	Description
RESET ALL SETTINGS	Reset to initial settings
CONT SETTING-> PROG	Store controller settings in programmer
PROG SETTINGS-> CONT	Load settings from programmer into controller
CLEAR DIAG HISTORY	Clear diagnostic history
CONTRAST ADJUSTMENT	Adjust the contrast display
LANGUAGE SELECTION	Select display language
PROGRAMMER INFO	View programmer information
CONTROLLER INFO	View controller information

BDI / TT

Battery Discharge Indicator / Hour-meter

This display provides information on the battery charge status.

Removal

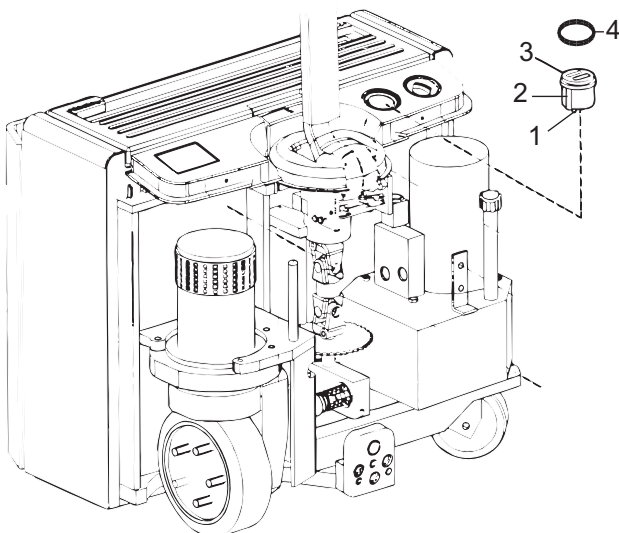
1. Disconnect the battery
2. Raise the truck until the drive wheel can move freely.
3. Remove the dashboard on the left.
4. Disconnect the battery discharge indicator.
5. Remove the two mounting screws (1) and take out the bracket (2).
6. Remove the battery discharge indicator (3) and glass panel (4).

Servicing

The instrument cannot be serviced. When replacing the display make a note of the service hours completed.

Assembly

Assembly is the reverse order of removal.



M1246

Battery Discharge Indicator (BDI)



WARNING

The following setting and calibration instructions for the BDI apply only to wet batteries.

- *For maintenance-free batteries follow the manufacturer's instructions regarding the discharge terminal voltage.*

General

A battery from the factory will require approx. 5 - 10 charge and discharge cycles to reach its full capacity.

A battery is considered to be technically discharged when it has reached 20% residual capacity. For example, a battery with a 500 amp hour capacity has an effective output of 400 amp hours.

In addition, the effective output will depend on the discharge speed, which in turn is affected by the particular truck application.

The battery discharge indicator must therefore be set according to the truck's particular application conditions.

The battery discharge indicator controls the lift cutout system. The lift cutout system is designed to prevent the battery from being operated to the point where is fully discharged.

If the battery is constantly discharged to below 20% of residual capacity it will become damaged.

If the lift cutout system is activated above 20% of the battery's residual capacity the battery will not be damaged, but the truck's maximum operating time under a single battery charge will not be attained.

The lift cutout system should therefore be activated as close to 20% of the battery's residual capacity as possible. It may be slightly above 20% but never below this level.

NOTE

For new trucks the battery discharge indicator should be set at the latest after ten discharge and charge cycles.

ELECTRICAL SYSTEM

BDI / TT



Battery Discharge Indicator Setting (BDI)

The acid density is a very reliable indicator of the charge status of a lead acid battery.

However, since it is unrealistic to continually measure the acid density of a truck battery to an industrial standard, the battery voltage is used to determine the charge status over longer journeys.

To adapt the BDI to the battery used and the truck's specific application profile, you need the battery manufacturer's data sheet. The values you require are the density of the electrolyte for an 80% discharged battery (20% battery residual capacity) and for a fully charged battery (100% battery capacity).

Finally, via the potentiometer on the back of the BDI the display is set to the actual discharge terminal voltage of the battery at 20% residual capacity.

The factory default setting of the battery discharge indicator is "N" (any setting from K to U is possible).

Calibration

- Fully charge the battery as indicated by the battery manufacturer in the operating instructions. Measure the acid density in accordance with the battery manufacturer's maintenance instructions to check

if the battery is actually 100% charged. Faulty battery cells will make calibration impossible.

- Operate the truck as usual under normal operating conditions until the battery is empty: both LEDs of the BDI will flash and the lift cutout system will be triggered.
- Leave the battery for at least 10 to 12 hours (one hour at the very minimum).
- After this interval measure the acid density on at least three different battery cells. The smallest recorded value is the one you need.
- Compare the recorded density with the density specified by the manufacturer for an 80% discharged battery (20% residual capacity).
- If the battery is more than 80% discharged (less than 20% residual capacity), set the potentiometer on the back of the BDI to direction K.
- If the battery is less than 80% discharged (more than 20% residual capacity), set the potentiometer on the back of the BDI to direction U.
- Re-charge the battery and check the calibration. Repeat the process if necessary.

Setting the discharge terminal voltage in volts/cell

K	L	M	N	O	P	Q	R	S	T	U
1.57	1.63	1.68	1.73	1.78	1.82	1.84	1.86	1.89	1.91	1.93



ELECTRICAL SYSTEM

Functional Description

Functional Description

Platform Logic Controller, Part No. 815043

Signal low = 0 V

Signal high = 24 V

Total pins: 22

Connections used: 18

The truck has 3 operating modes:

- Pedestrian mode
- Rider mode
- Travel inhibit mode

Pedestrian mode:

1. Both side restraints are folded in and the platform is folded up:
 - Input connection 2, GCSR signal is low **and**
 - Input connection 3, GCSL signal is low **and**
 - Input connection 4, PLS signal is low
 - Output connection 22, BRK is low
 - Output connection 12, SF is high
2. Both side restraints are folded in and the platform is folded down:
 - Input connection 2, GCSR signal is low **and**
 - Input connection 3, GCSL signal is low **and**
 - Input connection 4, PLS signal is high
 - Output connection 22, BRK is low
 - Output connection 12, SF is high

Rider mode:

- Input connection 2, GCSR signal is high **and**
- Input connection 3, GCSL signal is high **and**
- Input connection 4, PLS signal is high
- Output connection 22, BRK is low
- Output connection 12, SF is low

Travel inhibit mode:

If the truck is not in pedestrian or rider mode, travel inhibit mode is activated:

- Output connection 22, BRK is high
- Output connection 17, FS input (12) and input connection 16, RS input (11) signal is low

ELECTRICAL SYSTEM

Functional Description



Connection 13, SAS output:

Output connection 13 is only high if:

- SAS input connection 8 is high **and**
- Input connection 2, GCSR signal is low **and**
- Input connection 3, GCSL signal is low **and**
- Input connection 4, PLS signal is low connection 13, SAS output:

Connection 14, LLO output:

1. Output connection 14 is only high if:
 - Input connection 7, RAS signal is low **and**
 - Input connection 20, LMS 2 signal is high
2. Output connection 14 is low if:
 - Rider or pedestrian mode output connection 12 is low **and**
 - Input connection 20, LMS 2 signal is high
 - Input connection 7 is irrelevant
3. Output connection 14 is low if:
 - Rider or pedestrian mode output connection 12 is high **and**
 - Input connection 20, LMS2 signal is low
 - Input connection 7 is low
4. Output connection 14 is high if:
 - Rider or pedestrian mode output connection 12 is high **and**
 - Input connection 20, LMS2 signal is low
 - Input connection 7 is high

Connection 22, BRK output (brake released):

Output connection 22 is low if:

- Input connection 5, BRS signal is high **and**
- The truck is in pedestrian or rider mode.

Connection 16, RS input:

Output connection 16 is high if:

- Input connection 19, RS signal is high

Connection 17, FS input:

Output connection 17 is high if:

- Input connection 9, FS signal is high

Connection 18, FS speed reduction:

Output connection 18 is high if:

- Input connection 69, HSS signal is low

Connections 16 & 17 (FS & RS output):

are low if:

- Input connection 2 and input connection 3 and input connection 4, signals are high (rider mode) and
- Input connection 20, LMS2 signal is low

+BV (AK)

- Input connection 1 is connected to +BV (AK)

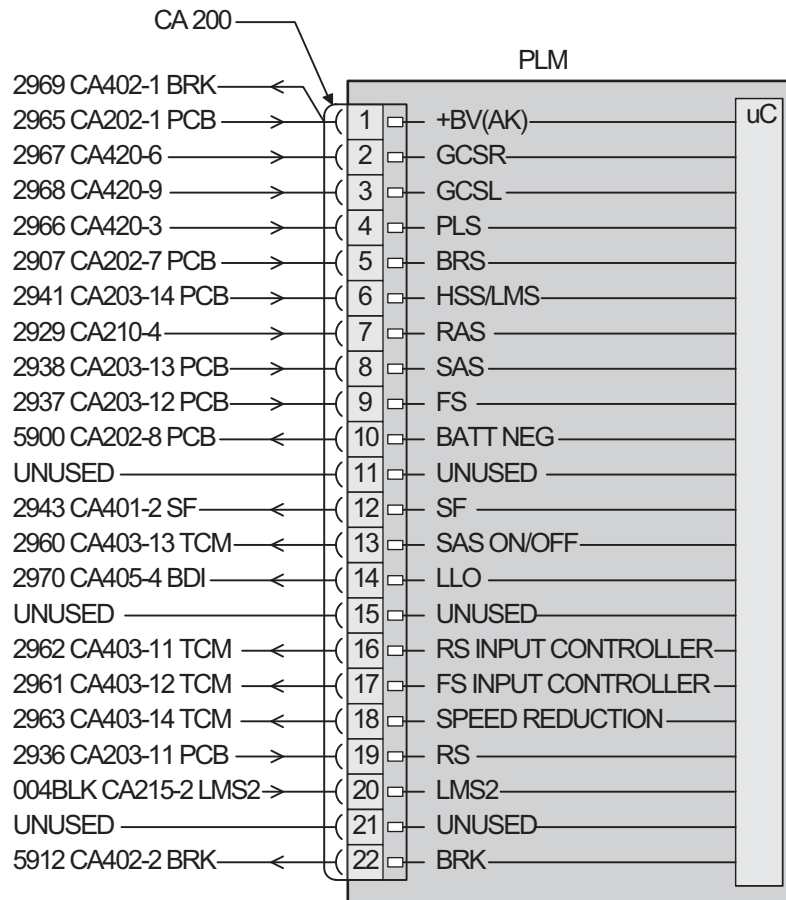
BATT NEG

- Output connection 10 is connected to BATT NEG



ELECTRICAL SYSTEM

Functional Description



MS-4223-037

ELECTRICAL SYSTEM

KYS Key Switch



KYS Key Switch

Removal

1. Remove power by disconnecting the battery.
2. Raise the truck until the drive wheel can move freely.
3. Open the panel.
4. Remove the dashboard on the left.
5. Remove the two plug connectors.

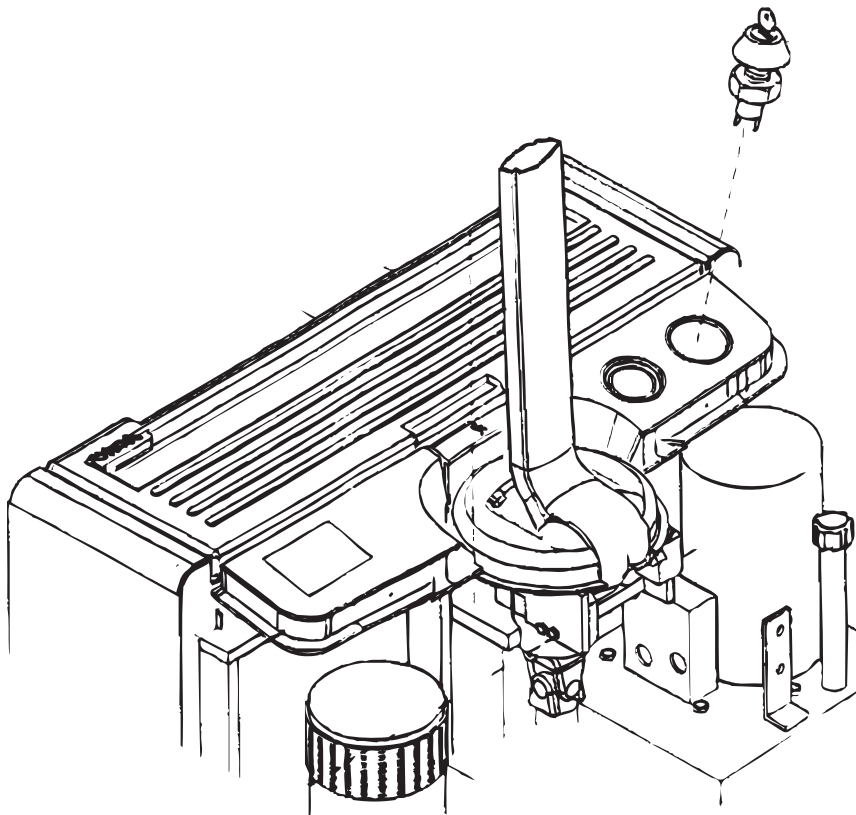
6. Unscrew the ring nut and remove the shim.
7. Remove the switch.

Servicing

The key switch cannot be repaired.

Assembly

Assembly is the reverse order of removal.



m1156



ELECTRICAL SYSTEM

Speed Limit Switch (LMS)

Speed Limit Switch (LMS)

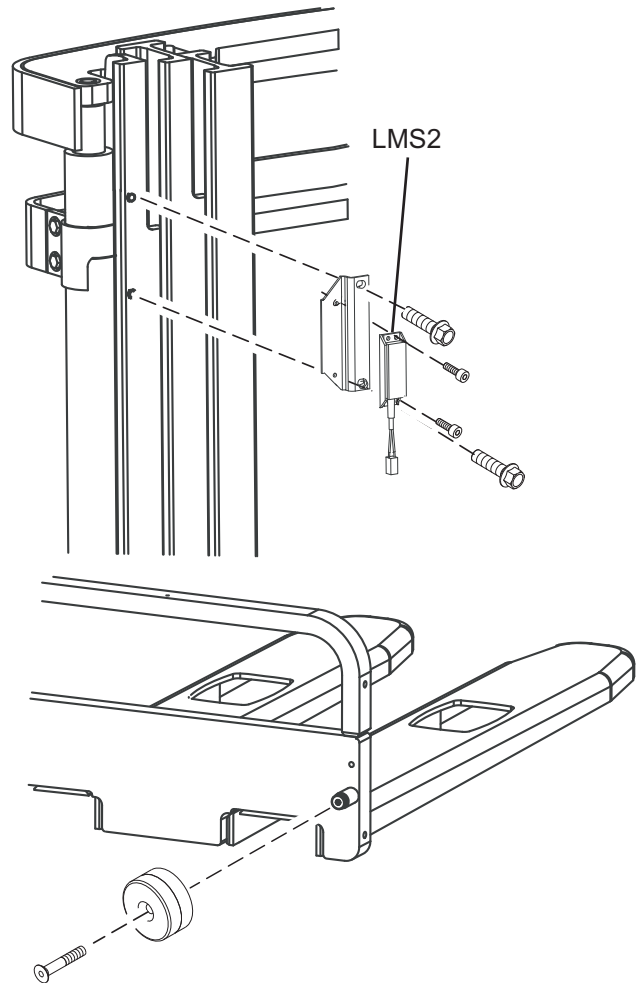
Removal

1. Raise the fork carriage until the switch can be reached.
2. Support the fork carriage securely using appropriate equipment.
3. Disconnect the battery.
4. Raise the truck until the drive wheel can move freely.
5. Remove the plug connection from the switch.
6. Remove the two mounting screws and take off the switch.

Assembly

Assembly is the reverse order of removal.
Carry out an operational check.

Speed Limit Switch on Mast (LMS2)



MS-4223-051

Removal

1. Fully lower the fork carriage.
2. Disconnect the battery.
3. Remove the plug connection from the switch.
4. Remove the two mounting screws and take off the switch.

Assembly

Assembly is the reverse order of removal.
Carry out an operational check.

ELECTRICAL SYSTEM

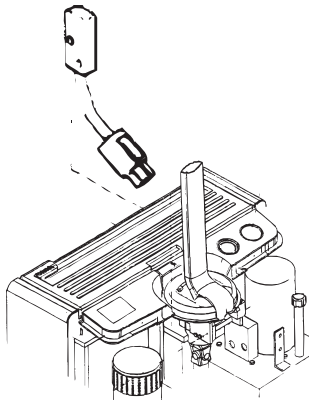
Brake Switch (BRS)



Brake Switch (BRS)

Removal

1. Disconnect the battery.
2. Open the panel.
3. Raise the truck until the drive wheel can move freely.
4. Remove the plug connection
5. Remove the two mounting screws and take off the brake switch with the switch actuator and spacer.



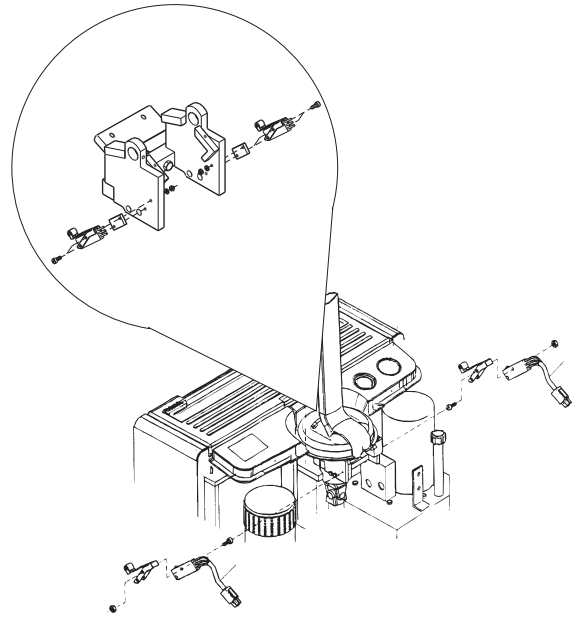
m1160

Assembly

Assembly is the reverse order of removal.

Carry out an operational check.

Up to serial no. 5A134880



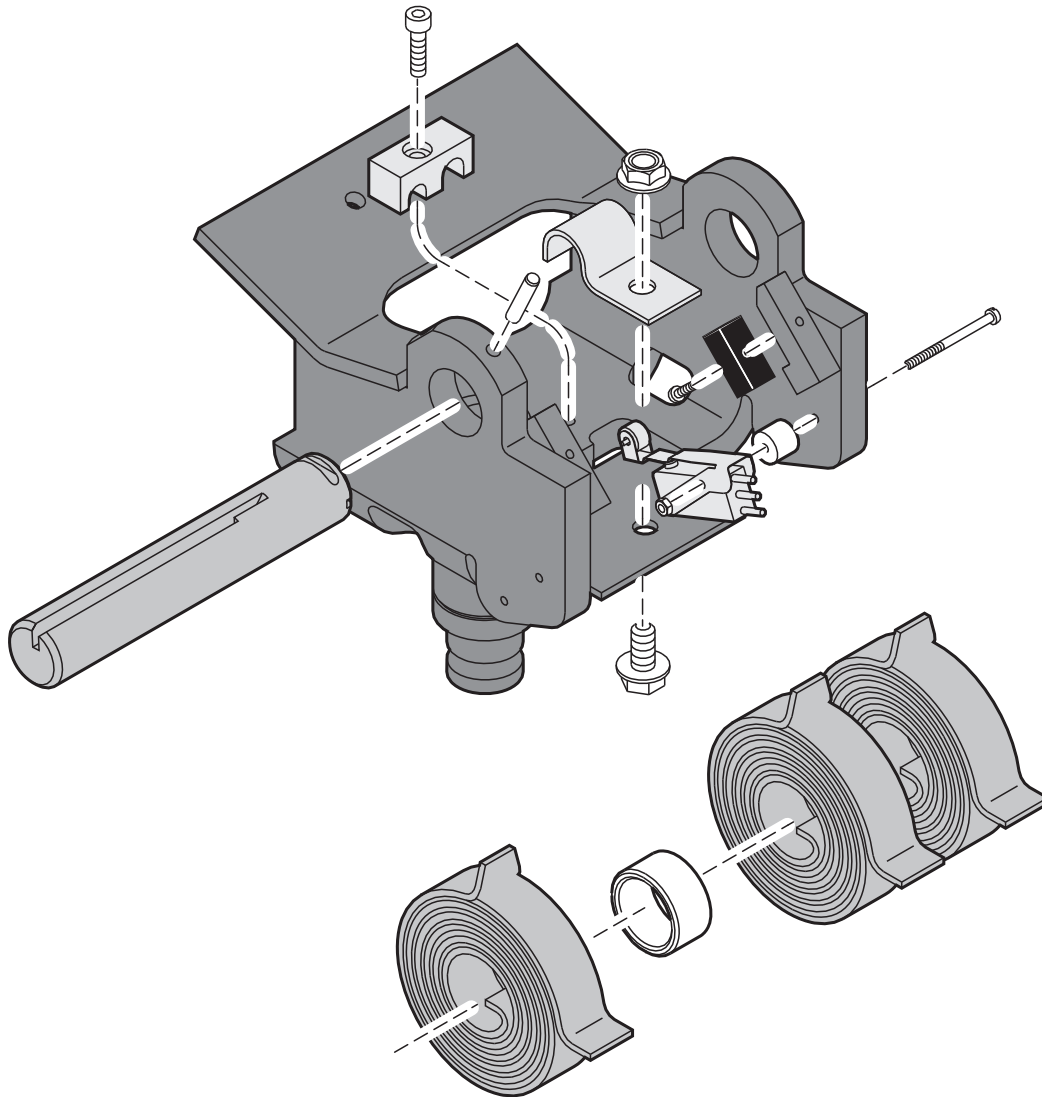
m1161



ELECTRICAL SYSTEM

Brake Switch (BRS)

From serial no. 5A134880



MS-4223-052

ELECTRICAL SYSTEM

Override Switch (ORS)



Override Switch (ORS)

Removal

1. Disconnect the battery.
2. Open the panel.
3. Raise the truck until the drive wheel can move freely.
4. Remove the plug connection
5. Remove the two mounting screws and take off the override switch with the switch actuator and spacer.

Assembly

Assembly is the reverse order of removal.



ELECTRICAL SYSTEM

Emergency Disconnect Switch (EDS)

Emergency Disconnect Switch (EDS)

Removal

1. Disconnect the battery.
2. Open the panel.
3. Raise the truck until the drive wheel can move freely.
4. Remove mounting nuts from the electrical panel and take out the panel.

5. Remove the wire.

6. Remove the three mounting screws and take off the switch.

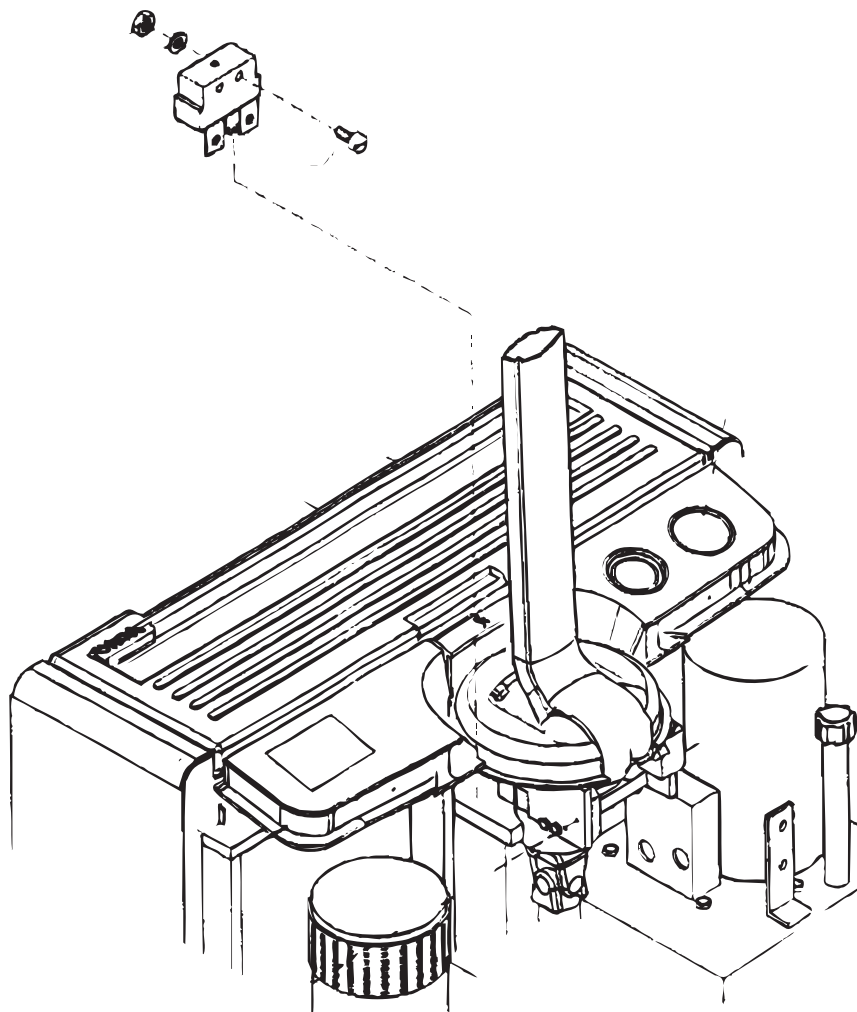
Servicing

The switch cannot be serviced.

Assembly

Assembly is the reverse order of removal.

Carry out an operational check



m1162

ELECTRICAL SYSTEM

On Board Charger



On Board Charger

Up to serial no. 5A134880

NOTE

This charger is designed solely for use with open lead acid batteries (wet batteries).



WARNING

The charger cannot be repaired in the field. Attempting to make repairs can result in accidents caused by electric shock and fire.

- *Replace the charger where necessary with an original Crown replacement charger.*

General

Read this paragraph carefully. It contains important information on the operation of the charger. You must understand how the charger operates in order to correctly assess any problems which may occur when charging the battery.

This charger is an "intelligent" device. A microprocessor controls the charging by taking into account the charge status of the battery.

A complete charge cycle consists of several phases, indicated by a yellow LED. A green LED indicates a mains supply presence.

Both LEDs are located on the instrument panel next to the socket to protect the mains lead.

Battery Charging Phases

The charge cycle begins with the connection to the mains supply. The green LED is continually lit.

First Phase (I1)

The first phase (I1) is a charge with constant (maximum possible) current. This phase lasts until the battery voltage > 24 volts. (The yellow LED is continually lit.)

Second Phase (P)

In the second phase (P) the charging capacity (product of charging current and charging voltage) is kept constant. In addition the charging current is reduced in proportion to the increasing battery voltage. This phase

ends when the battery voltage reaches a certain level. (The yellow LED is continually lit.)

Third Phase (U)

In the third phase (U) the charging current is kept constant. The output voltage of the charger is restricted to 29 volts. During this phase the charging current drops increasingly. (The yellow LED flashes rapidly.)

Fourth Phase (I2)

The fourth and for normal charges last phase (I2) is again a charge with constant current until the gassing voltage stage is reached. The amount of constant current used to charge is calculated from the charge consumed by the battery during the first two phases (I1 and P).

The duration of this phase is set to reach 17% of capacity (= boost factor 1.15) consumed by the battery during the first three phases (I1, P and U). The charging voltage is restricted to 34 volts. (The yellow LED flashes slowly.)

End of Normal Charging

Normal charging is completed at the end of the fourth phase (the yellow LED is off).

The battery is now fully charged and the total battery capacity can be used.

Special Charging Phases

Compensating Charge

For instructions on compensating charging, in particular charging intervals, please refer to the battery manufacturer's documentation

If the charger remains connected to the mains at the end of a normal charge, 15 minutes after Phase I2 a compensating charge will begin with half the constant current used during phase I2. (The yellow LED flashes either regularly or intermittently).

The compensating charge reduces the problem of sulphating and the cell voltage of the 12 battery cells is compensated to 2 volts / cell.

This phase ends when the battery voltage is stable, i.e. changes by less than 60 mV/h.



ELECTRICAL SYSTEM

On Board Charger

Float Charge

If the charger remains connected to the mains after the compensating charge, 48 hours later the charge recommences with the first phase (I1). As the battery however is still full, the individual charging cycles are severely reduced, and the first phase (I1) is even bypassed if the battery voltage has not fallen below 24 volts.

The float charge ensures that the battery can be used even after long periods of inactivity. (The yellow LED flashes regularly or intermittently).

Partial Charging

The charger is designed to adapt to all discharge conditions of the battery and all typical partial charge cycles. It uses an "occasional charging" feature. The electronic system takes into account these partial charges and adjusts the current in the fourth phase (I2) accordingly.

If charging is interrupted by the user (mains connector removed) and if the mains connector is re-inserted within 13 minutes, it then continues at the point at which it was interrupted.

The charger stores the capacity charged into the battery up to the interruption for 13 minutes and calculates a correction value which ensures that the capacity subsequently removed from the battery is re-charged.

If the mains interruption lasts for more than 13 minutes, the charging process will start again with phase 1.

Charging Errors

Green LED is not lit

Possible Causes:

Socket does not conduct mains supply

Check whether the socket conducts power supply by plugging in an item of equipment (e.g. lamp etc.) which you know is working.

Faulty mains lead to charger

Temporarily replace the mains lead to the charger with one which you know is ok. When you finally replace the mains lead avoid damaging the lead when fitting the clamp.

Charger faulty

Replace the charger.

Green LED flashing

In this case an error has occurred during charging. The charging time in phase I1 or P is too long (time limit exceeded).

Possible Causes:

One or more battery cells faulty. Repair the battery in accordance with the battery manufacturer's instructions.

The ambient temperature is too high. The charger automatically reduces the output capacity in order to avoid a thermal overload. When the ambient temperature is too high the charging current is reduced, which can lead to time limits being exceeded. Also check whether the fan starts up when the mains lead is connected. The air inlet and outlet of the charger must not be covered.

ELECTRICAL SYSTEM

On Board Charger



Charging phases										
Phases	I1 and P	U1	I2	U2	T _{Stop} = 15 Min	Com- pensat- ing Charge	T _{Stop} = 48 h	Float- charge	In the event of an error	Stop
Mains	Mains cable connected									Discon- nected
Fan	On				Off	On	Off	On	Non- speci- fied	Off
Green LED	Permanently on								Flashing	Off
Yellow LED	Continu- ally on	Rapid flash	Slow flash	Irregu- lar flash	Off	As for I2 and U2	Off		Non- speci- fied	Off

Error in charger microprocessor. Reset the microprocessor as follows:

- Remove the mains plug and disconnect the battery.
- Disconnect the charger connections to the earth contact or the pump contactor and fuse F1 and short-circuit the two leads of the charger. Alternatively, wait 10 minutes. Then re-connect the charger lead to the battery.
- Re-connect the mains plug.
- Check that the green LED is continually on and the charger fan is running.
- If the green LED is not on and/or the fan is not running, replace the charger.

NOTE

Before replacing a charger, always check whether the malfunction is due to a temperature problem or the battery.

Faulty battery cells of poorly serviced batteries or charger ambient temperatures above 40°C are typical causes of faults.

Take into account the fact that the charger emits heat (the temperature of the airflow extracted by the on-board fan is 20°C above ambient temperature). This

heat loss also warms the environment if the ventilation is inadequate.

If the temperature and battery can both be safely ruled out as possible causes, reset the microprocessor and check if it is possible to charge.

Important Technical Data

Mains voltage: 230 V +10% / -15 %

Mains frequency: 50 - 60 Hz + /-1 %

Output capacity: 720 W + /-3 %

1. Can be used for open lead-acid batteries with 12 cells and 2 V cell voltage (24 V battery)
2. Minimum battery capacity 160 Ah
3. Maximum battery capacity 300 Ah

The maximum charging time at room temperature for an 80% discharged battery is:

1. 15 h for a 300 Ah battery
2. 12 h for a 240 Ah battery
3. 8 h for a 160 Ah battery

Charger safety rating: IP20

Ambient temperature: 0°C to +40°C

Air humidity: 90% relative, non-condensing



ELECTRICAL SYSTEM

On Board Charger

Replacing the Charger



WARNING

Do not reverse the battery connection wires

- *If you reverse connect the charger wires to a battery, the minimum damage you will incur is a blown internal fuse.*
- *This fuse can only be replaced by the manufacturer. Replace the charger where necessary with an original Crown replacement charger.*

Removal / Assembly

- Remove the mains plug and disconnect the battery.
- Undo the mains supply lock on the charger and remove the connector.
- Disconnect the charger connections to the earth contact of the pump contactor and fuse F1.
- Disconnect the plug connection of the 3 wire lead to the LEDs.
- Remove the 4 screws which attach the charger to the retaining plate and remove the charger.
- Assembly is the reverse order of removal.

ELECTRICAL SYSTEM

On Board Charger



On Board Charger

From serial no. 5A134882

The charger disconnects the truck's control circuit as soon as it identifies voltage on the mains cable.

This occurs through an internal charger connection, see electrical diagrams.



WARNING

The charger cannot be repaired in the field. Attempting to make repairs can result in accidents caused by electric shock and fire.

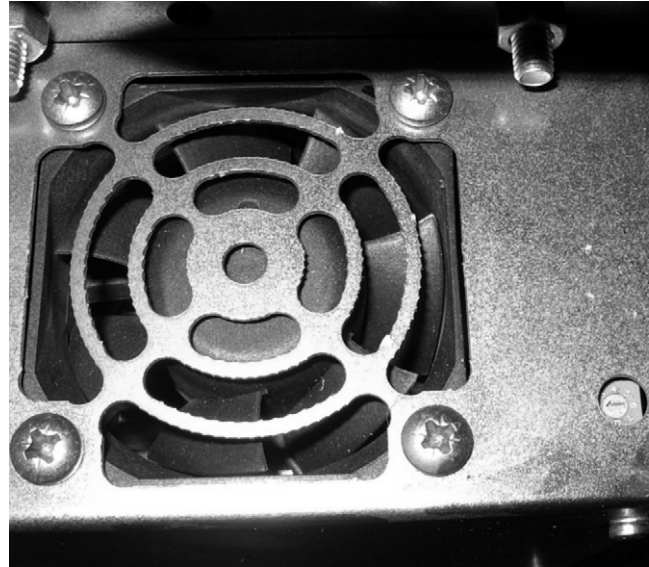
- Replace the charger where necessary with an original Crown replacement charger.

General

Please read this paragraph carefully. It contains important information on the operation of the charger. You must understand how the charger operates in order to correctly assess any problems which may occur when charging the battery.

This charger is suitable for a variety of battery types. A battery selector*) with eight settings (0-7) is located on the fan side of the charger.

Setting 1 is for maintenance-free, starter batteries and semi-industrial batteries. Setting 2 is for industrial batteries (open lead-acid batteries). Settings 0 and 3 - 7 are not used. (To avoid material damage, do not use these settings).



M1611

This charger is an "intelligent" device. A microprocessor controls the charging by taking into account the charge status of the battery.

A complete charge cycle consists of several phases, indicated by a yellow LED. A green LED indicates a mains supply presence.

Both LEDs are located on the instrument panel next to the socket to protect the mains lead.

*) Reset the microprocessor after adjusting the selector. The procedure is described in "Error in charger microprocessor. Reset the microprocessor as follows:".

Battery Charging Phases

The charge cycle begins with connection to the mains supply. The green LED is permanently lit.

First Phase (I1)

The first phase (I1) is a charge with constant (maximum possible) current. This phase lasts until the battery voltage > 24 volts. (The yellow LED is continually on.)

Second Phase (P)

In the second phase (P) the charging capacity (product of charging current and charging voltage) is kept constant. In addition the charging current is reduced in proportion to the increasing battery voltage. This phase



ELECTRICAL SYSTEM

On Board Charger

ends when the battery voltage reaches a certain level. (The yellow LED is continually on.)

Third Phase (U)

In the third phase (U) the charging current is kept constant. The output voltage of the charger is restricted to 29 volts. During this phase the charging current drops increasingly (the yellow LED flashes rapidly.)

Fourth Phase (I2)

The fourth and for normal charges last phase (I2) is again a charge with constant current until the gassing voltage stage is reached. The amount of constant current used to charge is calculated from the charge consumed by the battery during the first two phases (I1 and P).

The duration of this phase is set to reach 17% of capacity (= boost factor 1.15) consumed by the battery during the first three phases (I1, P and U). The charging voltage is restricted to 34 volts (the yellow LED flashes slowly).

End of normal charging

Normal charging is completed at the end of the fourth phase (the yellow LED is off).

The battery is now fully charged and the total battery capacity can be used.

Special Charging Phases

Compensating Charge

For instructions on compensating charging, in particular charging intervals, please refer to the battery manufacturer's documentation

If the charger remains connected to the mains at the end of a normal charge, 15 minutes after Phase I2 a compensating charge will begin with half the constant current used during phase I2 (the yellow LED flashes either regularly or intermittently).

The compensating charge reduces the problem of sulphating and the cell voltage of the 12 battery cells is compensated to 2 volts / cell.

This phase ends when the battery voltage is stable, i.e. changes by less than 60 mV/h.

Float charge

If the charger remains connected to the mains after the compensating charge, 48 hours later the charge recommences with the first phase (I1). As the battery however is still full, the individual charging cycles are severely reduced, and the first phase (I1) is even bypassed if the battery voltage has not fallen below 24 volts.

The float charge ensures that the battery can be used even after long periods of inactivity (the yellow LED flashes regularly or intermittently).

Partial charging

The charger is designed to adapt to all discharge conditions of the battery and all typical partial charge cycles. It uses an "occasional charging" feature. The electronic system takes into account these partial charges and adjusts the current in the fourth phase (I2) accordingly.

If charging is interrupted by the user (mains connector removed) and if the mains connector is re-inserted within 13 minutes, it then continues at the point at which it was interrupted.

The charger stores the capacity charged into the battery up to the interruption for 13 minutes and calculates a correction value which ensures that the capacity subsequently removed from the battery is re-charged.

If the mains interruption lasts for more than 13 minutes, the charging process will start again with phase 1.

ELECTRICAL SYSTEM

On Board Charger



Charging phases										
Phases	I1 and P	U1	I2	U2	T _{Stop} = 15 Min	Compensating Charge	T _{Stop} = 48 h	Float-charge	In the event of an error	Stop
Mains	Mains cable connected									Disconnected
Fan	On				Off	On	Off	On	Non-specified	Off
Green LED	Permanently on								Flashing	Off
Yellow LED	Continually on	Rapid flash	Slow flash	Irregular flash	Off	As for I2 and U2	Off		Non-specified	Off



ELECTRICAL SYSTEM

On Board Charger

Charging Errors

Green LED not lit

Possible Causes:

Socket does not conduct mains supply

Check whether the socket conducts power supply by plugging in an item of equipment (e.g. lamp etc.) which you know is working.

Faulty mains lead to charger

Temporarily replace the mains lead to the charger with one which you know is ok. When you finally replace the mains lead avoid damaging the lead when fitting the clamp.

After applying AC power supply check that the fan is audibly operational. This fan switches on when the charger energises the batteries. Fan speed changes are normal.

The fan is not always on, see table.

Charger faulty

Replace the charger.

Green LED flashing

In this case an error has occurred during charging. The charging time in phase I1 or P is too long (time limit exceeded).

Possible Causes:

One or more battery cells faulty. Repair the battery in accordance with the battery manufacturer's instructions.

The ambient temperature is too high. The charger automatically reduces the output capacity in order to avoid thermal overload. When the ambient temperature is too high the charging current is reduced, which can lead to time limits being exceeded. Also check whether the fan starts up when the mains lead is connected. The air inlet and outlet of the charger must not be covered.

Error in charger microprocessor. Reset the microprocessor as follows:

- Remove the mains plug and disconnect the battery.
- Disconnect the charger connections to the earth contact or the pump contactor and fuse F1 and

short-circuit the two leads of the charger. Alternatively, wait 10 minutes. Then re-connect the charger lead to the battery.

- Re-connect the mains plug.
- Check that the green LED is continually on and the charger fan is running.
- If the green LED is not on and/or the fan is not running, replace the charger.

NOTE

Before replacing a charger, always check whether the malfunction is due to a temperature problem or the battery.

Faulty battery cells of poorly serviced batteries or charger ambient temperatures above 40°C are typical causes of faults.

Take into account the fact that the charger emits heat (the temperature of the airflow extracted by the on-board fan is 20°C above ambient temperature). This heat loss also heats up the environment if the ventilation is inadequate.

If the temperature and battery can both be safely ruled out as possible causes, reset the microprocessor and check if it is possible to charge.

ELECTRICAL SYSTEM

On Board Charger



Important Technical Data

Mains voltage: 230 V +10% / -15%

Mains frequency: 50 - 60 Hz + /-1%

Output capacity: 720 W + /-3%

1. Can be used for open lead acid batteries with 12 cells and a cell voltage of 2 volts (24 volt battery)
2. Minimum battery capacity 160 Ah
3. Maximum battery capacity 300 Ah

The maximum charging time at room temperature for an 80% discharged battery is:

1. 5 h for a 300 Ah battery
2. 2 h for a 240 Ah battery
3. 8 h for a 160 Ah battery

Charger safety rating: IP20

Ambient temperature: 0 °C to +40 °C

Air humidity: 90% relative, non-condensing

Replacing the Charger



WARNING

Do not reverse the battery connection wires

- *If you reverse connect the charger wires to a battery, the minimum damage you will incur is a blown internal fuse.*
- *This fuse can only be replaced by the manufacturer. Replace the charger where necessary with an original Crown replacement charger.*

Removal / Assembly

- Remove the mains plug and disconnect the battery.
- Undo the mains supply lock on the charger and remove the connector.
- Disconnect the charger connections to the earth contact of the pump contactor and fuse F1.
- Disconnect the plug connection of the 3 wire lead to the LEDs.
- Remove the 4 screws which attach the charger to the retaining plate and remove the charger.
- Assembly is the reverse order of removal.

To ensure the charger is properly earthed, check again that the unpainted earth points on the charger sheet are not corroded. If necessary, remove paint or corrosion to create the important earth points.

Motors

General Maintenance Instructions

The following instructions apply to all motors. Details relating to specific models and designs are provided in the sub-sections (traction motor, pump motor etc.).



WARNING

Risk of serious injury

Avoid accidents by:

- Switching off the truck
- Disconnecting the battery
- Preventing the truck from being switched on again.
- Jacking up the truck and preventing it from rolling away

For further details refer to the Safety chapter.

Important Maintenance Instructions

- Remove all brushes and check for wear. If one or more brushes need to be replaced, replace all brushes at the same time. In addition to the brushes the pressure springs must also be replaced to ensure the correct pressure.

The length of the shortest brush determines whether the brush set needs to be replaced.

The brushes should be replaced even if they have not worn down to the minimum length. Their remaining useful life could be much shorter than the time until the next inspection.

- If a brush is too short the spring will lie on the brush support and there will be no pressure. The brush will spark during operation, burning the collector with consequential damage.

- Blast the motor with *dry* compressed air only.
- Check the armature for unevenness, burning, grooves and cracking of the multi-plate edges. Turn the armature if necessary. A non-oily, evenly distributed layer on the brush surfaces is normal.



WARNING

Health risk. Observe the manufacturer's safety instructions when handling solvents and lubricants.

- If oil or grease is found in the motor collector compartment (usually a paste consisting of oil, oil vapour, dust and carbon particles), immediately remove the cause and clean the motor thoroughly:
 - Oil or grease burns in the brush sparks and leaves behind a highly abrasive oil ash which can very quickly destroy the collector and the brushes.
- The brushes must be able to move freely in the brush support (without spring tension) without tilting. Never modify the brushes if one or more cannot move freely. In this case replace all brushes as they will probably have been thermally overloaded. Thermal overloading causes the brushes to swell up. Brushes which jam in the brush support produce intense sparking and destroy the collector.
- The brush edges must not be cracked. Brushes with cracking along the long edge of the surface will have been damaged by a worn collector. If information is provided in the manual, restore the collector to the specified limits. Otherwise, replace the armature in full.
- Loose brush connections are a clear sign of motor overload. In this case inspect the collector for burning and repair or replace as necessary.
- When fitting the brush take care to place the spring gently on the brush. If the contact is too hard the brush will be damaged.
- Make sure that all brushes contact the armature at the same pressure.
- New brushes must be run in with a medium load in the first hours. Never fully charge the motor straight away.

ELECTRICAL SYSTEM

Traction Motor



Traction Motor

Servicing

1. Remove the grille.
2. Blast off abrasion with dry pressurised air.
3. Check the motor brushes and armature (see page 129).
4. Measure the length of the brushes (see page 131).

Removal

(see Fig. M1154)



WARNING

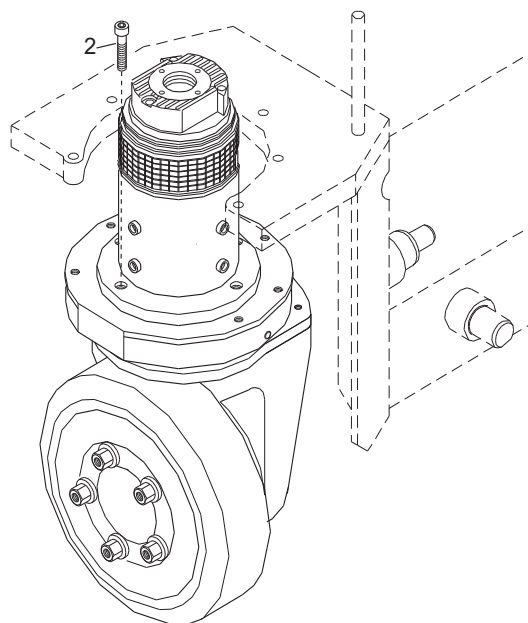
Risk of serious injury

Avoid accidents by:

- *Switching off the truck*
- *Disconnecting the battery*
- *Preventing the truck from being switched on again*
- *Jacking up the truck and preventing it from rolling away*

For further details refer to the Safety chapter.

1. Open the panel.
2. Remove the steering chain (see page 164).
3. Remove the brake (see page 154).
4. Unscrew the electrical wires from the drive motor.
5. Remove the mounting screws (2).
6. Lift the motor out of the truck.



M1154



ELECTRICAL SYSTEM

Traction Motor

Repairs

(see Fig. MP-4223-031)

NOTE

The traction motor is available as a replacement part.

1. Remove the grille (24).
2. Remove the brushes (19).
3. Remove the retaining rings (9) and take off the shims (3, 15).
4. Remove the Woodruff key (25).
5. Press the armature (7) out of the bearing plate (12).
6. Remove the wire from the terminal board (21).
7. Remove the mounting screws (20) from the bearing plate (12).

Take off the bearing plate.

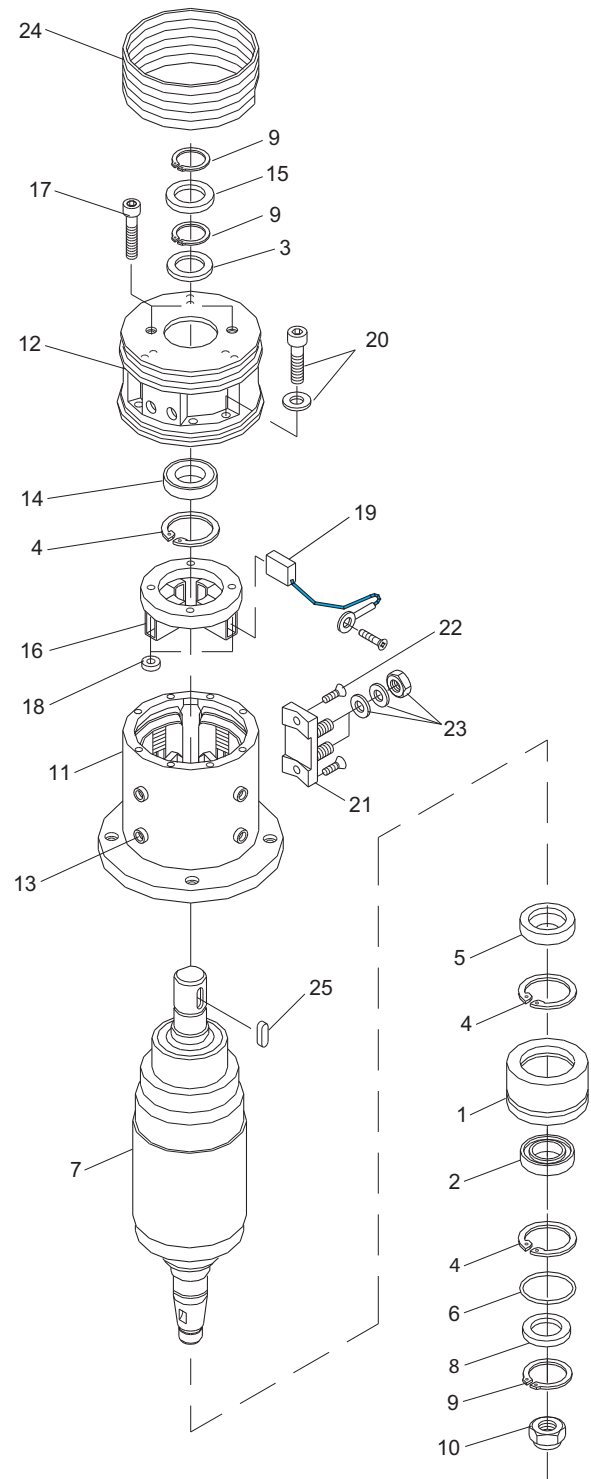
8. Remove the brush plate mounting screws.
9. Remove the retaining ring (9) and shim (8).
10. Remove the retaining ring (4) and bearing (2).
11. Extract the bearing sleeve (1).
12. Remove the radial shaft seal (5) from the bearing sleeve.



WARNING

Health risk. Observe the manufacturer's safety instructions when handling solvents and lubricants.

1. Clean all components thoroughly using a suitable solvent.
2. Check all components for wear. **Refer to the instructions on page 129.**
3. Brush length:
New 30 mm
Wear limit 23 mm
4. The armature can be turned off.
Rated position: min. 61.5 mm. After turning off the armature undercut the insulation between the commutator sections by 0.5 mm.
5. Check the field coils for damage. If a field coil is damaged replace the motor.
6. Check the bearing for wear and replace if necessary.



MP-4223-031

ELECTRICAL SYSTEM

Traction Motor



Assembly

NOTE

The ball bearings are maintenance-free. They must always be replaced when removed for repair work.

1. Fit a new radial shaft seal (5) and O ring (6).

Further assembly is the reverse of disassembly.



MS-4223-039

Pump Motor

Up to serial no. 5A134880

Removal



WARNING

Risk of serious injury

Avoid accidents by:

- Switching off the truck
- Disconnecting the battery
- Preventing the truck from being switched on again
- Jacking up the truck and preventing it from rolling away

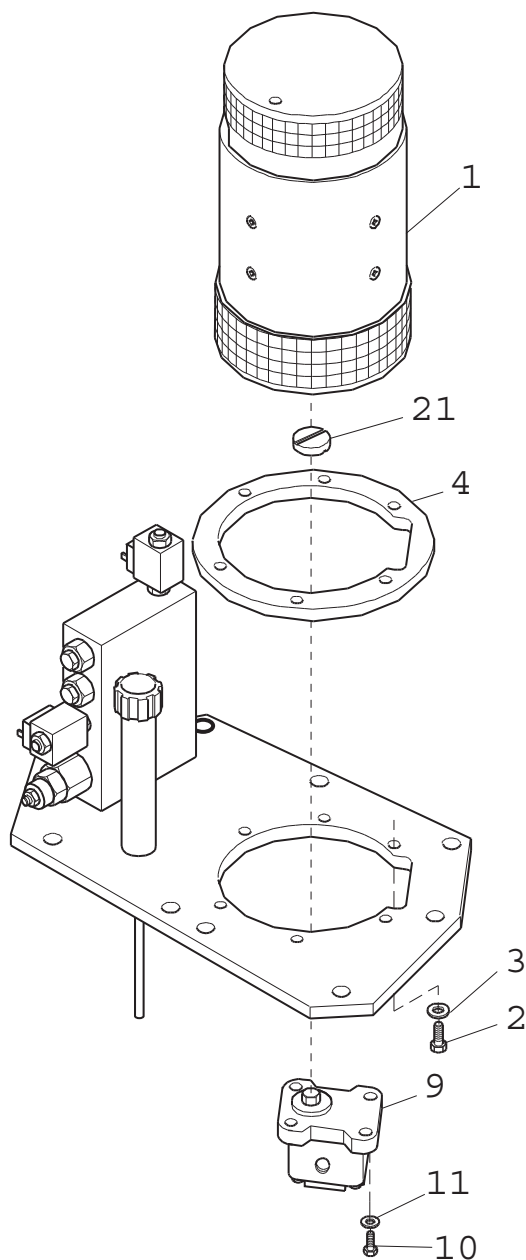
For further details refer to the Safety chapter.

1. Disassemble the pump unit.
2. Remove the hydraulic pump (9).
3. Remove the mounting screws (2) of the pump motor (1) and take off the pump motor.

Assembly

1. Check the coupling piece (21). Replace if worn.
2. Fit new seals (3, 4, 11).
3. Insert and tighten the screws (2) and (10) using threadlocker order no. 053050-006.

Further assembly is the reverse of disassembly.



M0428

ELECTRICAL SYSTEM

Pump Motor



Maintenance

Accessing brushes



WARNING

Risk of serious injury

Avoid accidents by:

- Switching off the truck
- Disconnecting the battery
- Preventing the truck from being switched on again
- Jacking up the truck and preventing it from rolling away

For further details refer to the Safety chapter.

1. Remove the tensioning belt from the pump motor.
2. Apply low pressurised air to remove dust from the motor.
3. Remove the brushes and dispose of them.
4. Brush wear limit: 11 mm
5. Remove and discard the springs.

Check all components for wear. **Refer to the instructions on page 129.**

6. Fit new springs.
7. Fit new brushes.
8. Check that the brushes can move freely.
9. Check that the contact pressure is the same for all springs.
10. Refit the tensioning belt.
11. Test the pump.

Armature (WE/WS 1.25 and 1.3)

NOTE

New armatures have a maximum 50 mm diameter. The commutator can be overwound provided the remaining diameter is no less than 47 mm.

1. After overwinding cut the mica down to a depth of 0.6 mm without changing the gap width between the multi-plates.
2. Carefully de-burr the multiplate edges.

Armature (WE/WS 1.4, 1.6 and 1.8)

NOTE

New armatures have a maximum 63 mm diameter. The wear limit is 60 mm.

The commutator can be overwound provided the remaining diameter is no less than 63 mm.

1. After overwinding cut the mica down to a depth of 0.6 mm without changing the gap width between the multi-plates.
2. Carefully de-burr the multiplate edges.

Bearings

- The ball bearings are maintenance-free. They must always be replaced if removed for repair work.



ELECTRICAL SYSTEM

Pump Motor

Pump Motor

From serial no. 5A134882



MS-4223-038

Removal



WARNING

Risk of serious injury

Avoid accidents by:

- Switching off the truck
- Disconnecting the battery
- Preventing the truck from being switched on again
- Jacking up the truck and preventing it from rolling away

For further details refer to the Safety chapter.

1. Remove all electrical connections from the pump motor.
2. Remove the clamp attaching the hydraulic unit to the chassis.
3. Tilt the hydraulic unit until the two mounting screws on top of the motor can be reached.
4. Remove the motor mounting screws.
5. Lift the motor out from the top.

Assembly

Assembly is the reverse of disassembly.

Maintenance

Accessing brushes



WARNING

Risk of serious injury

Avoid accidents by:

- Switching off the truck
- Disconnecting the battery
- Preventing the truck from being switched on again
- Jacking up the truck and preventing it from rolling away
- For further details refer to the Safety chapter.

1. Remove the tensioning belt from the pump motor.
2. Apply low pressurised air to remove dust from the motor.
3. Remove the brushes and dispose of them.
4. Remove and discard the springs.
5. Check the commutator for wear **Refer to the instructions on page 129.**

Brushes (WE/WS 1.25, 1.3)

- Length of a new brush: 25 mm
- Brush wear limit: 14 mm

Brushes (WE/WS 1.4, 1.6, 1.8)

- Length of a new brush: 23 mm
- Brush wear limit: 15 mm

Armatures (WE/WS 1.25, 1.3)

1. Turn the commutator and check for signs of burning or other damage. Replace the armature if necessary.

NOTE

New commutators have a 45 mm diameter. The wear limit is 44 mm.

The commutator must not be overwound. Instead it must be replaced when the wear limit is reached.

ELECTRICAL SYSTEM

Pump Motor



Armature (WE/WS 1.4, 1.6, 1.8)

1. Turn the commutator and check for signs of burning or other damage. Replace the armature if necessary.

NOTE

New commutators have a 48.5 mm diameter. The wear limit is 47.5 mm.

The commutator must not be overwound. Instead it must be replaced when the wear limit is reached.

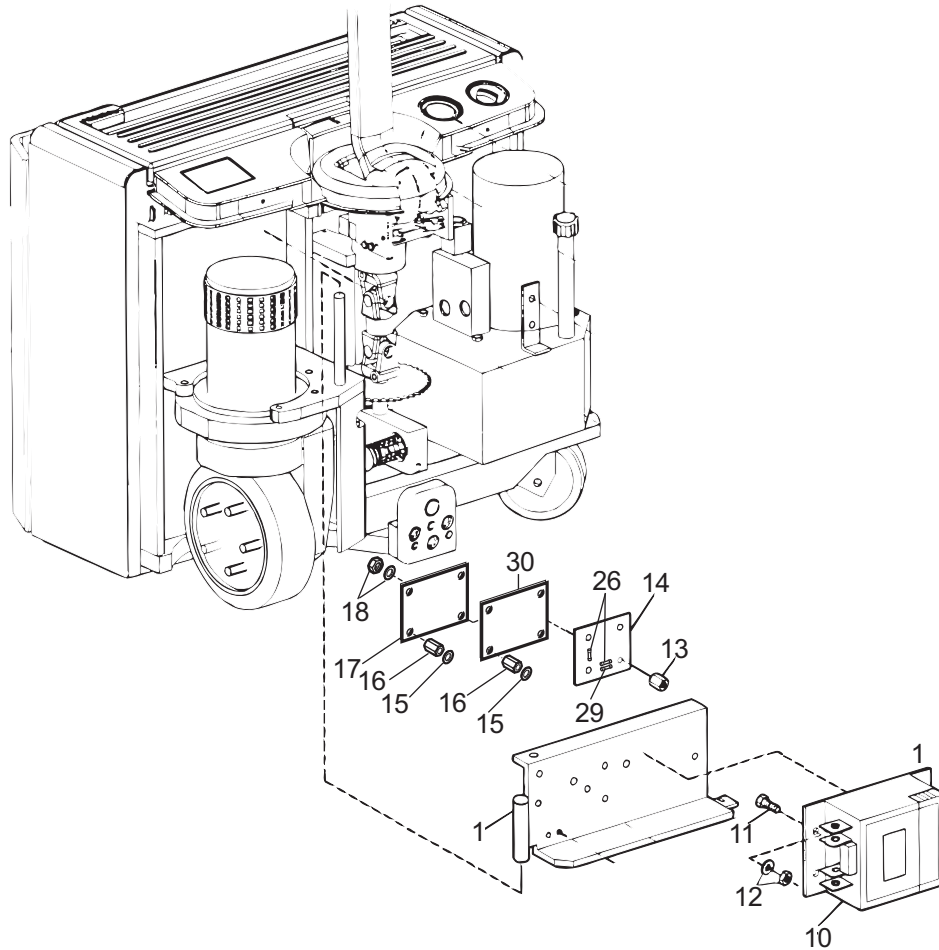


ELECTRICAL SYSTEM

Electrical Panel

Electrical Panel

Up to serial no. 5A134880



M1163

ELECTRICAL SYSTEM

Electrical Panel



General

The traction controller, travel contactor and distributor board are mounted on the detachable electrical panel.

Removal

(see Fig. M1163)



WARNING

Risk of serious injury

Avoid accidents by:

- *Switching the truck off*
 - *Disconnecting the battery.*
 - *Preventing the truck from being switched on again.*
 - *jacking up the truck and preventing it from rolling away*
 - *For further details refer to the Safety chapter.*
1. Loosen the hex. nut on the rubber buffer and take out the electrical board.
 2. Remove the direction contactor.
 3. Remove the traction controller.
 4. Remove the distributor PCB.
 5. Take off the electrical panel.

Assembly

NOTE

*Clean the back of the traction controller and apply a **thin** layer of heat conducting paste prior to assembly.*

Assembly is the reverse of disassembly.

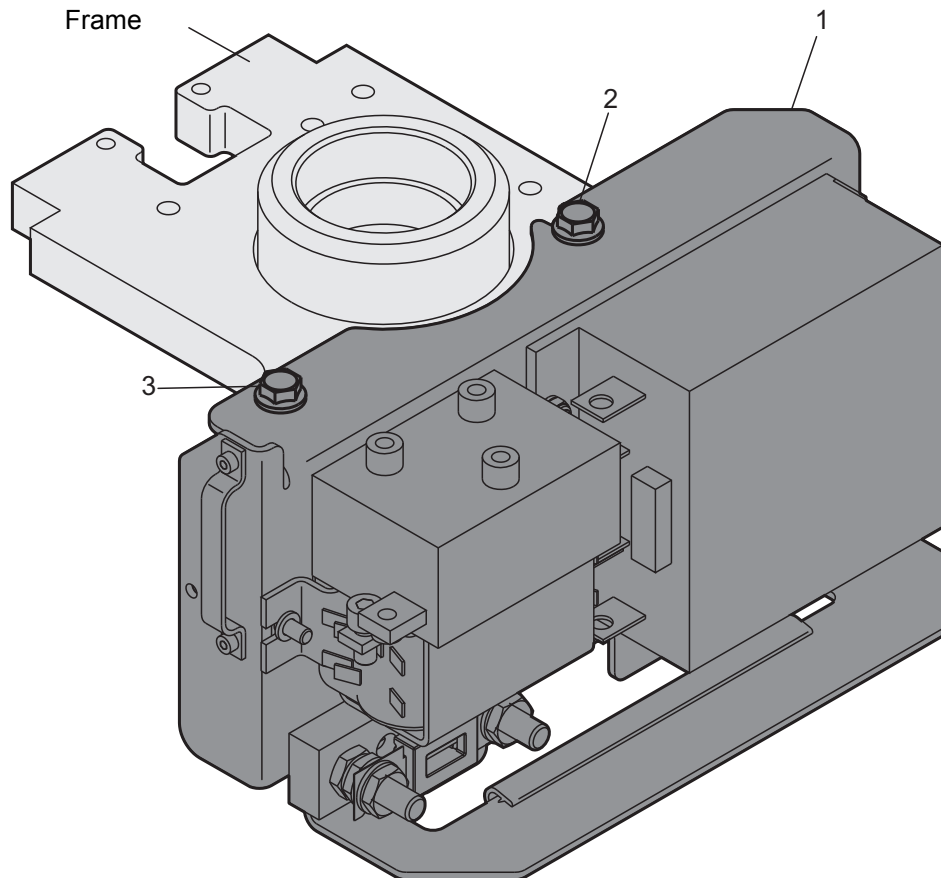


ELECTRICAL SYSTEM

Electrical Panel

Electrical Panel

From serial no. 5A134882



MS-4223-036

ELECTRICAL SYSTEM

Electrical Panel



General

The electrical panel carries the:

- Traction controller
- Direction contactor
- Distributor PCB

Removal

(see Fig. MS-4223-036)



WARNING

Risk of serious injury

Avoid accidents by:

- *Switching off the truck*
- *Disconnecting the battery.*
- *Preventing the truck from being switched on again.*
- *Jacking up the truck and preventing it from rolling away*
- *For further details refer to the Safety chapter.*

1. Gently undo the left screw (3).
2. Remove the right screw (2).
3. Tilt out the electrical board (1).
4. Remove the direction contactor.
5. Remove the traction controller.
6. Remove the distributor PCB.
7. Undo the electrical board screw and take out the electrical board.

Assembly

NOTE

*Clean the back of the traction controller and apply a **thin** layer of heat conducting paste prior to assembly.*

Assembly is the reverse order of removal.

Contactors



WARNING

Risk of serious injury

Avoid accidents by:

- *Switching off the truck*
- *Disconnecting the battery.*
- *Preventing the truck from being switched on again.*
- *Jacking up the truck and preventing it from rolling away.*

For further details refer to the Safety chapter.

NOTE

Use only Crown contactors. Use only Crown spare parts for repairs. The contactors are specially made for the truck.

Do not change the assembly position, location or the wiring.

Always mark the position of the contacts in relation to each other before disassembling a contactor:

Contacts already worked in with each other must be placed together again on assembly. Otherwise, excessive wear and premature failure will result.

Inspection

Contacts

The contacts can blacken, swell and roughen during normal operation.

This is normal, and there is no need to file or polish them. On the contrary: mechanically re-worked contacts burn out very rapidly.

Under certain conditions the contact silver coating can wander from one contact to another, where it can build up. This is quite harmless. The contacts must only be replaced if the silver coating has flaked off to such an extent that the supporting metal is visible.

Coils

Coils cannot be repaired. If you cannot measure a resistance when you place an ohmmeter between the connections, replace the coil.

Springs

Replace any springs which show signs of corrosion or decolouring caused by overheating. Always replace springs as a complete set, not individually.

Checking the coils

1. Remove power by disconnecting the battery.
2. Raise the truck until the drive wheel can move freely.
3. Remove all wires from the contactor coil.
4. Measure the coil resistance and replace the coil if necessary. It should be 29 Ω .

ELECTRICAL SYSTEM

Contactors



Servicing

Travel contactor, part no. 802815

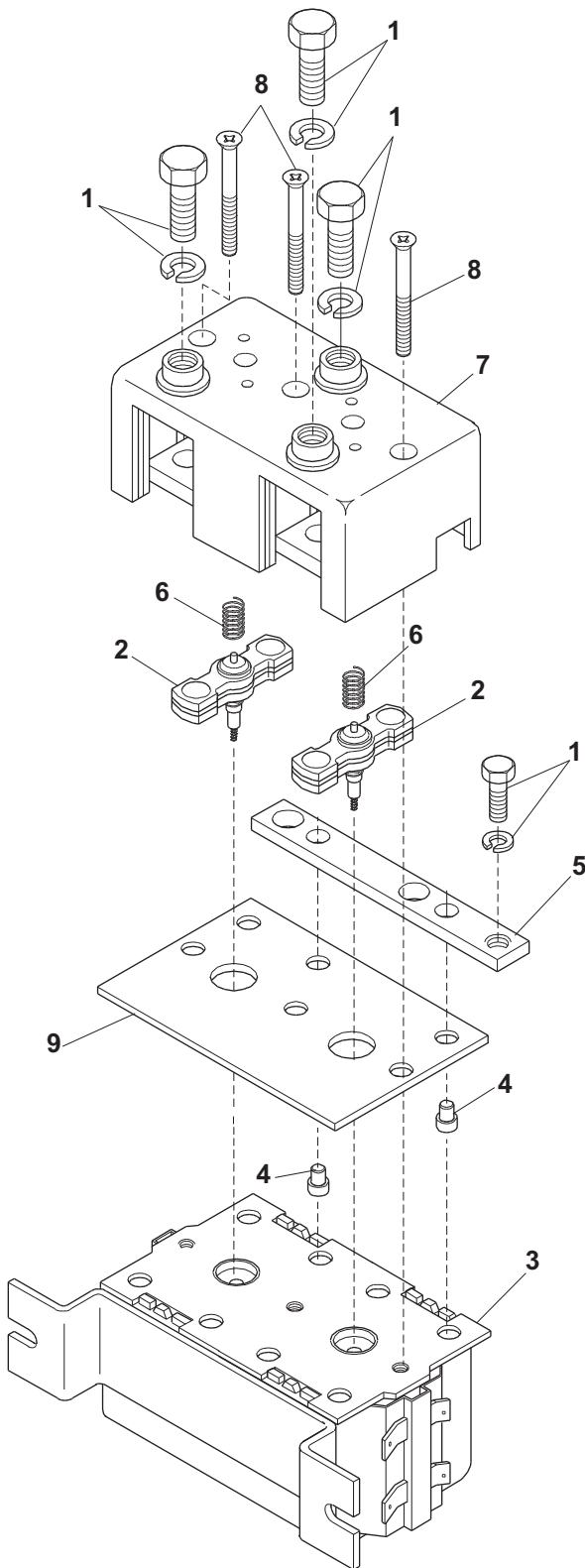
This contactor is used in the WE/WS models.

It has fixed contacts that are connected to the cover. As contacts must always be replaced in pairs, for servicing you need a complete cover, 2 moving contacts and 2 contact springs.

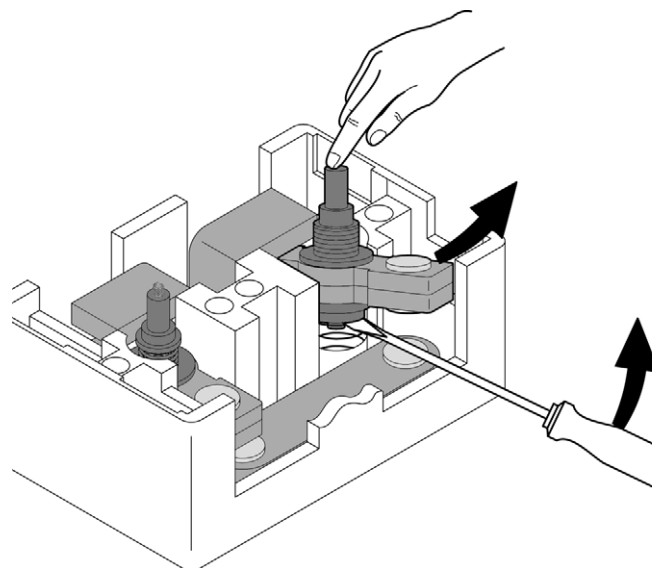
Dismantling

All item numbers refer to illustration M0041 unless otherwise stated.

1. Loosen the screws (8) and lift them off with the cover (7).
2. Turn the cover so that the moving contacts are facing up (see Fig. MS-6620-029).



M0041



MS-6620-0029

3. Use your thumbs to lift the moving contact slightly. Using a flat, small screwdriver push the contact spring down until it slides out of the seat in the moving contact.
4. Lift out the moving contact from the front.
5. Relieve and remove the contact spring.
6. Remove the 2nd contact and the contact spring as described above.



Assembly

All item numbers refer to illustration M0041 unless otherwise stated.

1. Turn the cover so that the moving contacts are facing up (see Fig. MS-6620-029).
2. Insert the contact spring in the cover receptacle.
3. Using a small flat screwdriver push down the contact spring and hold it in place. Push in the moving contact past the spring.
4. If the spring seat on the moving contact is above the contact spring, remove the screwdriver.
5. Check that the contact spring has fully drifted over the spring seat.
6. Now assemble the 2nd contact and the contact spring as described above.

When the contact springs and the moving contacts have been replaced, the contactor must be assembled in full:

7. Insert the dowel pins (4) into the coil body (3).
8. Place the insulation (9) on the coil body (3).
9. Place the common fixed contact (5) onto the dowel pins (4).
10. Place the cover (7) with the previously mounted moving contacts onto the coil body. Make sure the spring-loaded contact actuators are fully immersed in the coil body holes. The cover should lie flush against the coil body when pressed gently by hand.
11. Insert the screws (8) and tighten them evenly in stages starting from the centre and working out.

ELECTRICAL SYSTEM

Contactors



Travel contactor, part no. 804226

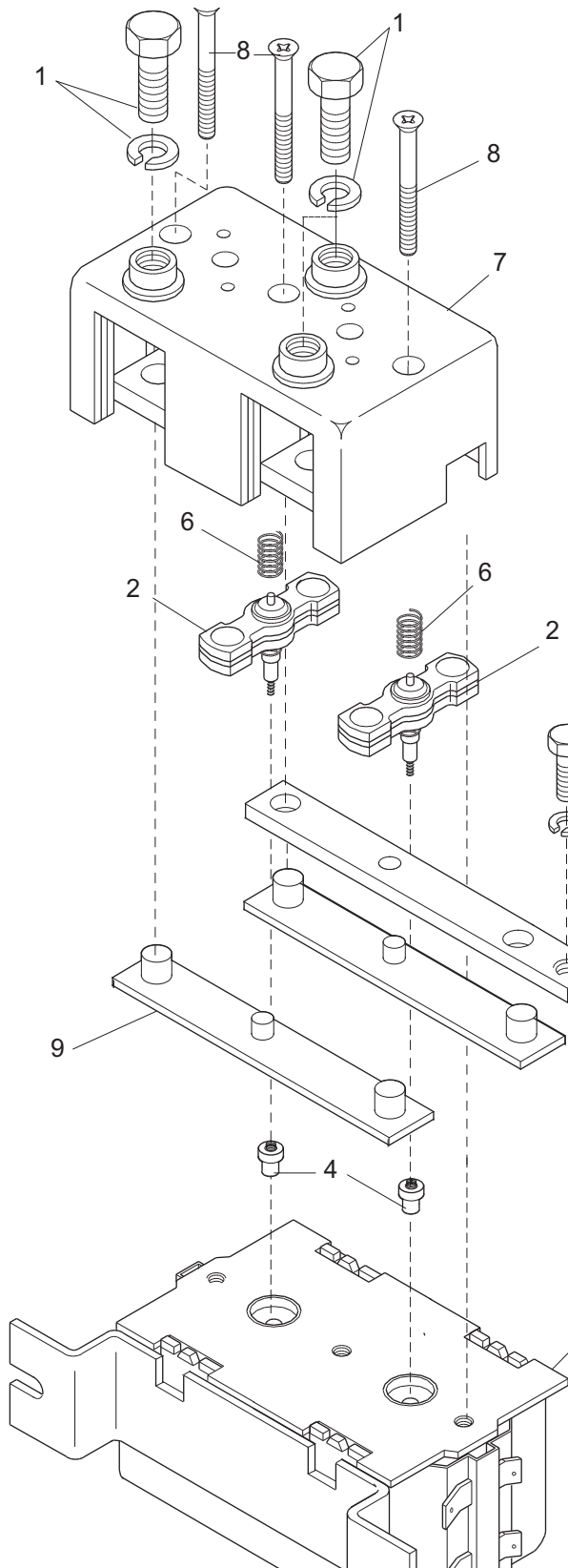
This contactor is used in the WE-S/WS-S models.

It has fixed contacts that are connected to the cover. As contacts must always be replaced in pairs, for servicing you need a complete cover, 2 moving contacts and 2 contact springs.

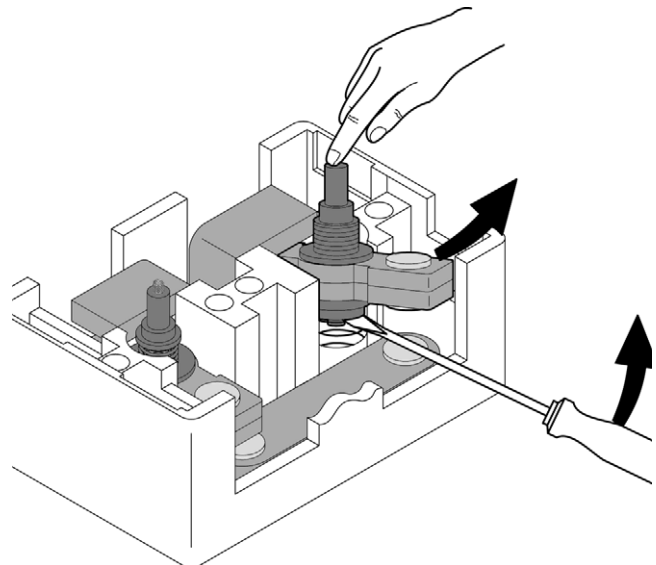
Dismantling

All item numbers refer to illustration M0170 unless otherwise stated.

1. Loosen the screws (8) and lift them off with the cover (7).
2. Turn the cover so that the moving contacts are facing up (see Fig. MS-6620-029).



M0170



MS-6620-0029

3. Use your thumbs to lift the moving contact slightly. Using a flat, small screwdriver push the contact spring down until it slides out of the seat in the moving contact.
4. Lift out the moving contact from the front.
5. Relieve and remove the contact spring.
6. Now assemble the 2nd contact and the contact spring as described above.

Assembly

1. Turn the cover so that the moving contacts are facing up (see Fig. MS-6620-029).
2. Insert the contact spring in the cover receptacle.



ELECTRICAL SYSTEM

Contactors

3. Using a small flat screwdriver push down the contact spring and hold it in place. Push in the moving contact past the spring.
4. If the spring seat on the moving contact is above the contact spring, remove the screwdriver.
5. Check that the contact spring has fully drifted over the spring seat.
6. Now assemble the 2nd contact and the contact spring as described above.

When the contact springs and the moving contacts have been replaced, the contactor must be assembled in full:

7. Place the two insulating strips (9) on the coil body (3).
8. Place the common fixed contact (5) onto the insulating strip opposite the contactor mounting bracket.
9. Place the actuators (4) with the springs leading on the axles of the moving contacts (2).
10. Place the coil body (3) with the insulating strips and the fixed contact on the cover. Make sure the contact actuators are fully immersed in the coil body holes.
11. Carefully turn the entire contactor so that the cover (7) is facing up. The cover should lie flush against the coil body when pressed gently by hand.
12. Insert the screws (8) and tighten them evenly in stages starting from the centre and working out.

ELECTRICAL SYSTEM

Contactor Removal / Assembly



Contactor Removal / Assembly

Travel Contactor

Removal

1. Remove power by disconnecting the battery.
2. Raise the truck until the drive wheel can move freely.
3. Remove the distributor PCB.
4. Remove all wires from the direction contactor (3).
5. Unscrew two mounting screws (4) and remove the direction contactor (5).

Assembly

Assembly is the reverse order of removal.

Lift Contactor

Carry out the lift contactor checks in the same way as for the direction contactor.

Removal

1. Remove power by disconnecting the battery.
2. Raise the truck until the drive wheel can move freely.
3. Remove the wires from the lift contactor.
4. Remove the two mounting screws and take off the contactor.

Assembly

Assembly is the reverse order of removal.



Battery

Removal & Installation



WARNING

Only use batteries of the permitted size, weight and specifications for this truck.

An incorrect battery type can cause damage to the truck.

Incorrect weight and dimensions alter the truck's centre of gravity. This can result in fatal accidents.

Removal with a lifting device

1. Prevent the truck from rolling away.
2. Remove power by disconnecting the battery.
3. Secure the battery cable.
4. Remove the panels on either side.
5. Attach the lifting slings to the battery so that the battery tray is not compressed.
6. Using a suitable lifting device carefully lift the battery out of the truck.
7. Place the battery on a pallet for subsequent transportation.

Assembly

Assembly is the reverse order of removal.

Removal using the optional battery rollers:

1. Prevent the truck from rolling away.
2. Remove power by disconnecting the battery.
3. Secure the battery cable.
4. Remove the panels on either side.
5. Place the battery rack firmly and securely on the ground next to the truck's battery compartment.
6. Check the height from the battery rack to the bottom of the battery tray. The rack must not be higher than the bottom of the battery tray. The maximum permissible height difference is -0.5 cm.
7. Pull the battery off the battery rack.

Servicing the Battery

General

The condition of the battery has a considerable impact on the performance of the truck. Optimal maintenance is key to maintaining the performance and useful life of the battery.



WARNING

The battery must be serviced solely in accordance with the battery manufacturer's instructions.

Incorrect or inadequate maintenance will initially reduce the performance of the truck and ultimately result in premature failure of the battery.

It is essential to adjust the battery discharge indicator (BDI) correctly to ensure on the one hand that the battery is not fully discharged and on the other that there is maximum battery capacity available for the task at hand.

Battery Connector

The battery connector is located under the battery cover. The shape of both connector parts is the same. The battery connector has a handle to pull it off more easily.

Removal

1. Remove power by disconnecting the battery.
2. Raise the truck until the drive wheel can move freely.
3. Remove the battery cable from the battery terminals.
4. Remove the four mounting screws of the connector halves from the battery cover.
5. Disconnect and remove the cable.

Servicing

1. Using a screwdriver push the locking spring (1) under the plug contact (2) and extract the plug contact.
2. Check the plug contacts and replace the entire cable if necessary.

ELECTRICAL SYSTEM

Battery



DANGER

Make sure the wire polarity is correct.

Cable ends with plug contacts are colour-coded. The positive terminal is red, the negative terminal is marked blue.

The positive cable is routed to the Emergency Disconnect, the negative cable to the pump motor.

The positive and negative symbols are engraved on the connector housing.

Hydraulic Control Module (HCM)

From serial no. 5A134882

The system must be re-calibrated whenever the wiring of the HCM module (1, Fig. M1617), the proportional valve or the hydraulic wiring has been disconnected. Apply the following procedure:

1. Connect the battery if it has not already been connected.
2. Turn the key switch ON (lifting and lowering must be operational).
3. Raise the forks to a height of approx. 1 m.
4. Disconnect the battery.
5. Depress and hold down the "Lower" button.
6. Connect the battery.

Depress and hold down the "Lower" button for 5 seconds. The forks should not lower during this period.

7. Release the lowering functions.
8. Switch the truck off and on again.
9. The procedure is complete. Test all functions in accordance with the truck's specifications.

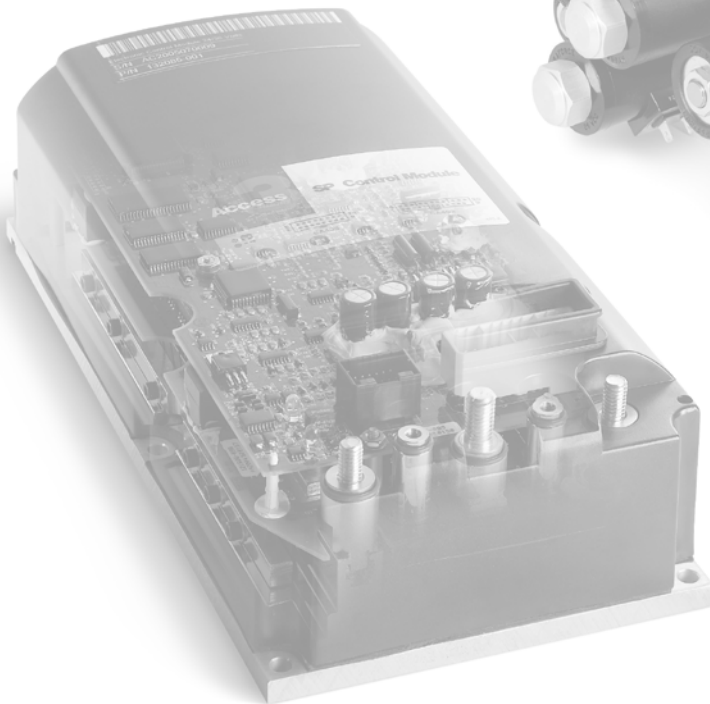
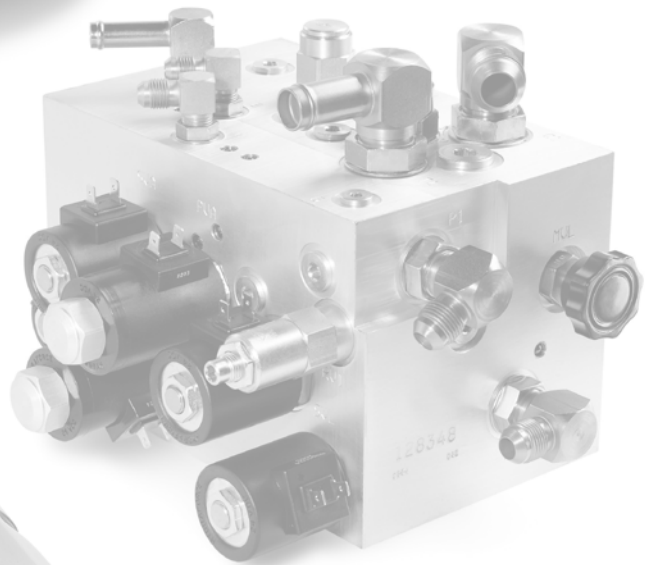


M1617

Figure M1617 shows the HCM assembly position on the ST / SX.



Notes:



BRAKE SYSTEM



Notes:



BRAKE SYSTEM

Brake Operation

Brake Operation

(see Fig. M0633).

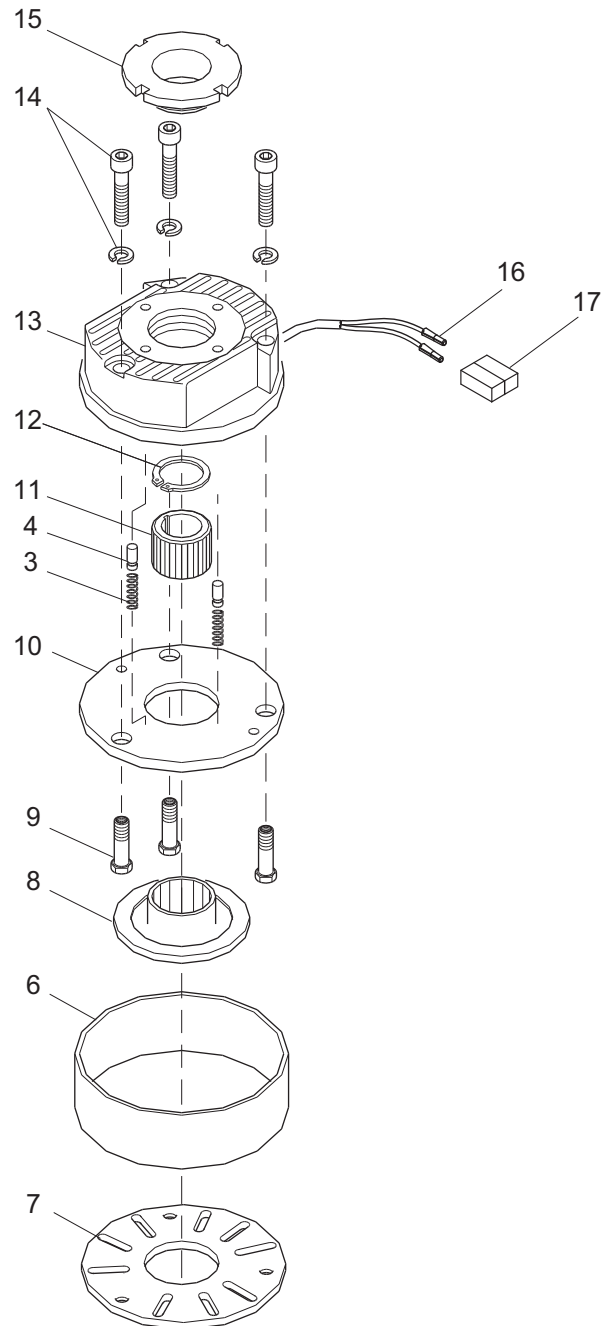
The brake is located on the drive motor. It interlocks with the motor shaft.

The brake is released electromagnetically. The brake is activated when zero voltage is applied.

Springs (3) push the axially moving armature disk (10) against the rotor (8) which also moves axially. This jams the rotor between the armature disk and the friction plate (7). The rotor has friction linings on both sides.

The brake is released when a DC voltage is applied to the exciter coil in the magnetic housing (13).

The armature disk (6) is pulled against the compression springs by the magnetic force. The rotor can turn freely and the brake is released.



M0633

BRAKE SYSTEM

Repairing the Brake



Repairing the Brake

Removal



WARNING

Risk of serious injury

Avoid accidents by:

- *Switching off the truck*
- *Disconnecting the battery*
- *Preventing the truck from being switched on again*
- *Jacking up the truck and preventing it from rolling away*

For further details refer to the Safety chapter.

1. Open the panel.
2. Remove electric plug connection (2).
3. Remove dust shield ring (6).
4. Remove three screws (14).
5. Remove magnetic body (13) from motor (including everything connected to it).

Dismantling

1. Remove two screws (1) from their respective nuts (5).
2. Unscrew the hollow screws (9) from the magnetic body (3 off).
3. Remove armature disk (10).
4. Remove the rotor (8) from the hub (11).

NOTE

The hub can remain on the motor shaft. Only remove retaining ring (12) if the hub has to be replaced.

5. Remove the friction plate (7) from the motor flange.



WARNING

Health risk. *Observe the manufacturer's safety instructions when handling cleaning agents and solvents.*

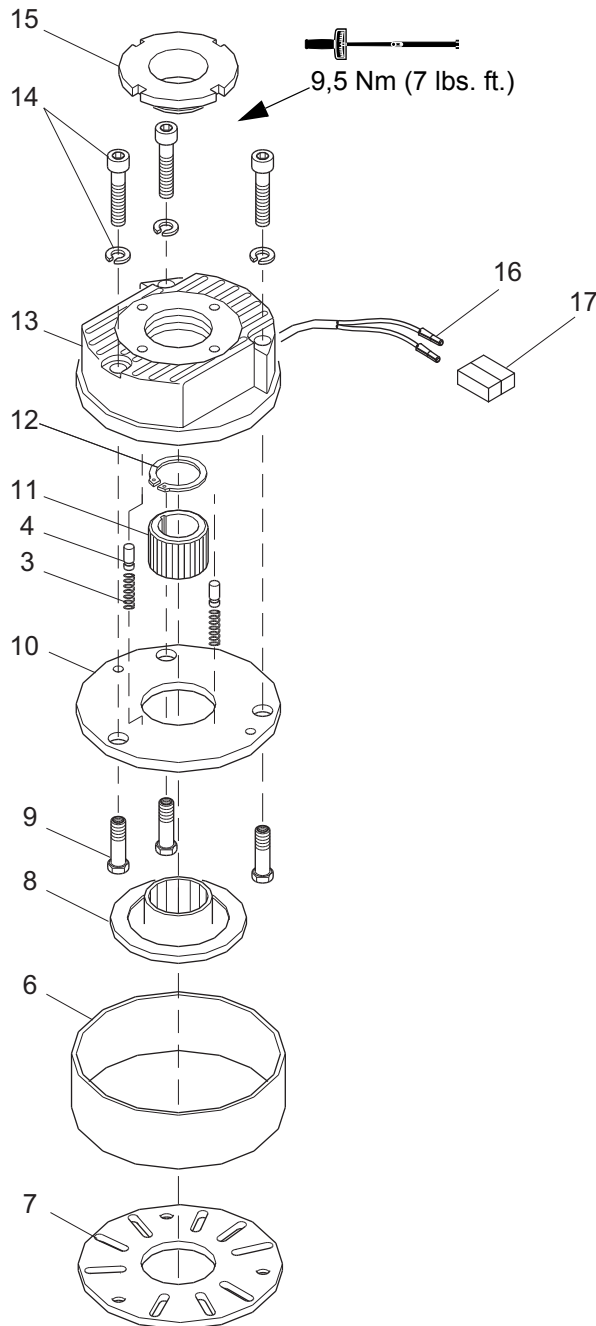
1. Clean all components thoroughly using a brake cleaning agent.

2. Check for deep grooves, uneven wear, cracks and burning.
3. Armature disk (10)
4. Friction plate (7)
5. Rotor (8)

Measure the rotor thickness over several points: if less than 7.3 mm (0.2874 inch) the friction linings are worn.

6. Replace any worn or damaged components.

Assembly



CAUTION

On the WE 1.25 t and WS 1.35 t 2 springs are used with thrust pieces. On the WE 1.6 t and WS 1.8 t 4 springs are used with thrust pieces.

1. Re-insert any fallen thrust pieces (4) and springs (3) back in the magnetic body (13).
2. First the thrust pieces, then the springs.
3. Place the armature disk (10) on the magnetic body (13).
4. Screw the hollow screws (9) into the magnetic body (13) as far as the stop, using a medium strength threadlocker.
5. Insert screws (1) into nuts (5) only so far that a uniform gap of at least 1 mm remains between the armature plate and the magnetic body.

Assembly

1. If the hub (11) was previously removed:
2. Install hub (11) and fasten with retaining ring (12).
3. Note the hole pattern on the friction plate (7). Place the friction plate in the correct position on the motor.
4. Push the rotor (8) onto the hub (11).
5. Attach the pre-assembled magnetic body (13) with the hex. socket screws (14) to the motor.
6. Restore the electric plug connection (2).

NOTE

Now adjust the air gap and the braking distance.

MS-4223-011

BRAKE SYSTEM

Brake Air Gap Adjustment



Brake Air Gap Adjustment

The operating air gap is measured between the magnetic body and the armature disk when the brake is applied (brake de-energised).

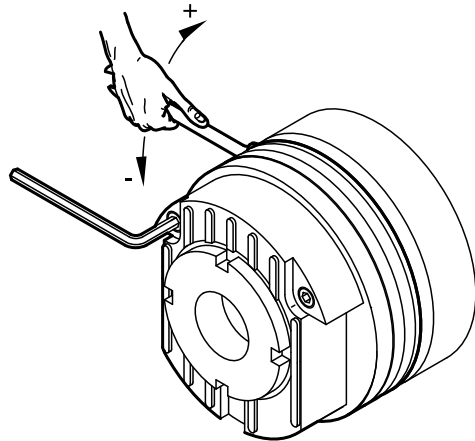
NOTE

The air gap on all WE/WS 2300 models is 0.2 mm (0.00787 inch).

- Unscrew hollow screws (9, Fig. MS-4223-011) until they firmly contact the friction plate (7, Fig. MS-4223-011).
- Torque the 3 screws (14, Fig. MS-4223-011) evenly to 9.5 Nm (7 lbs. ft.).
- Now check the operating air gap along several points using a feeler gauge (see Fig. MS-6620-020):
 - The air gap must be uniformly 0.2 mm (0.00787 inch).

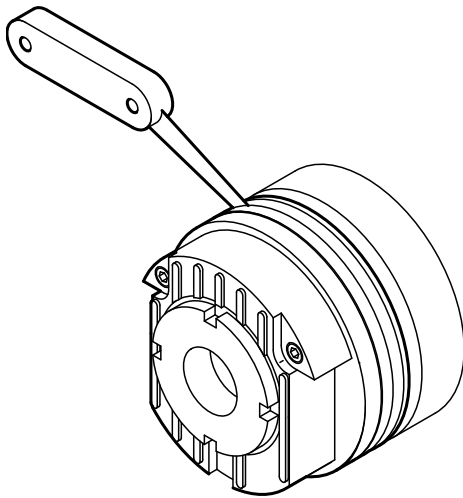
Adjusting the Air Gap:

- Unscrew the hollow screws to increase the air gap.
- Screw in the hollow screws to reduce the air gap.

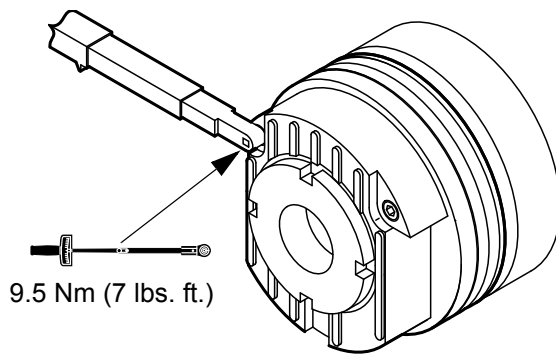


MS-6620-018

- When the air gap has been correctly set, torque the 3 screws (14, Fig. MS-4223-011) again to 9.5 Nm (7 lbs. ft.).



MS-6620-020



MS-6620-019



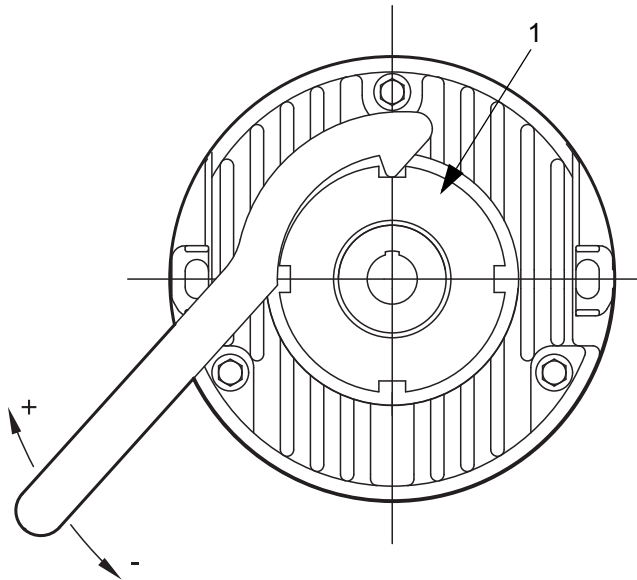
BRAKE SYSTEM

Setting the Braking Distance

Setting the Braking Distance

Turn the setscrew (1, Fig. MS-6620-017) into the magnetic body to reduce the braking distance. Turn it out to increase the distance.

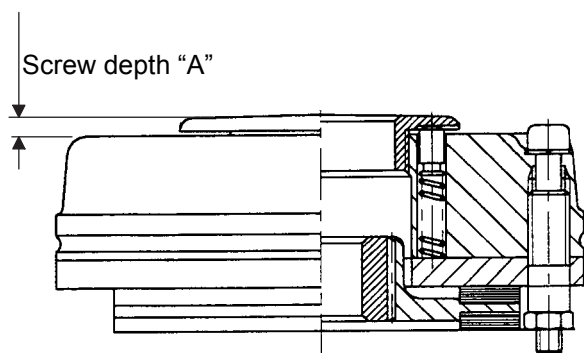
Default setting



MS-6620-017

NOTE

The setting is graded according to the groove of the safety plate. No intermediate settings permitted.



M0091

- Using a calliper gauge pre-set the screw depth "A" in accordance with the respective model (see following table).

Screw depth "A"

Model	"A"
WE 1.25_t	9.5 mm (0.374 inch)
WE 1.6 t WE 1.8 t WS 1.6 tAux	10 mm (0.394 inch)
WE 1.25 t S WE 1.4 t S WS 1.4 t S WS 1.4 t S Aux	7.5 mm (0.295 inch)

NOTE

Always check and adjust the braking distance after making the default setting.

BRAKE SYSTEM

Setting the Braking Distance



Testing and Adjusting the Braking Distance



DANGER

Danger from fast traveling truck and possible falling load.

Bystanders could be fatally injured.

Only perform the brake test in an area that has been closed off to other people.

Calculating the braking distance

Tools required: Measuring tape

NOTE

The brake test is performed first with maximum load and then with no load.

1. Mark brake point on the ground.
2. Raise the maximum permissible load.
3. With the truck at operating temperature, accelerate to maximum speed on a level, dry and non-treated concrete surface.

4. On reaching the brake point apply the brake suddenly.
5. Measure the distance from the brake point (= measuring point) to the point where the truck has stopped.

Repeat the test three times and obtain the average braking distance.

Then repeat the measurements with an unladen truck.

NOTE

Note the different permissible braking distances for new brakes (or rotors) and used brakes:

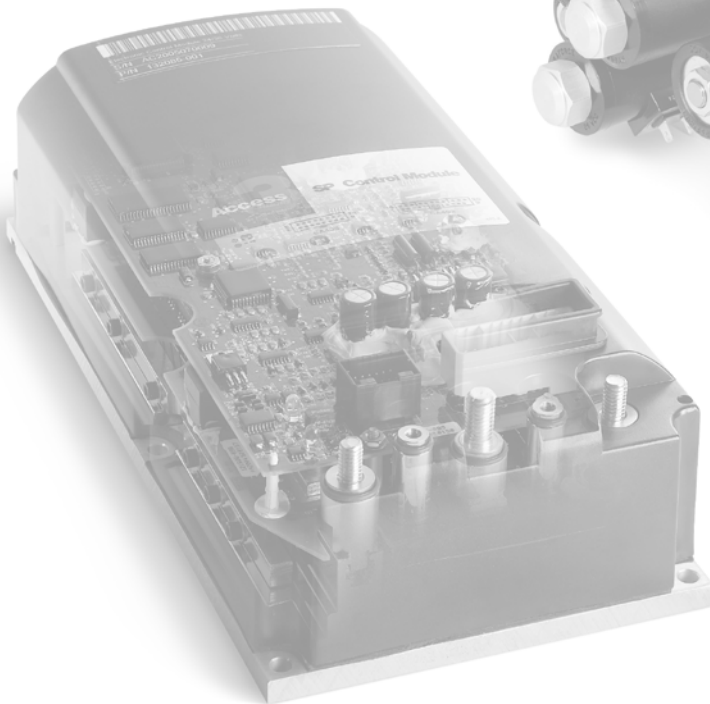
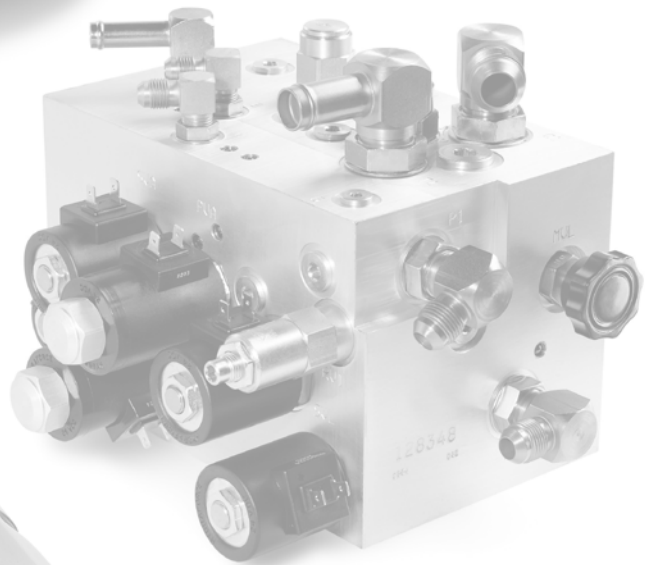
A brake is new until it has completed a maximum of 10 full brake operations. The "new brake" distances apply. For used rotors the "used brake" stopping distances apply.

The stopping distances must be within the "Permissible Braking Distance" limits shown in the table.

- Adjust the brake default setting to obtain permissible braking distances. Do not chock the drive tyre.
- After adjusting the brake secure the setscrew (1, Fig. MS-6620-017) in a recess by bending up the tappet of the safety plate.

Permissible Braking Distances

Model	"New Brake"		"Used Brake"	
	With max. load	No load	With max. load	No load
WE 1.25 t	1.0 - 1.1 m (39.37 - 43.31 inch)	0.6 - 0.7 m (23.62 - 27.56 inch)	0.95 - 1.05 m (37.40 - 41.34 inch)	0.55 - 0.65 m (21.65 - 23.62 inch)
WE 1.6 t				
WE 1.8 t				
WS 1.6 t Aux				
WE 1.25 t S	1.35 - 1.45 m (53.15 - 57.09 inch)	1.05 - 1.15 m (41.34 - 45.28 inch)	1.3 - 1.4 m (51.18 - 55.12 inch)	1.0 - 1.10 m (39.37 - 43.31 inch)
WE 1.4 t S				
WS 1.4 t S				
WS 1.4 t S Aux				



STEERING



Notes:

Control Handle Return Springs



WARNING

Risk of serious injury

Avoid accidents by:

- *Switching off the truck*
- *Disconnecting the battery*
- *Preventing the truck from being switched on again.*
- *Jacking up the truck and preventing it from rolling away*

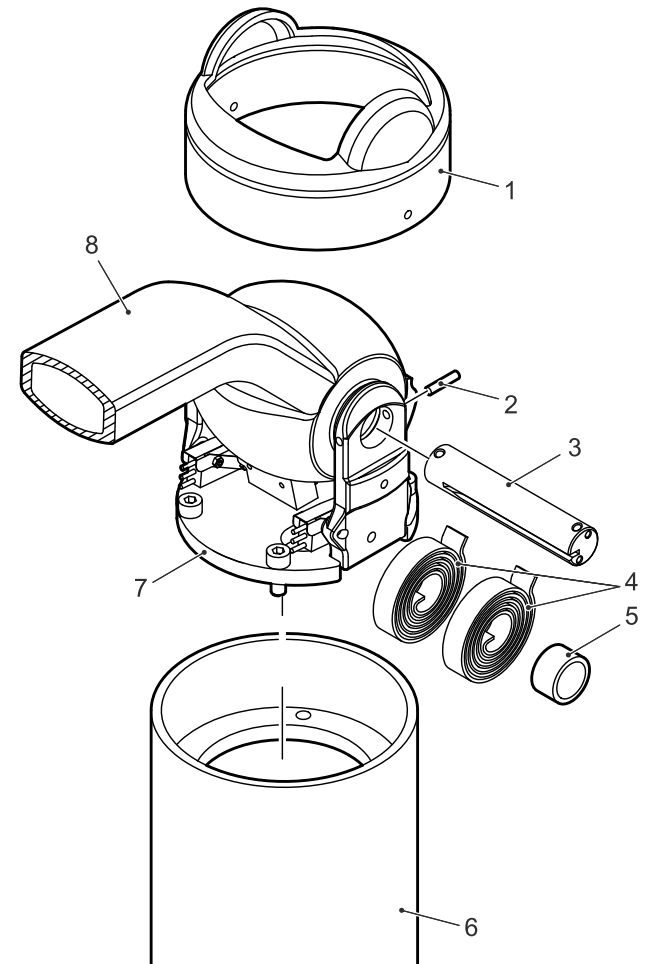
For further details refer to the Safety chapter.

Spring Tension Adjustment

The LH side of the axle (3) is factory fitted with a dowel pin (5). If the bias spring force reduces over time, the pre-tension of the springs (4) can be increased as follows:

- Unscrew the panel (1) and push it up.
- Leave the control handle (8) in the neutral position (up).
- Drive out the dowel pin (2) on the LH side.
- Use a face wrench to turn the axle (3) a corresponding distance. Drive in the dowel pin (2) on the RH side.

If the spring tension is now still not sufficient to keep the control handle (8) up, replace the springs (4).



MS-3400-042



WARNING

Risk of injury from pre-tensioned springs.

To avoid injury, observe the following instructions for handling springs.

- Remove the mounting screws of the panel (1) and push the panel up.
- Bring the control handle (8) up fully and maintain it in that position.
- Mark the axle (3) position.
- Drive out the dowel pin (2).

The charged springs (4) should now turn the axle (3) and discharge themselves in the process.

STEERING

Control Handle Return Springs



- Set the control handle (8) all the way down to fully discharge the springs.

If the axle (3) has still not turned, it is fixed rigidly:

- Using a face wrench, turn the axle (3), viewed from the LH side, approx. 20° anti-clockwise from the fixed position to fully discharge the springs (4).
- Drive the axle (3) out to the right so that the springs (4) can be removed.

Assembly

- Push the springs (4) onto the axle (3). The inner, angled end should enter the groove of the axle (3) in the process. It can be useful to attach a belt around the inner end of the first inserted spring (4), in order to help line up the other springs (4).
- Drive the axle (3) in fully.
- Tilt the control handle (8) up as far as the stop.
- Drive the dowel pin (2) into the LH side (RH side if necessary). To do this turn the axle (3) a sufficient distance.



WARNING

Health risk. Observe the manufacturer's safety instructions when handling solvents and lubricants.

- Grease the springs (4) (for lubricant refer to table on page 22).
- Secure the panel (1).
- Check the brakes.

Cardan Joint

Removal



WARNING

Risk of serious injury

Avoid accidents by:

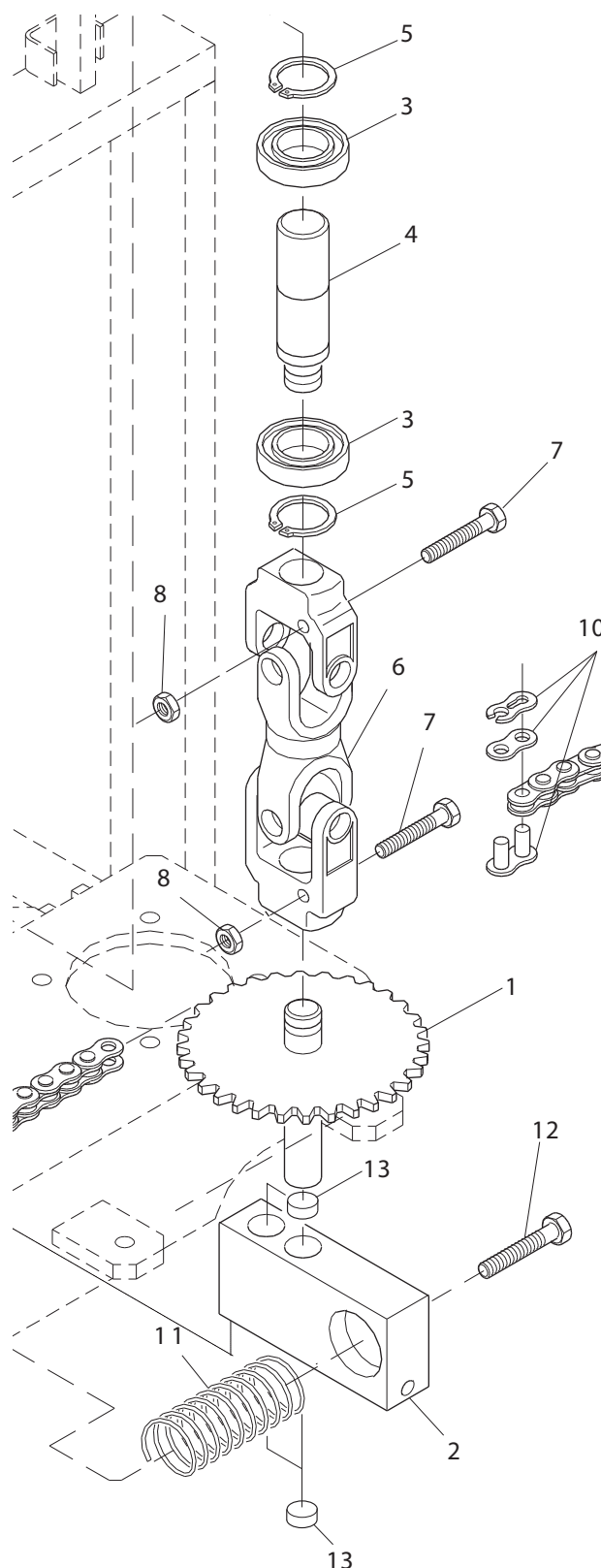
- Switching off the truck
- Disconnecting the battery
- Preventing the truck from being switched on again.
- Jacking up the truck and preventing it from rolling away

For further details refer to the Safety chapter.

- Mark the assembly position of the tiller support with reference to the chassis.
- Mark the assembly position of the chain wheel with reference to the chain tensioner.
- Undo the bottom locking screw (7) and push the chain wheel (1) down.
- Undo the top locking screw (7).
- Remove the cardan joint (6) from the steering pivot.

Assembly

Assembly is the reverse order of removal. Note the markings.



MS-4223-019

STEERING

Steering Chain



Steering Chain

(see Fig. MS-4223-019)

- Using screw (12, Fig. MS-4223-019), adjust the chain tension. Finally check forward travel and adjust if necessary.

Removal



WARNING

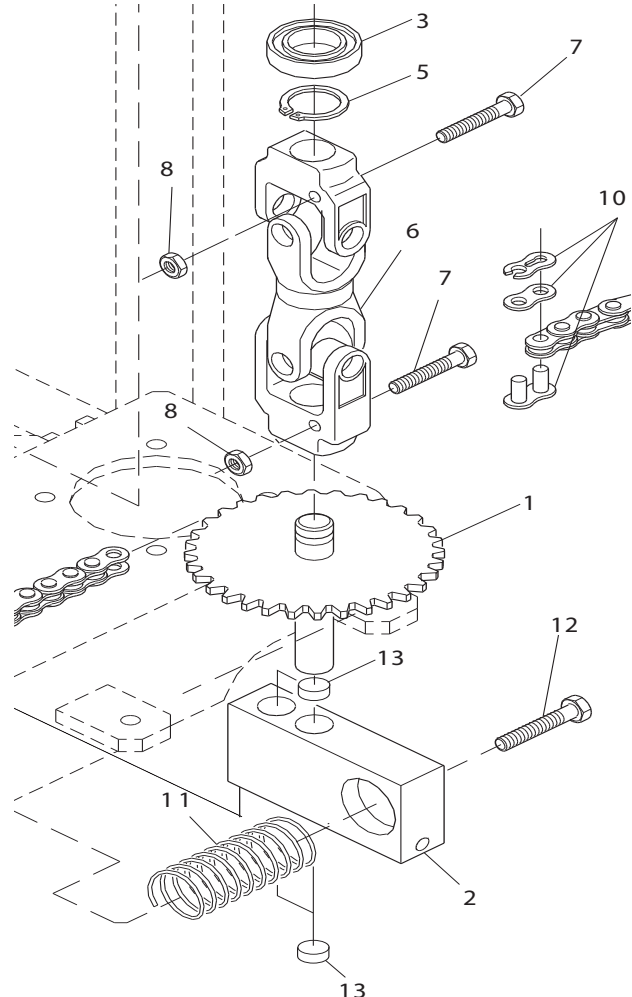
Risk of serious injury

Avoid accidents by:

- Switching off the truck
- Disconnecting the battery
- Preventing the truck from being switched on again
- Jacking up the truck and preventing it from rolling away

For further details refer to the Safety chapter.

- Turn the tiller until the chain lock is visible.
- Mark the position of the drive wheel with reference to the chassis.
- Mark the assembly position of the chain wheel with reference to the chain tensioner.
- Undo the stop screw (12).
- Insert a suitable tool in the bore (2) and push the chain tensioner against the compression spring (11). Secure with a wooden wedge.
- Open and remove the chain lock (10).
- Remove the steering chain (9).



Assembly

MS-4223-019

- Pull the steering chain around the pinion on the drive motor (using a wire as an aid).
- Align the chain wheel and drive wheel with the markings.

Further assembly is the reverse of disassembly. Finally, adjust the chain tension.

Tensioning the steering chain

NOTE

The steering chain should yield approx. 3 – 5 mm when you push your thumb onto the front middle section.

Forward Travel

Test and Adjustment

Test forward travel. If the tiller angle has to be slightly offset in order to travel straight ahead, the position of the tiller must be adjusted.

Up to serial no. 5A134880:

(see Fig. MS-4223-019)

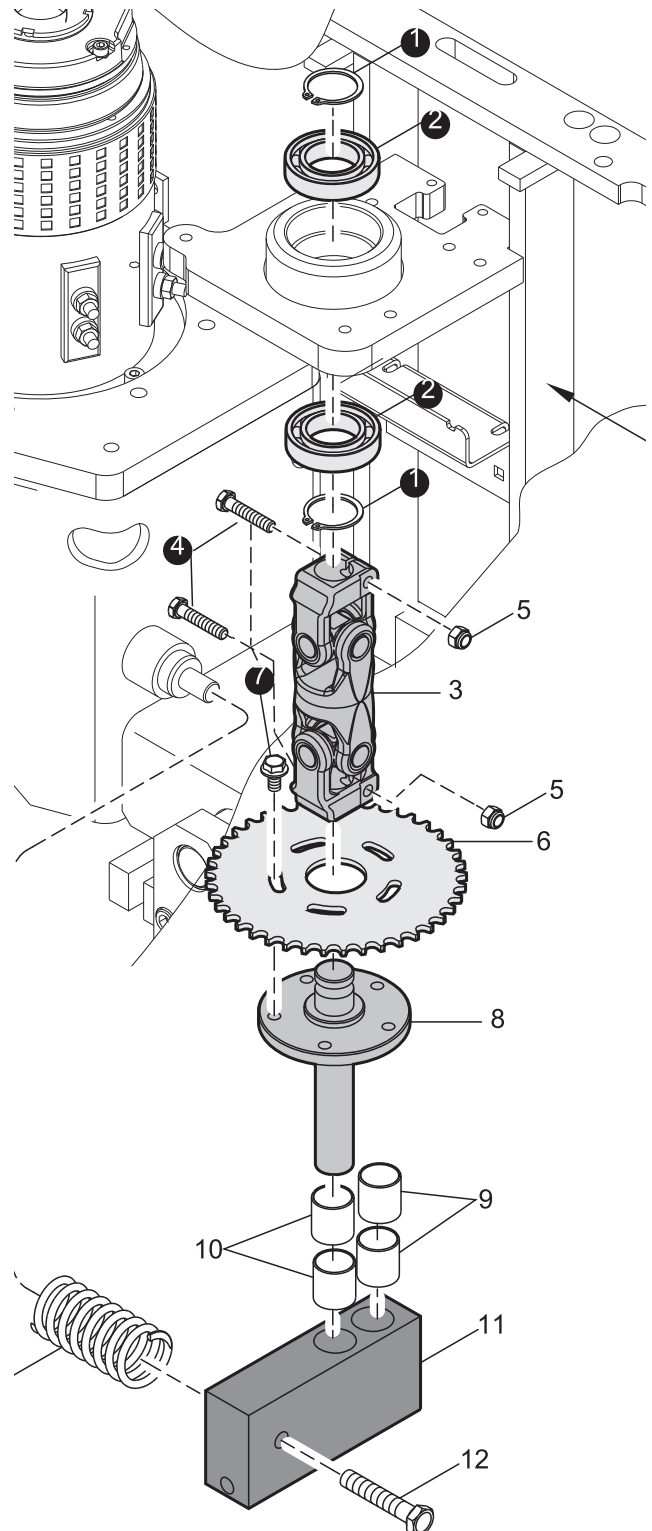
- Loosen the locking screw (7).
- Push the pinion (1) down out of the cardan joint without twisting it.
- Set the tiller to the middle position.
- Push the pinion (1) up into the cardan joint without twisting it.
- Tighten the locking screw (7).

Test forward travel again. Repeat the adjustment if necessary.

From serial no. 5A134882:

(see Fig. MS-4223-020)

- Loosen the screws (7) on the chain pinion.
- Turn the tiller to the middle position.
- Tighten the screws (11) again.
- Test forward travel again. Repeat the adjustment if necessary.



MS-4223-020

STEERING

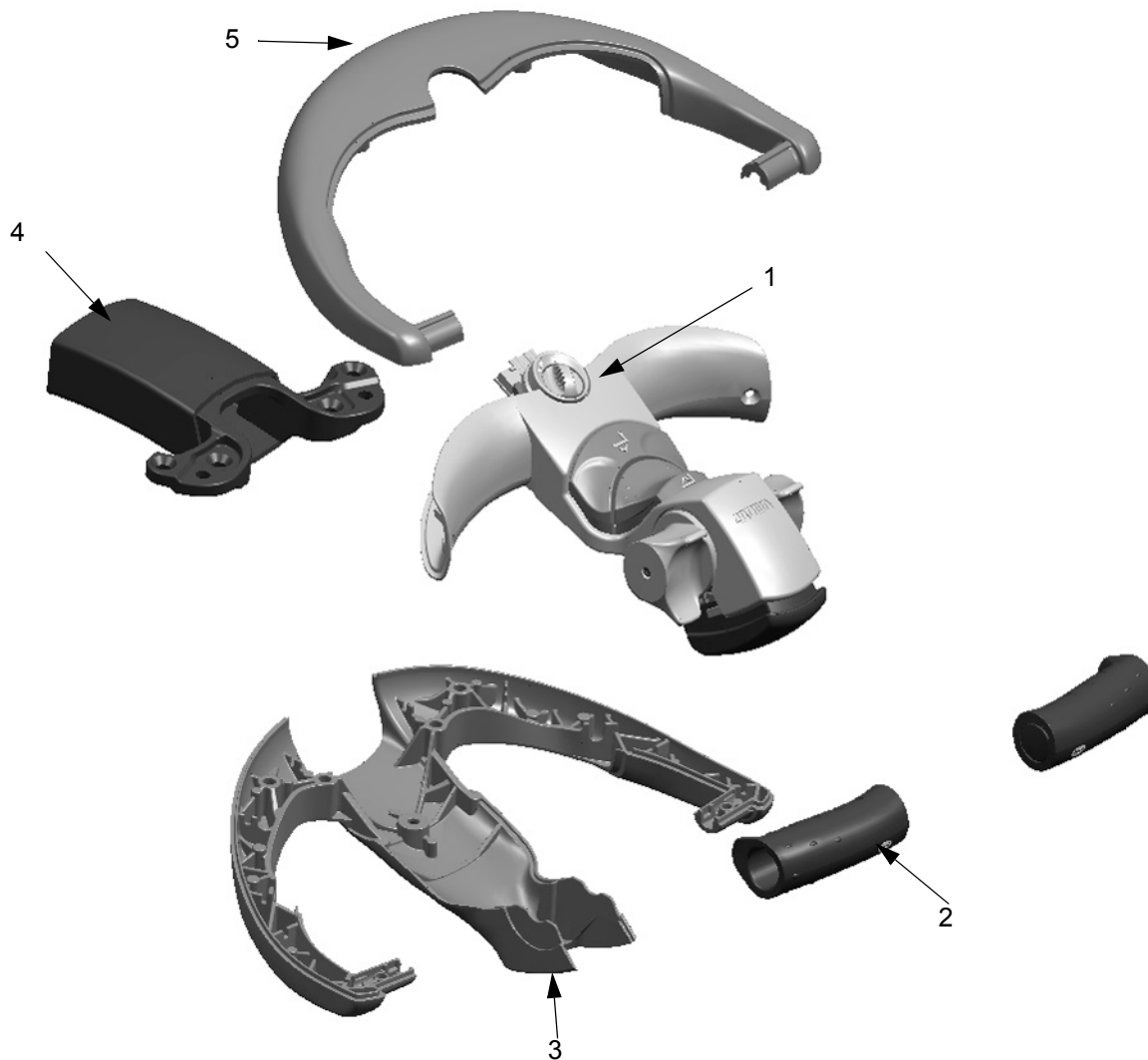
Tiller Handle Components



Tiller Handle Components

Main Components

This section contains an overview of the main components and associated terms:



MS518-150

- 1 Switch unit
- 2 Hand grip
- 3 Lower shell
- 4 Tiller tube
- 5 Upper shell



STEERING

Tiller Handle Components

Tools required

To access the individual components of the hand grip you will require:

- Torx® screwdriver set
- A small screwdriver with a flat blade.



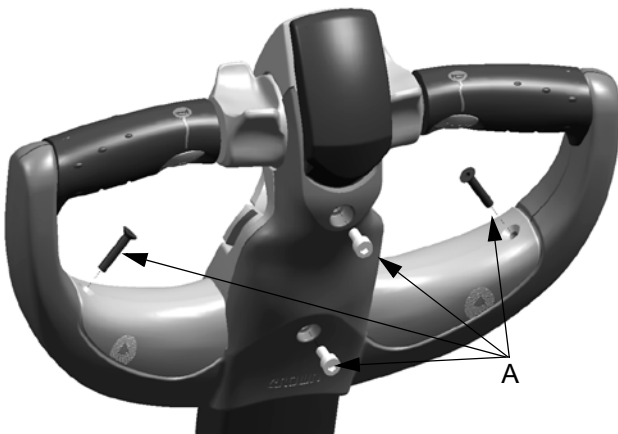
CAUTION

Short circuit hazard. De-energise the truck (disconnect the battery) and prevent it from being switched on again.

Unless otherwise stated, all screws must be torqued to the standard rating (see *Lubrication & Adjustment* chapter).

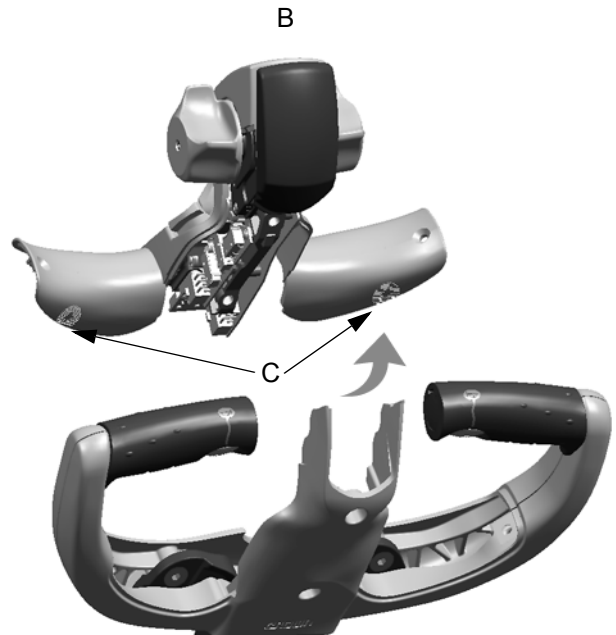
Hand Grip Shells

Removal



MS-4223-021

- Remove the 4 screws (A, Fig. MS-4223-021).



MS-4223-022

- Press the thumb markings (B, Fig. MS-4223-022) on the switch unit or pull on the thumbwheels (C). The switch unit will slide up out of the bottom shell.
- Remove the plug connection of the tiller wire harness and the horn switches from the switch unit PC boards.

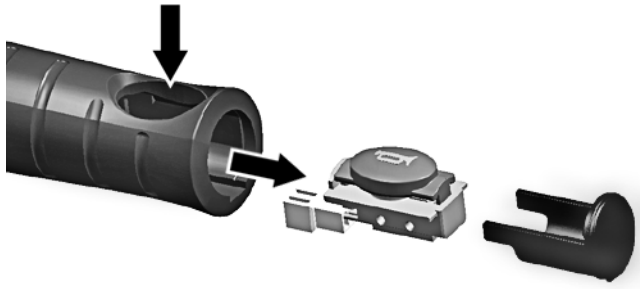


MS-4223-023

- Using a small flat bladed screwdriver lever off the covers on each hand grip (see Fig. MS-4223-023).

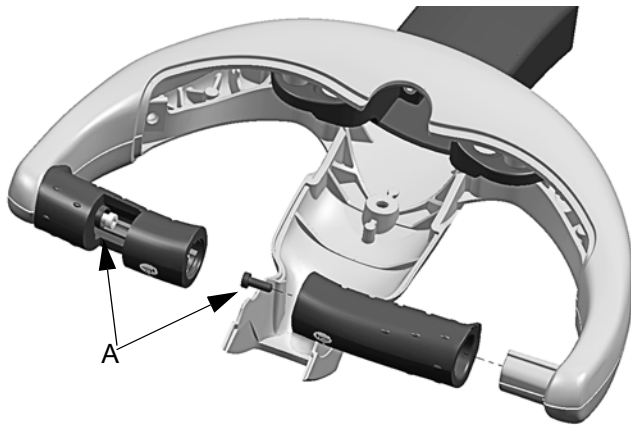
STEERING

Tiller Handle Components



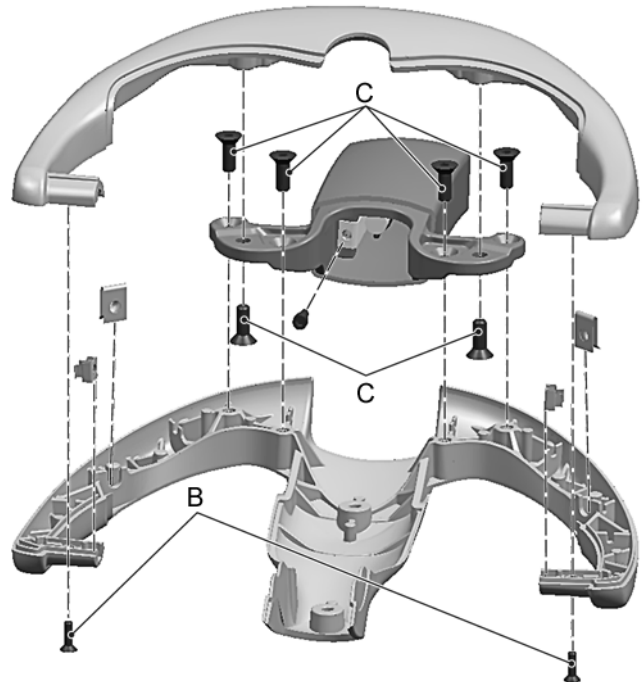
MS-4223-024

- Push the horn switch in gently and pull it out of the grip (see arrows, Fig. MS-4223-024). Remove the plug connection from the switch.



MS-4223-025

- Remove the inside screws (A, Fig. MS-4223-025).
- Remove the grips.



MS-4223-026

- Remove the two screws (B, Fig. MS-4223-026) and the six screws (C).
- Take off the shells.

Assembly



CAUTION

When assembling, take care not to damage the wiring.

- Assembly is the reverse of disassembly.
- Connect the battery and test all functions.

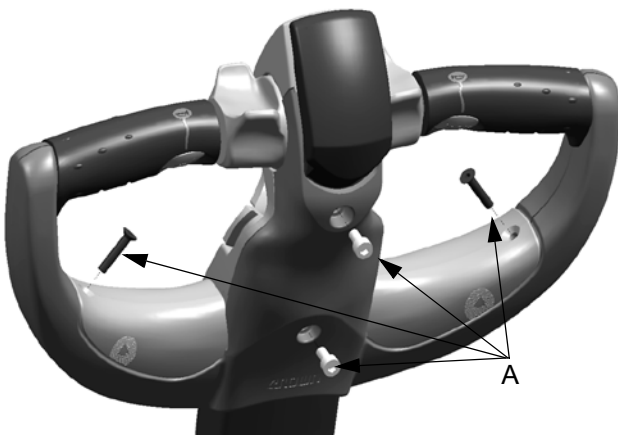
Switch Unit

Removal

The switch unit contains the:

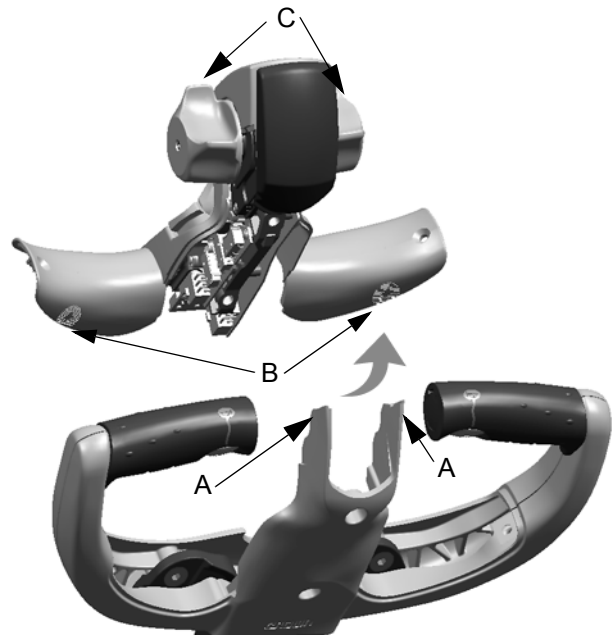
- Safety reverse switch
- Travel switch / traction potentiometer
- “Rabbit/Turtle” toggle switch
- Main PC board
- Hydraulic PC board
Hydraulic PCB = Lift / lower switches

Replacing any of these components requires the switch unit to be replaced.



MS-4223-021

- Remove the screws (A, Fig. MS-4223-021).



MS-4223-022

- Press the thumb markings (B, Fig. MS-4223-022) on the switch unit or pull on the thumbwheels (C). The switch unit will slide up out of the bottom shell.
- Remove the plug connections of the tiller wire harness and the horn switches from the switch unit PC boards.

Assembly

NOTE

Make sure you re-connect the tiller wire harness and the horn wiring. The connectors cannot be interchanged and are protected against incorrect polarity.

Assembly is always the reverse of disassembly.

- Push the switch unit over the two side panels (A, Fig. MS-4223-022). Guide the switch unit down and to the front.
- Tighten the screws (A, Fig. MS-4223-021).
- Connect the battery and test all functions.

STEERING

Switch Unit

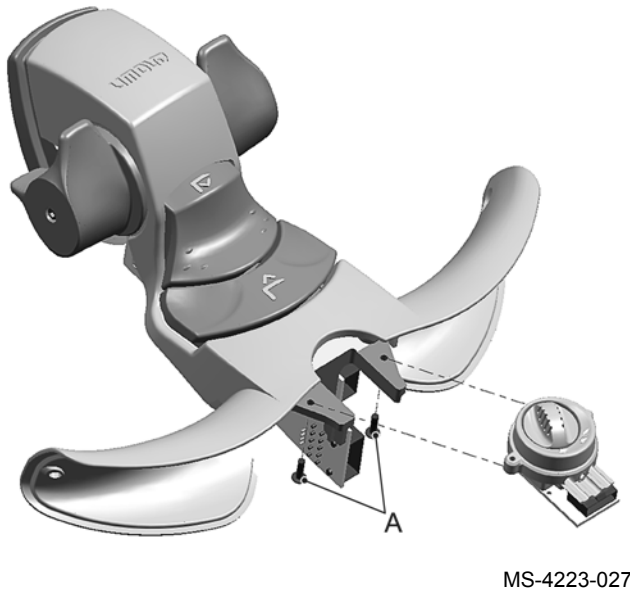


“Rabbit/Turtle” Toggle Switch

There are no parts on this module that can be repaired. It must be replaced in full.

NOTE

This module comes in two versions: a standard and a cold store version. Make sure you use the right module!



Removal

- Disassemble the switch unit (see page 169).
- Remove the two screws (A, Fig. MS-4223-027).
- Remove the toggle module.

Assembly

- Insert the toggle module and fix it with the screws (A, Fig. MS-4223-027).
- Disassemble the switch unit (see page 169).
- Connect the battery and test all functions.

Hydraulic PC Board

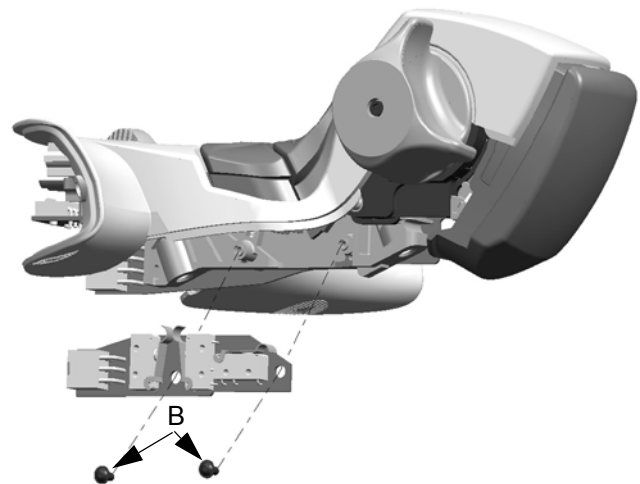
There are no parts on this PC board that can be repaired. It must be replaced in full.

NOTE

This PC board is available in two versions: a standard and a cold store version. Make sure you use the right PC board!

Removal

- Disassemble the switch unit (see page 169).



- Remove screws (B, Fig. MS-4223-028) from the smaller of the two PC boards (the larger one is the main PC board).
- Remove the hydraulic PC board.

Assembly

- Insert the hydraulic PC board.
- Secure the board with 2 screws (B, Fig. MS-4223-028).
- Disassemble the switch unit (see page 169).
- Connect the battery and test all functions.



STEERING Switch Unit

Main PC Board

There are no parts on this PC board that can be repaired. It must be replaced in full.

NOTE

This PC board is available in two versions: a standard and a cold store version. Make sure you use the right PC board!

Its compact design can make it difficult to reach the connector on the main PC board. If this is the case, remove the thumbwheel, the bottom cover and the top shell cover (see "Potentiometer Assembly" in this chapter).

Removal

- Disassemble the switch unit (see page 169).

NOTE

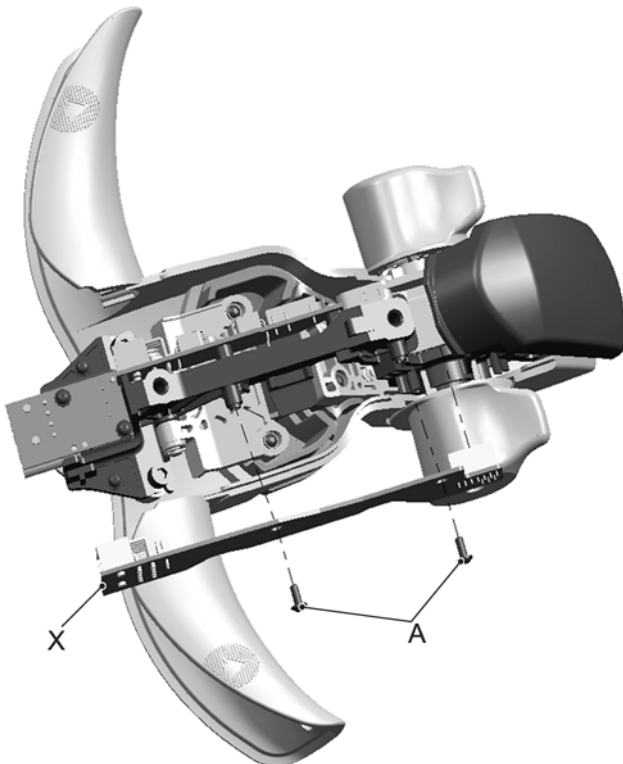
The main PC board is the larger of the two PC boards!

- Disconnect the potentiometer from the main PC board.

- Remove the screws (A, Fig. MS-4223-029).
- Remove the connector of the safety reverse switch from the main PC board.
- Remove the main PC board (X).

Assembly

- Refit the main PC board in the reverse order.
- Connect the battery and test all functions.



MS-4223-029

STEERING

Switch Unit



Potentiometer

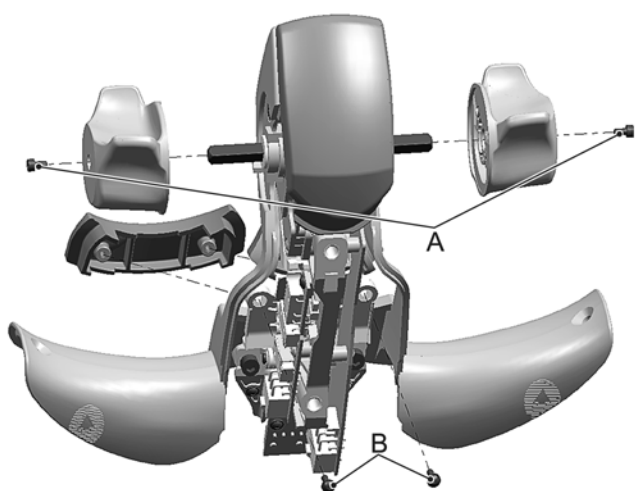
There are no parts on this module that can be repaired. It must be replaced in full.

NOTE

This module comes in two versions: a standard and a cold store version. Make sure you use the right module!

Removal

- Disassemble the switch unit (see page 169).



MS-4223-030

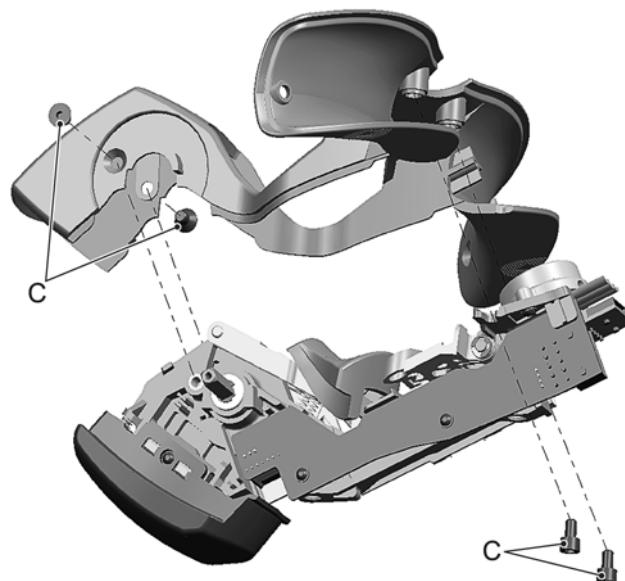
- Remove the screws (A, Fig. MS-4223-030) from the thumbwheels.



CAUTION

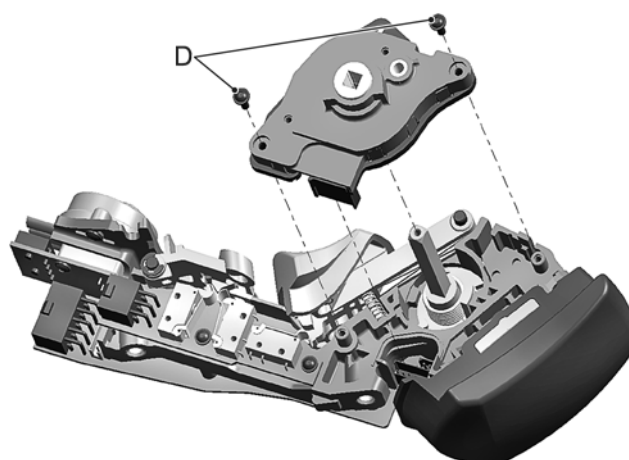
Take care not to lose the plastic slide bearings (washers) when removing the thumbwheels.

- Remove the thumbwheels.
- Remove the screws (B) (holding the orange lowering switch cap in place).
- Remove the lowering switch cap.



MS-4223-031

- Remove the screws (C, Fig. MS-4223-031).
- Remove the switch unit cover.



MS-4223-032

- Remove the screws (D, Fig. MS-4223-032).
- Remove connectors from the PC boards.
- Remove potentiometer from the square axle.

Assembly



CAUTION

*Before connecting the cable to the potentiometer:
Fill bushing for connectors on potentiometer with grease part no. 053002-005. Do not use any other grease.*

- Assemble the potentiometer in the reverse order of disassembly.

NOTE

*The thumbwheels cannot be incorrectly positioned.
They will only fit in one position.*

- Disassemble the switch unit (see page 169).
- Connect the battery and test all functions.

STEERING

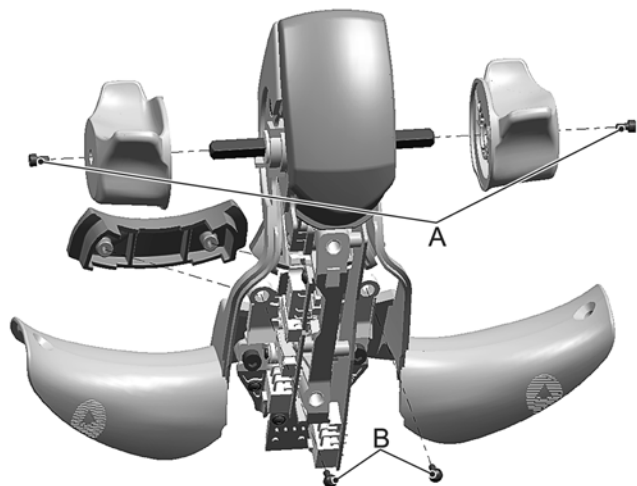
Switch Unit



Safety Reverse Switch

Removal

- Disassemble the switch unit (see page 169).



MS-4223-030

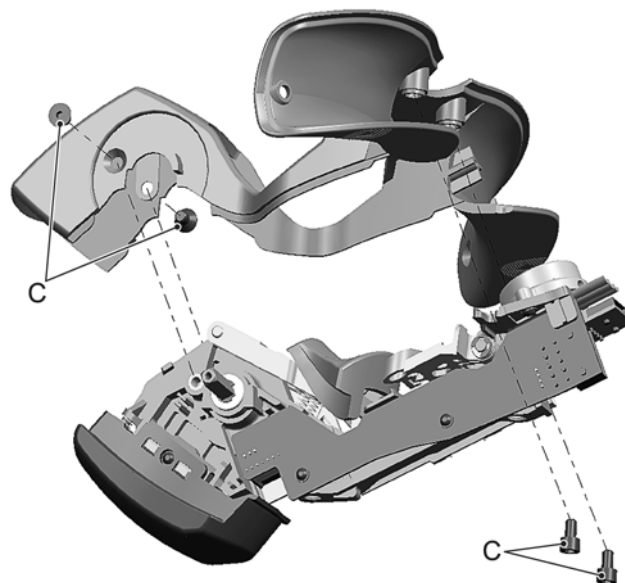
- Remove the screws (A, Fig. MS-4223-030) from the thumbwheels.



CAUTION

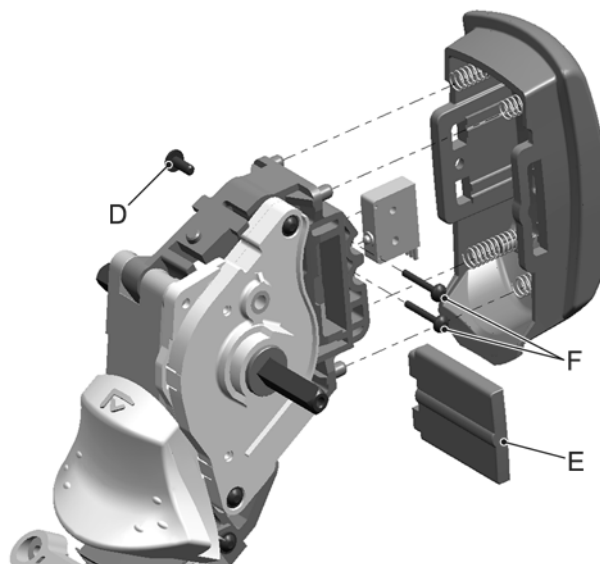
Take care not to lose the plastic slide bearings (washers) when removing the thumbwheels.

- Remove the thumbwheels.
- Remove the screws (B) (holding the orange lowering switch cap in place).
- Remove the lowering switch cap.



MS-4223-031

- Remove the screws (C, Fig. MS-4223-031).
- Remove the switch unit cover.



MS-4223-033

- Remove the screws (D, Fig. MS-4223-033).
- Remove the switch bypass (E).
- Remove the screws (F, Fig. MS-4223-033).

- Disconnect the microswitch from the main PC board.

Assembly



CAUTION

Before connecting the microswitch:

Fill connector with grease part no. 053002-005. Do not use any other grease.

- Assemble the safety reverse switch in the reverse of assembly.

NOTE

The thumbwheels cannot be incorrectly positioned. They will only fit correctly in one position.

- Disassemble the switch unit (see page 169).
- Connect the battery and test all functions.

Horn Switch

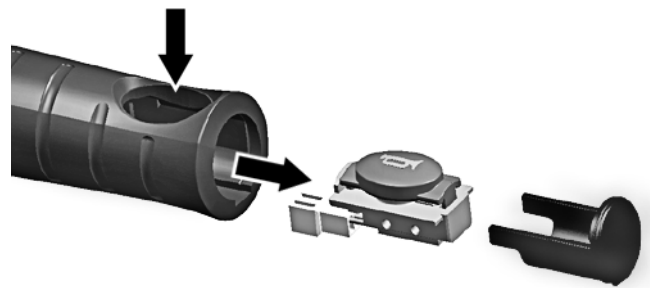
Removal

- Disassemble the switch unit (see page 169).



MS-4223-023

- Using a small flat bladed screwdriver lever off the cover on the hand grip (see Fig. MS-4223-023).



MS-4223-024

- Push the horn switch in gently and pull it out of the grip (see arrows, Fig. MS-4223-024). Remove the plug connection from the switch.

Assembly

NOTE

The switches on the LH and RH grips are different. If you fit the switch on the wrong side the horn symbol will be upside down!

- Assemble the horn switch in the reverse of disassembly.

STEERING

Switch Unit



- Disassemble the switch unit (see page 169).
- Connect the battery and test all functions.

Hand grip

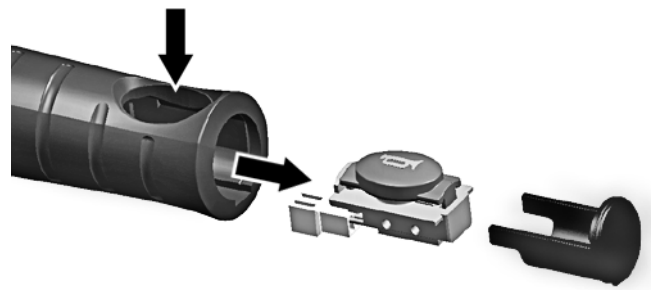
Removal

- Disassemble the switch unit (see page 169).



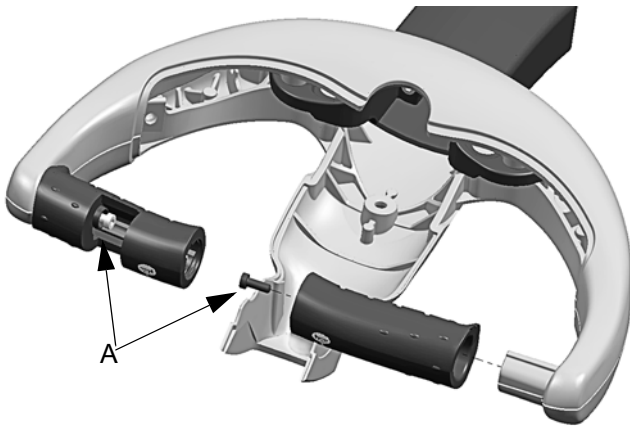
MS-4223-023

- Using a small flat bladed screwdriver lever off the cover on the hand grip (see Fig. MS-4223-023).



MS-4223-024

- Push the horn switch in gently and pull it out of the grip (see arrows, Fig. MS-4223-024). Remove the plug connection from the switch.



MS-4223-025

- Remove the inside screw (A, Fig. MS-4223-025).
- Pull off the grip.

Assembly

NOTE

The switches on the LH and RH grips are different. If you fit the switch on the wrong side the horn symbol will be upside down!

- Assemble the grip in the reverse of disassembly.
- Disassemble the switch unit (see page 169).
- Connect the battery and test all functions.

Auxiliary Hydraulics Switch

Removal



MS-4223-034

- Disassemble the switch unit (see page 169).
- Remove the screws holding the switch strap to the shell.
- Remove the screw holding the auxiliary hydraulics switch (A, Fig. MS-4223-034) to the strap.
- Remove the switch block.
- Remove both screws from the switch block.
- Take out the microswitch.

Assembly

Assemble the auxiliary hydraulics switch in the reverse order of assembly.



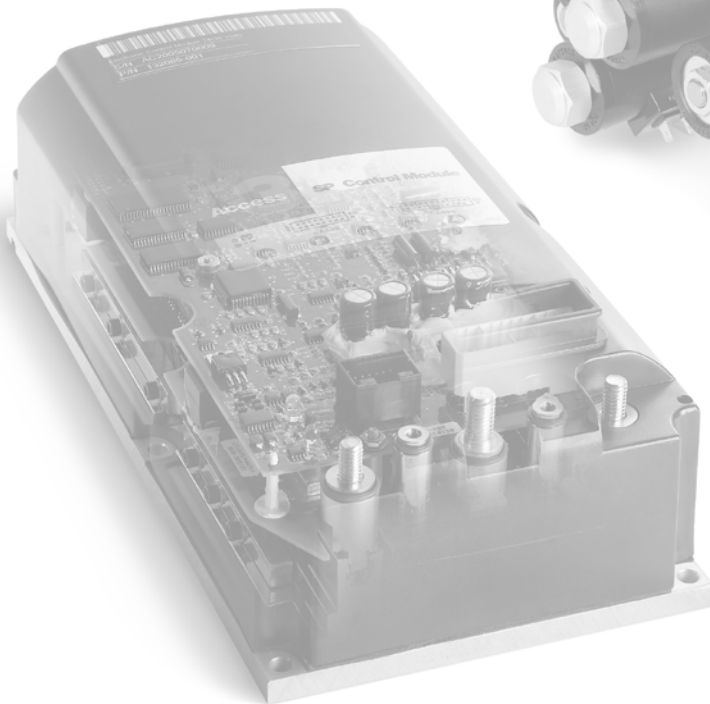
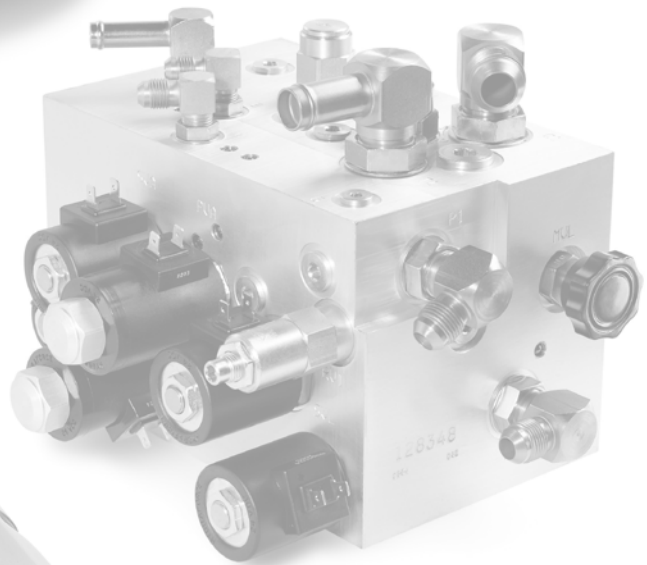
CAUTION

*Make sure the gap between the switch cap and the shell (B, Fig. MS-4223-034) is constant along the circumference. **The switch cap should not jam when applied.***

- Disassemble the switch unit (see page 169).
- Connect the battery and test all functions.



Notes:



LIFTING MECHANISM



Notes:



LIFTING MECHANISM

Mast

Mast

General



DANGER

Risk of trapping and severing limbs! When carrying out work on the mast and the attachments always block the mast stages and attachments to prevent accidental movement even if they are being held by lifting gear. Make sure the wooden blocks and lifting gear used have sufficient capacity.

Lifting Gear Minimum Capacity

Note the minimum capacity for the lifting gear whenever carrying out work on the mast:

- Mast with fork carriage: 800 kg
- Fork carriage: 150 kg



WARNING

Risk of serious injury

Avoid accidents by:

- Switching the truck off
- Disconnecting the battery.
- Preventing the truck from being switched on again.
- Jacking up the truck and preventing it from rolling away.

Removal

1. Park the truck under a suitable lifting device (minimum capacity 800 kg).
2. Fully lower the fork carriage.
3. Remove the hook-on forks, if applicable.
4. Remove power by disconnecting the battery.
5. Remove the forks (WE only)
6. Remove the electrical plug connection from the speed limit switch (LMS).
7. Prepare a flat tray and bonding agent to collect any spilled hydraulic oil.
8. Attach the lifting gear to the mast and slightly tension the lifting gear.



WARNING

High pressure hydraulic system!

Escaping hydraulic oil can cause serious injury.

To avoid accidents:

- Depressurise the hydraulic system before opening any sections of it.
- Tighten all connections before pressurising the system.
- Keep hands and body away from pressurized fluid.
- Only trace leaks with a piece of paper or cardboard.

Whenever a high pressure fluid enters the skin it must be treated as a medical emergency.

Seek medical assistance even if the skin appears normal at first.

9. Depressurise the hydraulic system.
10. Disconnect all hydraulic lines leading to the mast and seal the connections immediately with dummy plugs.
11. Remove the four mast attachment screws and lift off the mast.
12. Place the mast on pallets with the fork carriage facing up.

Assembly

Assembly is the reverse order of removal. **Torque the mast attachment screws to 80 Nm.**

Then adjust the chain tension and bleed the hydraulic system.

LIFTING MECHANISM

Fork Carriage



Fork Carriage



DANGER

Risk of trapping and severing limbs! When carrying out work on the mast and the attachments: Always block the mast stages and attachments to prevent accidental movement even if they are being held by lifting gear.

Make sure the wooden blocks and lifting gear used have sufficient capacity.

Removal

1. Raise the fork carriage approx. 0.5 m.
2. Disconnect the battery. Secure the truck to prevent it from being switched on again.
3. Drive one of the two dowel pins out of each of the chain bolts.
4. Connect the battery.
5. Fully lower the fork carriage.
6. Disconnect the battery.
7. Loosen the counternuts and nuts until the chains are discharged.
8. Pull the chain bolts out of the chain anchors.
9. Connect the battery and remove the anti-power up mechanism.
10. Apply a lift operation. Raise the mast until the fork carriage is clear. Keep the mast stage in this position using a lifting device.
11. Disconnect the battery. Secure the truck to prevent it from being switched on again.
12. Secure the mast stage(s) with suitable hard wooden blocks.
13. Remove the fork carriage.

Assembly

Assembly is the reverse of disassembly. Now adjust the chain tension.

Adjusting the fork carriage clearance

1. Raise the fork carriage as far as the stop.
2. Lower the fork carriage approx. 50 mm.

3. Using a mounting iron push the top fork carriage roller against the inner mast

4. Using a feeler gauge measure the clearance between the roller and the shim:

– It should be 0 - 0.5 mm

If there is excessive clearance:

1. Remove the fork carriage and insert shims only on the right side of the fork carriage.
2. First insert enough shims to attain the permissible clearance level on the top roller.
3. Insert the same number of shims on the bottom right roller.
4. Assemble the fork carriage.
5. Measure the clearance again.

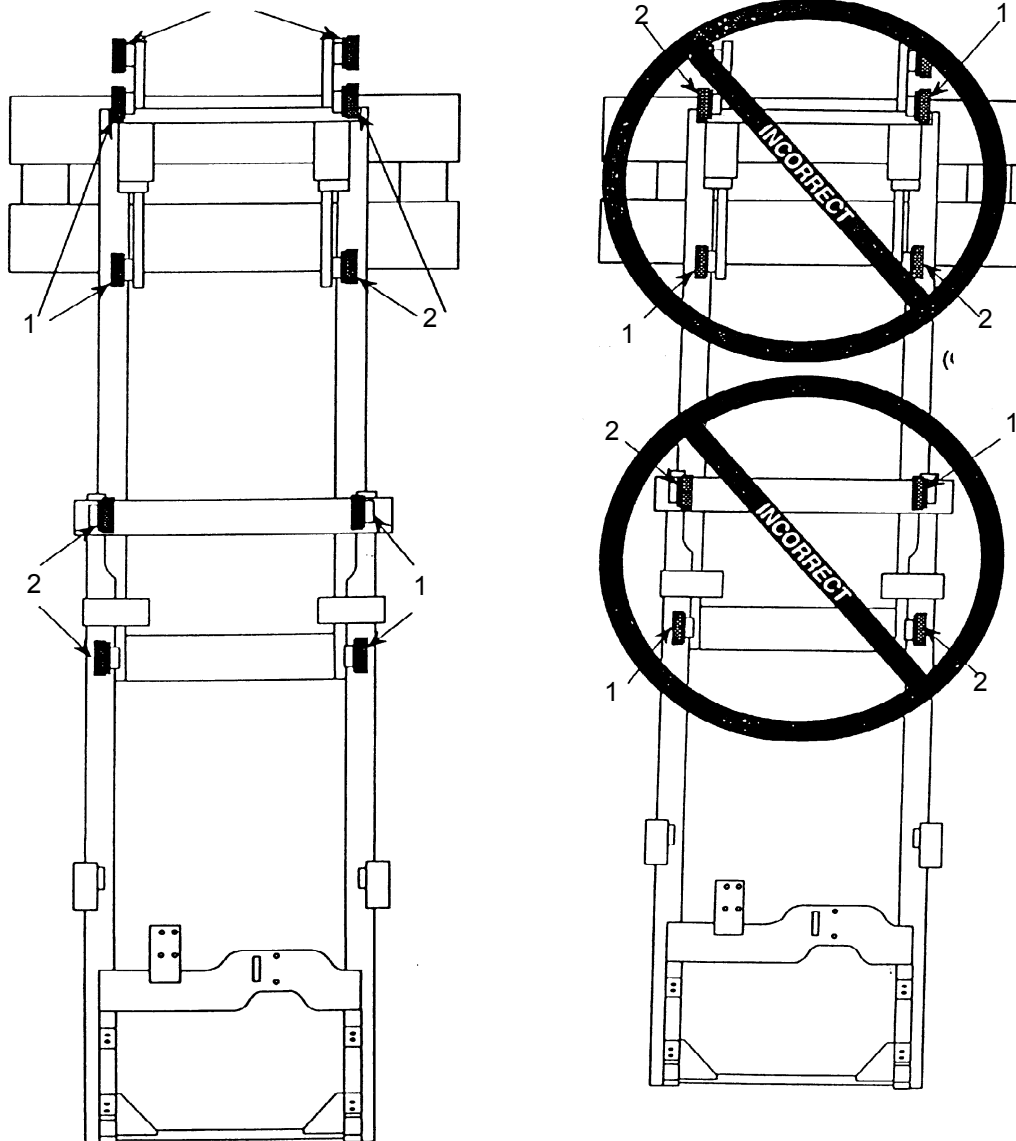
The fork carriage must not jam on the highest point of the mast.



LIFTING MECHANISM

Fork Carriage

Mast and fork carriage clearance setting example



M0381 / M0382

LIFTING MECHANISM

Mast Maintenance



Mast Maintenance



DANGER

Risk of trapping and severing limbs! When carrying out work on the mast and the attachments: Always block the mast stages and attachments to prevent accidental movement even if they are being held by lifting gear.

Make sure the wooden blocks and lifting gear used have sufficient capacity.

Greasing the Roller Tracks

1. Fully lower the fork carriage.
2. Remove power by disconnecting the battery.



WARNING

Health risk. Observe the manufacturer's safety instructions when handling solvents and lubricants.

3. Clean the roller tracks.
4. Grease the roller tracks thoroughly.

Mast rollers

Removal

1. Remove the fork carriage or inner mast.
2. Pull off the rollers while paying attention to the shims.

Assembly

Assembly is the reverse order of removal.

Adjust the clearance of the inner mast and the fork carriage.



LIFTING MECHANISM

Lift Chains

Lift Chains

Lift chains are a major component of a fork lift truck. The chain system on this mast is designed to transmit the lift force from the hydraulic cylinder to the fork reliably and efficiently. Safe, uninterrupted truck operation depends on careful servicing and maintenance of the lift chains.

Most complaints about the chain performance are due to lack of maintenance. Highly stressed precision chains require regular maintenance to ensure a long useful life.

Inspection

The chain must be inspected every 100 hours for any signs of faults or damage. If used in a corrosive or dusty environment, this interval must be reduced to 50 hours. If this cannot be performed on the truck, the lift chains must be removed.

The inspection should include the following:

- Chain wear and elongation
- Pitting due to rust or corrosion, in particular on the outer surfaces of the connection plates.
- Pins turning in or extruding from the outside plates.
- Loss of freedom of movement.
- Damage to the anchor bolt attachment
- Wear and corrosion to the anchor bolt and anchor. Wear between the bolts and the connection plates.

The following sections cover the above items in detail.

Cleaning Methods



CAUTION

Never use chemical solvents or steam to clean the chains. The lubricant applied at the factory will be removed from the inner plate surfaces.

The chain surface should be cleaned with paraffin, a hard bristle brush and lint-free cloth.

After inspection apply another film of chain spray or chain oil. The oil acts both as a lubricant and as an anti-corrosive protection.

Wear



WARNING

The maximum allowed chain elongation is 3%. If the chain has elongated by 3% replace the detachable chain anchors, anchor bolts and lift chains.

The chain bends as it passes over the chain rollers. This leads to a gradual wearing of the chain links.

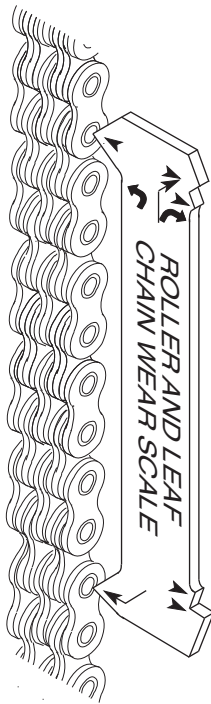
Any slack a chain undergoes during its lifetime is due to wear to the links and the chain plate eyelet.

When checking for chain wear be sure to measure a part of the chain which passes over the guide pulleys. Never repair chains by cutting out the worn section and replacing it with a new section. If a chain is worn, always replace both lift chains.

Chain wear can be measured with a wear gauge (Crown No. 106440) or a steel tape measure (see Fig. 2771).

LIFTING MECHANISM

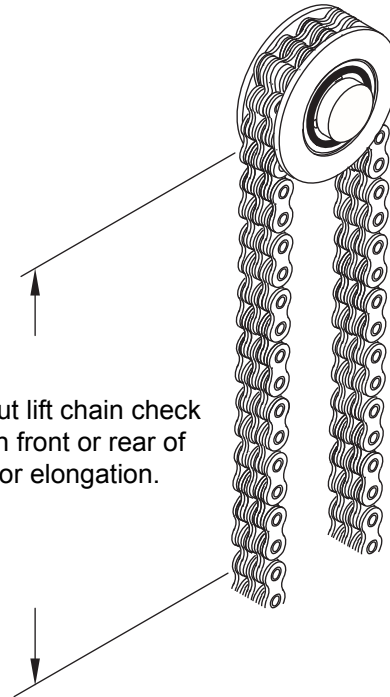
Lift Chains



2771

The Crown wear gauge has two scales: Scale "A" is used for 19.05 mm (0.75 inch) and 25.4 mm (1 inch) pitch chains. Scale "B" is used for 15.88 mm (0.625 inch) pitch chains.

Before testing the chain elongation it is important to tension the lift chain if necessary. For non-detachable lift chains the weight of the fork carriage or mast is sufficient. If the lift chain is detached it must be kept taut during measurement.



7771_EU

The chain elongation test must include at least 10 links (if a steel tape measure is being used). Measure over at least three different points in a section of the chain which always passes over a pulley during operation.

Chain Elongation			
Chain pitch	Number of chain links	Length New	Wear limit
25.4 mm 1 inch	12	305 mm 12 inch	314 mm 12.375 inch
19.05 mm 0.75 inch	16	305 mm 12 inch	314 mm 12.375 inch
15,88 mm 0.625 inch	20	318 mm 12.5 inch	327 mm 12.875 inch

NOTE

If just one of the faults mentioned in this chapter is detected, chains together with their chain anchors or bolts must be immediately replaced. If 2 chains are used paired, replace in pair.

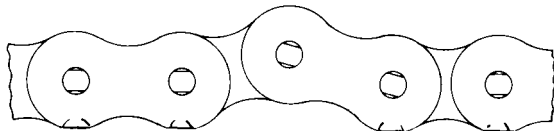


DANGER

Never repair damaged chains! This can result in fatal accidents.

Freedom of Movement of Chain Links

Each individual chain link must flex freely. Tight chain links (see Fig. 2775si) increase friction and the chain tension during lifting. Excessive chain tension in turn accelerates material wear.



2775si

Possible causes of stiff chain links are as follows:

- Bent pins or plates
- Rusty chain links
- Peened plate edges.
- Plate edge distortion is caused by:
- Ruptured chain pinion.
- Constant overloading of the chain.
- Chain striking the mast components.

Replace any chains with stiff joints immediately.

Chain Tension

When installed, both lift chains should have the same chain tension to ensure even distribution of the load over the two chains when lifting.

When replacing the forks make sure that both forks lie evenly on the surface. If they are not even, compensate the chain length via the chain anchor so that both chains have the same chain tension.

After adjusting, tighten the counternuts of the chain anchors (refer to Chapter 1, Torque Table, for the correct torques).

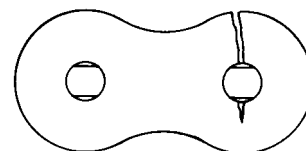
Chain Anchor and Pulleys

In the course of checking the chain system, the chain anchors, chain bolts and pulleys must be checked for wear.

On the chain anchor watch out for wear and cracking of the individual fingers. If one of the above problems occurs replace the chain anchor.

Pulleys with heavily worn flanges and contact surfaces must be replaced. Worn flanges are due to misalignment. The chain tension and mast roller setting must be checked.

Worn Connection Plates



2774si

Generally speaking, material wear is the cause of worn or missing connection plates. The plates near the chain pin hole (see Fig. 2774si) can crack after a large number of lifting cycles with heavy loads.

Replace *both* chains immediately if cracking shows or plates are missing. If 2 chains are used paired, replace in pair.

LIFTING MECHANISM

Lift Chains

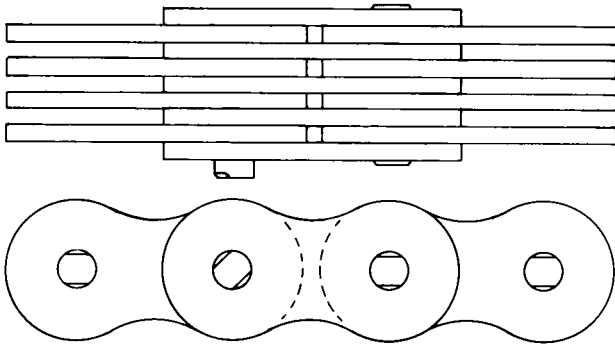


Protruding or Turned Chain Pins



DANGER

Never attempt to repair the chain by driving pins back into the chain. This can result in accidents with severe or even fatal injuries if the chain tears. Fit new chains.



2776S

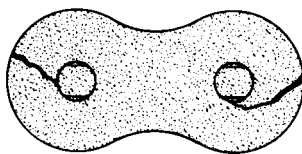
Considerable frictional forces between the connection plates and the pins occur when lifting heavy loads with an insufficient or non-existent film of oil.

In extreme cases the frictional torque in the joints can be such that the pins turn and gradually work out of the chain (see Fig. 2776S). This can result in chain failure.

Turned pins can be rapidly identified if the flat ends are not all pointing in the same direction.

Chains with twisted or protruding pins must be replaced immediately. If 2 chains are used paired, replace in pair.

Corrosion



2773si

The chains used on fork lift trucks are highly stressed precision components. It is particularly important to maintain the original fatigue strength throughout its useful life.

Corrosion considerably reduces the capacity of a lift chain. It results in cracking in the side plates.

Lift chains must therefore be protected from corrosion. The layer of grease applied in the factory hot dip galvanizing process is an excellent protection and fully penetrates the joints.

Do not remove this initial layer. After commissioning the chain supplement the factory lubrication through a regular lubrication schedule.

Rust *film* on lift chains can be removed and neutralised by cleaning with chain oil. **Always replace heavily corroded and rusting chains. The risk of cracking as a result of rust is too great.**

Chain Lateral Wear

Wear traces along a stretch of the chain on the pin heads and the outer plates indicate misalignment. This can have one of two causes: uneven chain tension or misalignment between the pulleys and the chain anchors.

Uneven Chain Tension

When fitting or adjusting the chains make sure that they are evenly charged. If for example the fork heel height or the platform height are changed, the chain anchors must be loosened until both forks touch the ground.

Both chains must have equal amounts of air or tension at this point. The lower chain anchor nuts must be tightened by the same number of turns. When the required height has been reached, fix the setting with the top (chain side) lock nut and its respective lock washer.

Misaligned Lift Components

Misalignment of the chain pinion and the chain due to the wrong number of washers on the mast or a damaged mast or cylinder components can also contribute to wearing of the chain sides.

To test whether this is the case, proceed as follows: Place the truck on a horizontal surface in the service station. Support the fork carriage and/or platform and detach both ends of the lift chain from the chain anchor and visually inspect the alignment with the anchor slots.



LIFTING MECHANISM

Lift Chain Lubrication

Lift Chain Lubrication

Lubrication is the most important factor in lift chain maintenance. It considerably affects the chain's useful life.

Highly stressed chains under constant use cannot last sufficiently long if they are not regularly lubricated within a planned maintenance schedule.

As with all contact surfaces, the tensiled steel precision moving parts require a durable lubricant film between the contact surfaces to avoid excessive wear.

Maintaining a lubricant film on all the chain surfaces provides the following benefits:

- Restricts joint wear to a minimum (chain elongation).
- Avoids corrosion.
- Reduces the risk of chain bolts turning.
- Restricts the danger of chain links turning in to a minimum.
- Ensures an even movement of the chains and thus reduces noise levels.
- Reduces the chain tension due to less friction in the chain system.

Key factors when considering which lubricant to use are as follows:

- High degree of penetration in the narrowest of gaps
- Maximum tolerance of pressure and shearing forces before the lubricant film comes off.
- Suitability to the operating temperature range, especially important for cold store trucks.

You will find details of Crown approved chain oils in the Lubricant table in Chapter 1 "Lubrication & Adjustment" of this manual.

Lubrication intervals depend on the operating conditions and the environment. Trucks parked outdoors, in cold stores or which are subjected to extreme weather conditions must be lubricated more frequently.

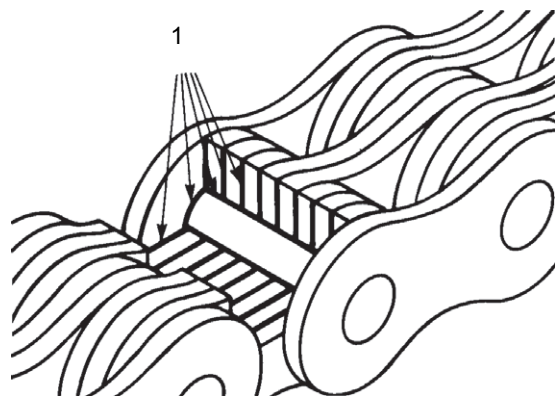
Dust will gather on oiled chains in dusty environments. However, even in these conditions, regular lubrication can considerably reduce wear.

A paste mixture of oil and dirt will gather on the chain links, but they will not wear as fast as they would if they were left to dry, leaving a metal to metal contact between the pins and plates.

NOTE

A lift chain must never be allowed to dry.

In dusty operating conditions the multi-plate chains can be more efficiently lubricated than roller chains. Multi-plate chains consist of several plates. Therefore they provide several paths for the lubricant to reach the chain bolt (see Fig. MS-3400-065) and allow the oil to penetrate to the bearing surface on the chain bolt, even when the chain is dirty.



MS-3400-065

1 Oil film

In normal operating conditions the chains should be cleaned and immediately lubricated every 100 service hours. In extreme conditions this interval must be reduced accordingly.

LIFTING MECHANISM

Separating Lift Chains



Separating Lift Chains

Lift chains are supplied by the meter and must be cut to the required length.

Tools and Equipment Required

- A secure working plate with a hole slightly larger than the head diameter of a chain bolt. The hole must be deeper than the chain bolt length.
- A bearing ring (washer) with a hole slightly larger than the head diameter of a chain bolt. The bearing ring thickness must be slightly larger than the height of the head of a chain bolt.
- A grinder.
- A hole with a diameter slightly shorter than the chain bolt and a hammer. Or a press with a suitable mandrel.

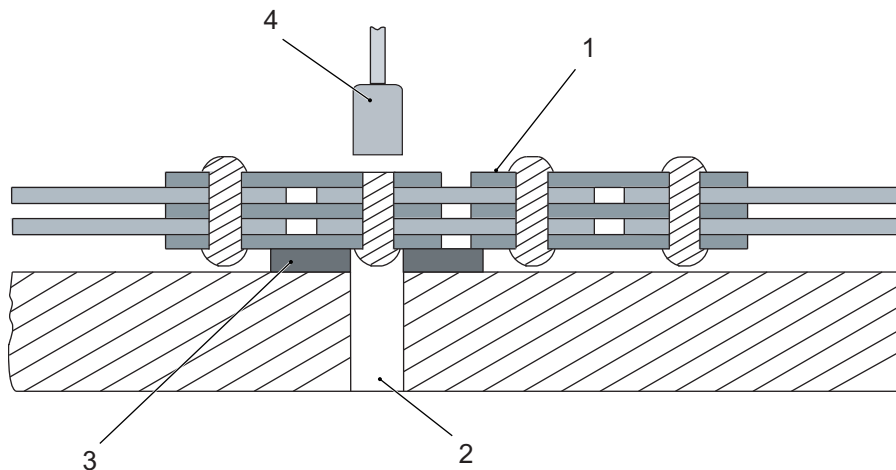
Separation



CAUTION

Wear goggles to protect your eyes.

- Carefully grind the head of the chain bolt. The inner plate surface must not be damaged.
- Place the bearing ring onto the hole in the working plate. The bearing ring prevents the inner plate surface from being damaged when you drive out the chain bolt.
- Place the head of the chain bolt to be driven out into the bearing ring.
- Make sure the chain bolt, the bearing ring and the hole are aligned in the working plate and drive the chain bolt out.



MS-3400-066

- 1 Connecting plate
- 2 Hole in working plate

- 3 Bearing ring
- 4 Grinder



LIFTING MECHANISM

Forks

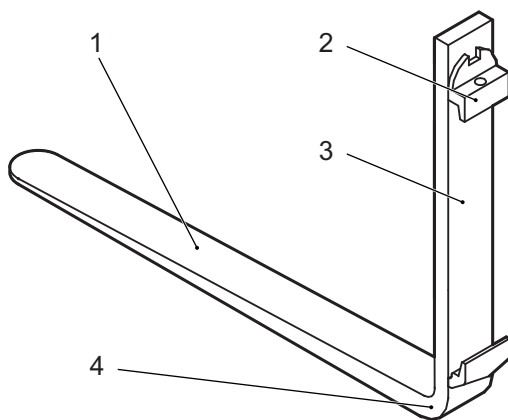
Forks

General

The fork tines and forks must be checked by trained personnel at the specified maintenance intervals (see chapter 1) for cracks, damage and wear.

If the forks are used to transport abrasive loads the inspection must be carried out at shorter intervals.

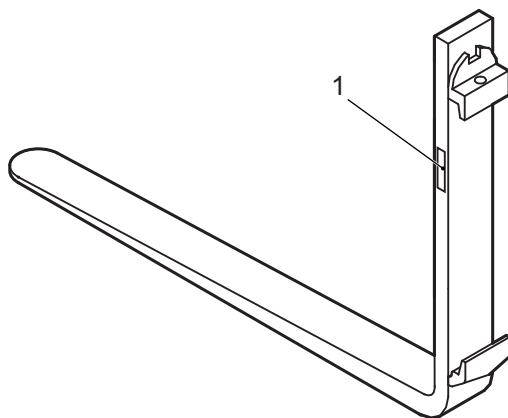
Terms



MS-3400-067

- 1 Fork blade
- 2 Fork hanger
- 3 Fork shank
- 4 Heel (curved area)

Fork identification



MS-3400-068

The marking is on the side on the fork shank (see Fig. MS-3400-068) and contains the following data:

- Capacity
- Load centre of gravity
- Manufacturing data (month / year)
- Company logo
- Manufacturing site

Repairs



DANGER

Risk of fatal injury! Never carry out repair welding to surface cracks, damaged or worn parts around the heel of the fork.

Fork repairs must only be carried out by the manufacturer / qualified personnel.

LIFTING MECHANISM

Checking the Forks



Checking the Forks



DANGER

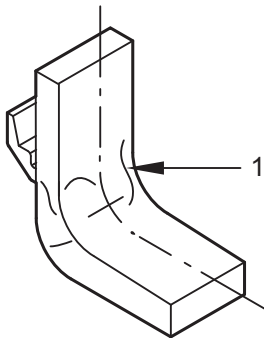
Forks showing signs of cracking, distortion or wear beyond the stated tolerance levels must be de-commissioned. They endanger the life of the operator and other people.

Crack Inspection

Inspect all fork tine surfaces for signs of cracks.

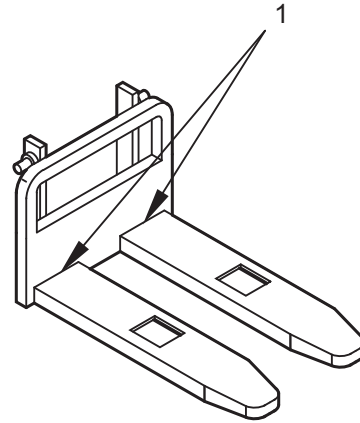
Heel area

Fatigue cracking (1, Fig. MS-3400-069) tends to occur around the heel of the forks. Check this area with particular care. If necessary carry out a non-rupturing crack test (paint penetration process or Magnaflux®).



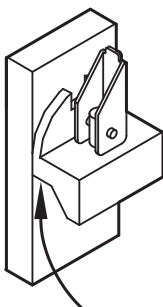
MS-3400-069

With fork over versions, check the welding seam between the fork and the fork carriage or the fork shank for cracks (1, Fig. MS-3400-071). Replace the forks if any cracking is detected.



MS-3400-071

Welding seams



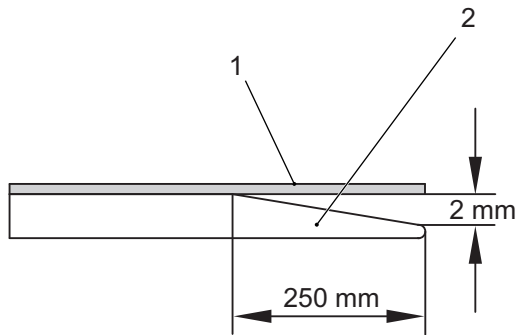
MS-3400-070

On the upper and lower fork hangers (see Fig. MS-3400-070) including their fork shank attachment, check for cracks on the welding seam. Remove the fork in question if any cracking is discovered which could affect safety.

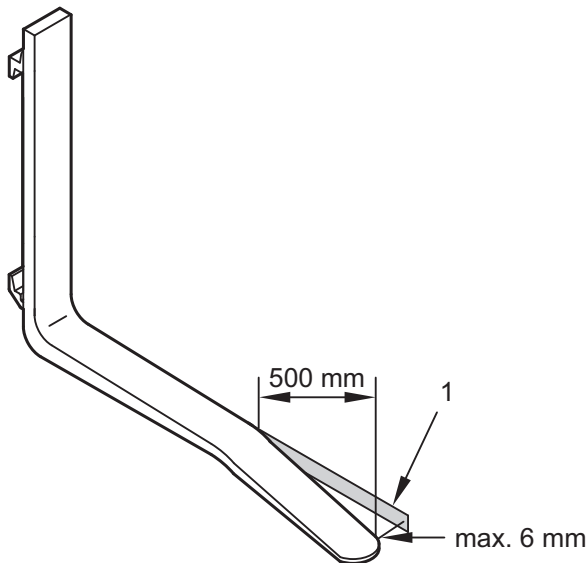
Verticality Test

(See Fig. MS-3400-072 and MS-3400-073)

Check the fork tip (2) for straightness using a ruler (1). Replace the fork if the tolerance level has been exceeded.



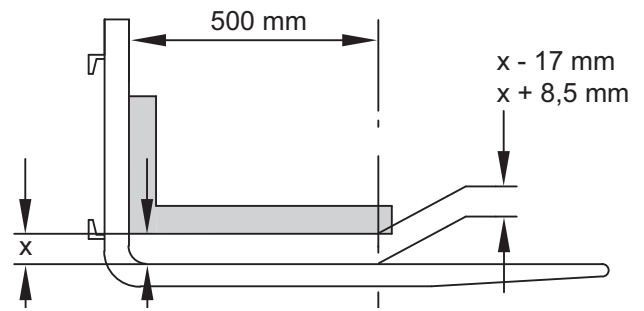
MS-3400-072



MS-3400-073

Fork Blade Warping

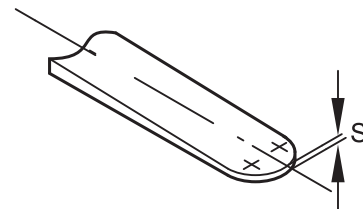
Measure the angle deflection between the top of the fork blade and the front of the fork shank (see Fig. MS-3400-074). If dimension x is outside the tolerance range, the fork must be aligned by a specialist and re-checked.



MS-3400-074

Measuring the Fork Tip Width

If the fork tip width S is less than a = 6 mm (a = fork back width) take the fork out of service (Fig. MS-3400-075).



MS-3400-075

LIFTING MECHANISM

Checking the Forks

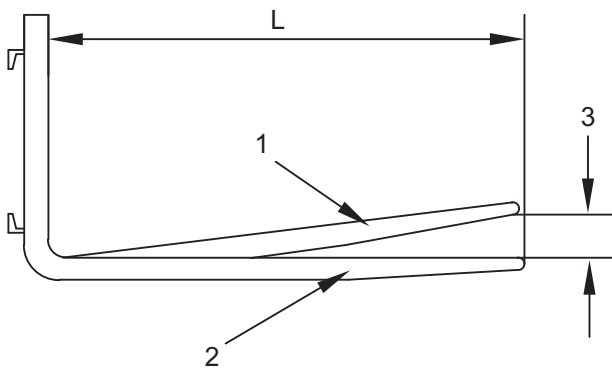


Fork Tine Height Difference

Check the height of the fork tips in relation to each other (1 and 2, Fig. MS-3400-076) if the forks are fixed to the fork carriage. If the difference is more than 3 % (3) of the fork blade length (L), the fork tines must be aligned professionally.

For example: If the length of the fork blade is 1150mm the maximum deviation is approx. 35mm.

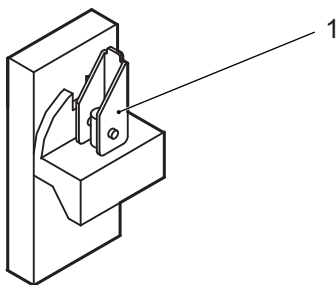
However, this would prevent the fork from working. In practice, forks must be aligned if the deviation is max. 10 mm.



MS-3400-076

Fork Stop

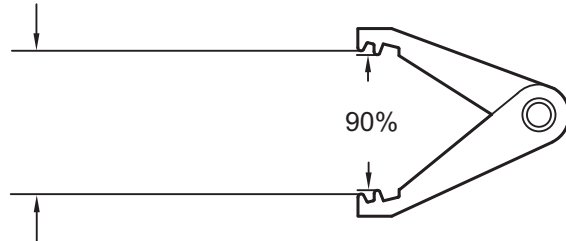
Check the stop mechanism (1, Fig. MS-3400-077) on both fork tines. The mechanism should lock securely, otherwise the fork must be taken out of service.



MS-3400-077

Fork Blade Wear

Check the fork blade for wear. The heel is particularly sensitive to wear. If the width is 90% or less than the original value, the fork must be taken out of service. For checking, use the caliper with order no. 107330.

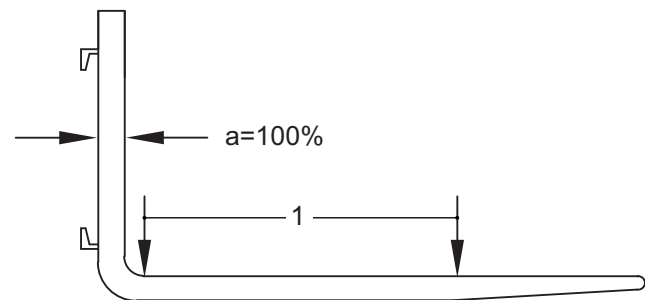


MS-3400-078

This calliper has 2 opposite tappets (see Fig. MS-3400-078). The outer tappet is used to determine the original fork blade thickness at a section with no wear. This is the fork shank. This determines the 100% value. The inner tappets correspond to 90% of the value previously obtained.

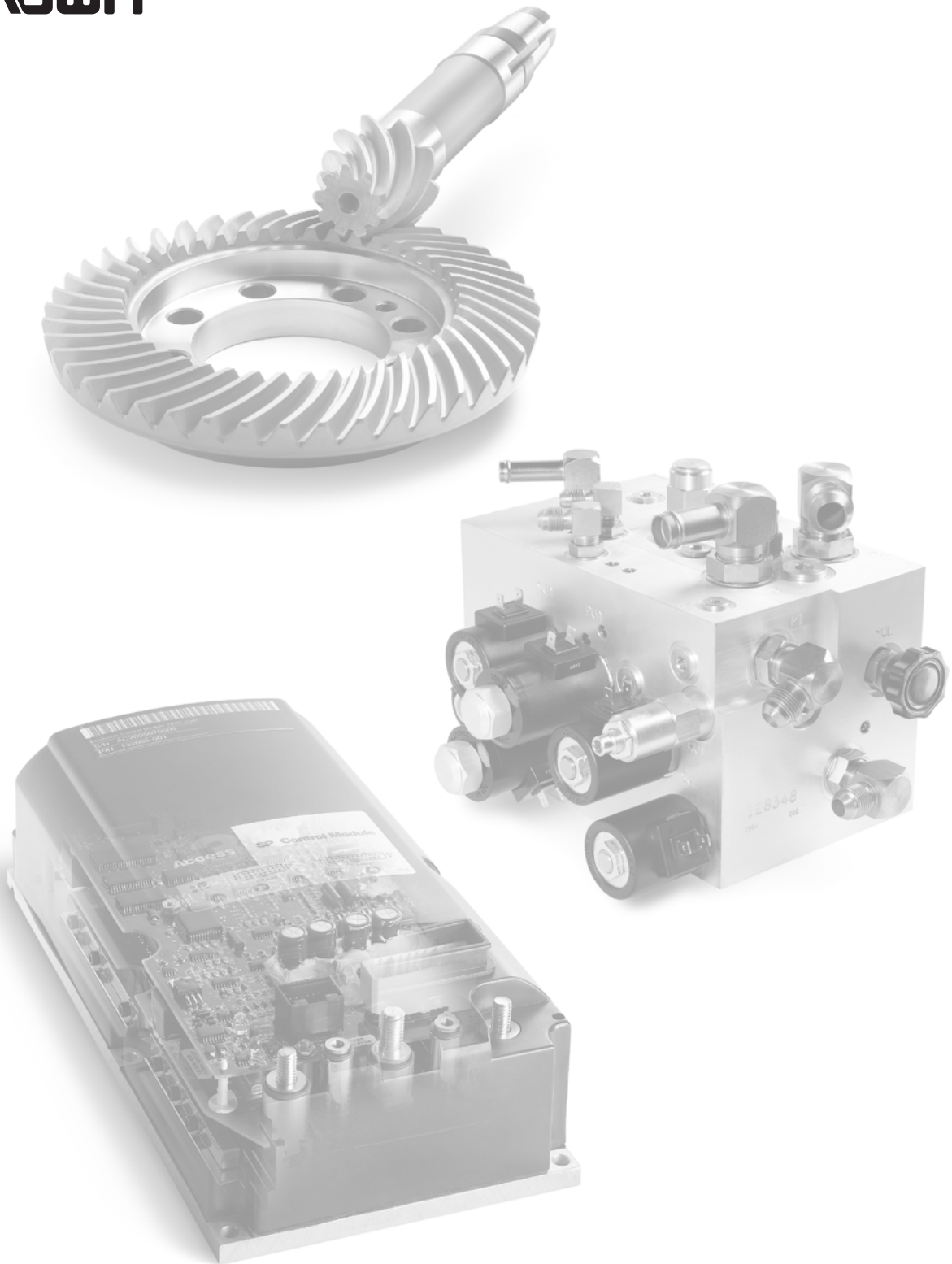
Scan the thickness of the fork shank using the outer tappets (Point a = 100 % in Fig. MS-3400-079). Fix the calliper.

Now use the inner tappets (90 %) to scan the fork blade between the shank and the start of the curved area. If the callipers fits at any point over the fork blade, then the fork is worn. Take the fork out of service.



MS-3400-079

CROWN



CYLINDERS



Notes:



CYLINDERS

Seal Assembly

Seal Assembly

General

Safety When Working on Hydraulic Systems



DANGER

Risk of serious injury from pressurized hydraulic oil.

AVOID HIGH PRESSURE FLUIDS - Escaping fluids under pressure can penetrate the skin causing serious injury. Relieve pressure before disconnecting hydraulic lines. Tighten all connections before applying pressure. Keep hands and body away from pin holes which eject fluids under high pressure. Use a piece of cardboard or paper to search for leaks. Do not use your hand.

Any fluid injected into the skin under high pressure should be considered as a serious medical emergency despite an initial normal appearance of the skin. There is a delayed onset of pain, and serious tissue damage may occur. Medical attention should be sought immediately by a specialist who has had experience with this type of injury.

General Instructions for Repairing Hydraulic Components

Hydraulic systems are sensitive to dirt.

- Thoroughly clean any hydraulic components you have removed before dismantling them and placing them on a workbench.
- Always repair hydraulic components in a clean working environment.
- Immediately protect cleaned and de-greased components with a thin coating of hydraulic oil. Use the same grade as is used in the truck.
- Protect all components from re-contaminating until they are installed again.
- Immediately seal any open hydraulic ports on repaired assemblies with filler plugs. This also applies to the open ports and lines on the truck when you remove any hydraulic components.

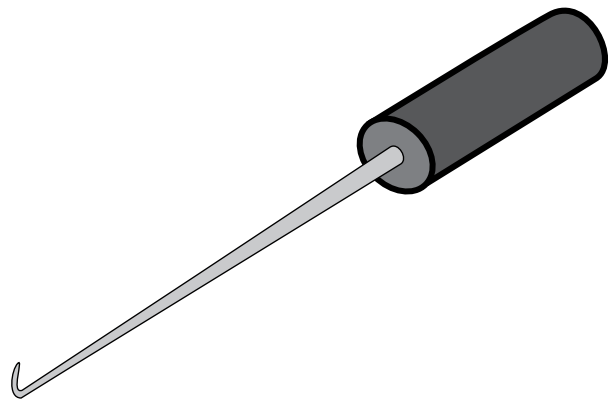
- Do not refinish any cylinder surfaces. Replace any damaged components.
- When carrying out repairs always replace all the seals in the assembly. Never recycle seals which have already been used.

Rod Seal Assembly

General

All tools and equipment used for rod seals must be burr-free and not have sharp edges. The tools should be made either of soft metal (aluminium, brass) or a suitable plastic.

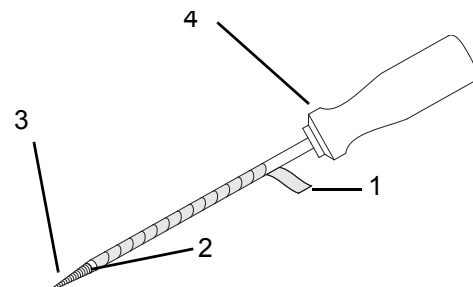
Do not use hooks to remove seals. The same rule applies: Burr-free, rounded tips and made of soft metal to avoid damaging the seal seat.



MS-2232-013

Screwdrivers or similar tools will damage the seal seats and the seals. This will result in leaks.

To remove rod seals from the lift cylinder and the free-lift cylinder, you will require 2 specially produced tools (see Figure MS-2232-016).



MS-2232-016

CYLINDERS

Seal Assembly



- 1 Tape
- 2 Hard-soldered screw. Soldering joint sanded.
- 3 4 mm self-tapping screw
- 4 Screwdriver, shaft min. 150 mm long, max. 4 mm

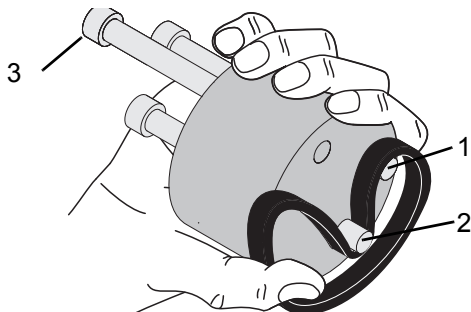
If the seal has to be pushed over sharp edges, cracks or nicks, use appropriate protective devices.

We will now demonstrate 2 procedures – depending on the seal rod diameter – for ensuring safe assembly.

Large Rod Seal Assembly

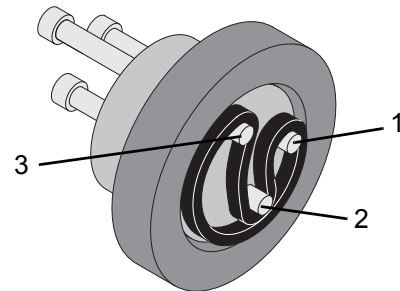
Tools required:

- Tool body (outer diameter must fit the internal diameter of the cylinder cap).
- Three pins (1, 2 and 3). Pin (1) is fixed; pins (2) and (3) are moveable.
- Assembly:
- Apply a thin coating of hydraulic oil to the rod seal and the seal seat in the cylinder cap.
- Place the rod seal over the fixed pin (1).
- Bend the rod seal under pin (2) (see Fig. MS-2232-019).



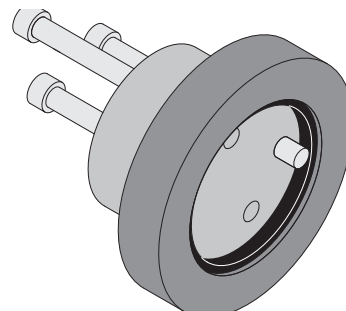
MS-2232-019

- Bend the loop created in this way so far up that pin (3) can be pushed into the loop.
- Now push the tool body into the cylinder cap until the rod seal is aligned with the seal seat (see Fig. MS-2232-020).



MS-2232-020

- Pull back pin (3). One segment of the rod seal jumps into the seal seat.
- Now pull back pin (2). The rod seal is now fully seated in the seal seat.



MS-2232-021

- Pull the tool body out of the cylinder cap.

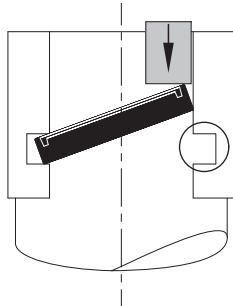
Small Seal Rod Assembly

Tools required:

Groove aligning arbor. The outer diameter must fit the internal diameter of the cylinder cap. The arbor should end at the bottom of the seal seat.

Arbor to drive in the seal.

- Apply a thin coating of hydraulic oil to the rod seal and the seal seat in the cylinder cap.
- Place the cylinder cap onto the groove aligning arbor.
- Gently squeeze the rod seal together.
- Place the rod seal at one point of the seal seat.
- Press the rod seal and the arbor into the seal seat.

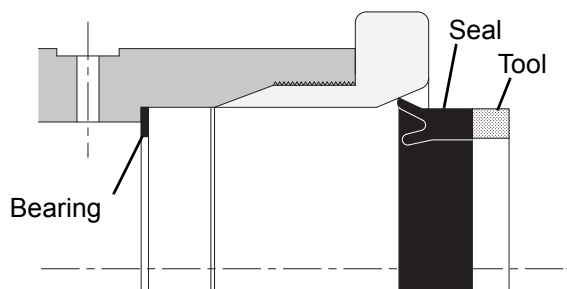


MS-2232-024

Rod Seal Assembly, Sealing Lip First

The sealing lip is sensitive and must not be damaged. You therefore require special protective sleeves when pushing the seal over the thread and holes.

Sealing lip assembly direction: Always to the pressure side.



MS-2232-025

CYLINDERS

Cylinder Removal and Assembly



Cylinder Removal and Assembly

Great care and cleanliness should be exercised in the disassembly and assembly of any hydraulic cylinder. Wipe all surfaces clean of dirt and oil before attempting disassembly. Care should be taken when removing the ram from the cylinder. Once disassembly is complete, wash all metallic parts in solvent and blow dry with clean compressed air. Carefully inspect the ram assembly and cylinder bore. Replace if scored, grooved, pitted or worn. Minor damage to the cylinder bore can be removed with the use of a hydraulic cylinder honing tool. Place washed components in a clean container until reassembly.



DANGER

High pressure hydraulic oil can cause serious injuries.

De-pressurise all components before carrying out maintenance work on the hydraulic system.

When repairing the hydraulic system always wear protective clothing, goggles and gloves.

Whenever a high pressure fluid enters the skin it must be treated as an emergency, even if the skin initially shows no reaction.

Physical effects may take time to set in. Secure all ports before re-applying system pressure. Keep hands and body away from any ports as high pressure hydraulic oil can emerge.

Use absorbent paper to trace leaks, never use your hands!

TL Mast Lift Cylinder

Seal Replacement

When excessive hydraulic oil is evident on the cylinder, where the piston rod exits the cap, one or more of the seals are bad and need replaced. It is recommended that all the seals in the cylinder be replaced whenever a cylinder is removed and disassembled for seal replacement. Follow the procedure outlined below to remove cylinders and replace seals.

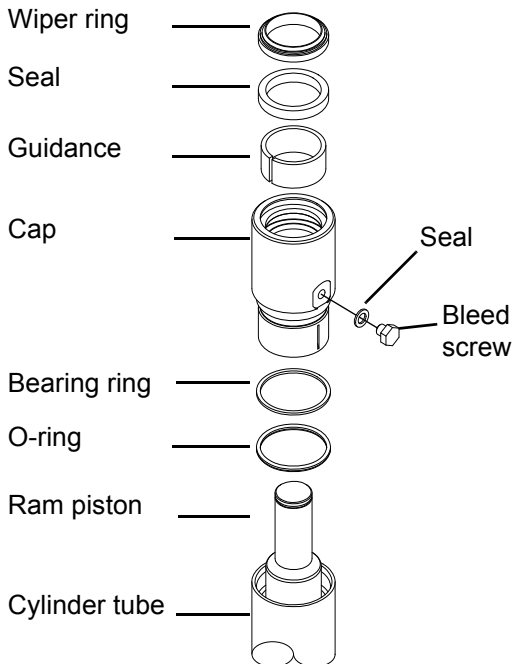
- Turn the key switch OFF. Remove the key and disconnect the battery.

- Attach warning tag to control handle to advise others that the truck is being serviced.
- Chock drive tire and outrigger load wheels.
- Remove R.H. cylinder cover from bottom of outer mast.
- Disconnect the hydraulic supply line to the R.H. mast lift cylinder. Seal connections to minimize oil loss and prevent hydraulic system contamination.
- Remove retaining ring and shims from the top of the R.H. mast lift cylinder.
- Before removing the R.H. cylinder bracket from outer mast, secure the cylinder to the mast to prevent it from falling when the bracket is removed and the mast is raised. Make certain the device used to secure the cylinder is capable of withstanding the weight of the cylinder. Then remove the R.H. cylinder bracket from the outer mast.
- Repeat the previous steps on the L.H. side, if that cylinder is being removed for seal replacement.
- Attach a lifting device to the inside of the mast. Now raise the mast and install the lift cylinder(s).
- Lower mast to collapsed height.
- Remove cap from cylinder tube.



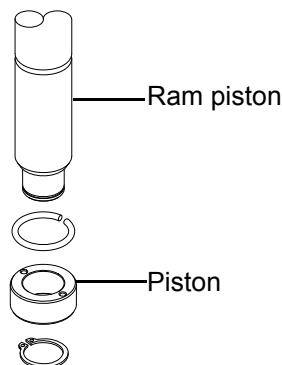
CYLINDERS

Cylinder Removal and Assembly



11103

- Remove bleed screw from cap. Then remove seal from bleed screw and discard seal.



11104

- Remove wiper, seal, guide, backring and o-ring from cap and discard.
- Carefully remove ram from cylinder tube. Do not allow ram to come in contact with any sharp edges.
- Remove retaining rings and piston from ram. Discard piston.
- Inspect contact surfaces on the ram and cylinder cap. If slight scoring is present, sand with fine em-

ery paper until all high surfaces have been removed. Heavily scored components must be replaced. After all parts have been disassembled and inspected, thoroughly wash all metal parts and blow dry with clean compressed air.

- Apply a thin layer of hydraulic oil to all the seals to be fitted.
- Install retaining ring in groove on ram. Then install new piston on bottom of ram and secure it with retaining ring previously removed.
- Install ram in cylinder tube. Use care when installing ram to avoid contact with sharp edges. Make certain ram is properly seated in tube.
- Install new wiper, seal, guide, backring and o-ring in cap. Use care when installing to avoid nicking the components.
- Install new seal on bleed screw. Then install bleed screw in cap and tighten securely.
- Install cap on cylinder tube and tighten securely. Use care when installing cap to prevent sharp edges from damaging the new seals.
- Install mast lift cylinders following procedure outlined under "Installing TL Mast Lift Cylinders."

Installing TL Mast Lift Cylinders

- Attach lifting device to the inside of the mast. Now raise the mast and install the R.H. lift cylinder. Install R.H. cylinder bracket and tighten screws securely to secure cylinder to mast. Repeat this step, if necessary, on L.H. cylinder.
- Carefully lower mast and align ram(s) with mounting hole(s) in mast. Continue lowering mast to collapsed height.

NOTE

1 shim must always be fitted on TL masts. Otherwise the mast will drop too far.

- Install shims and retaining rings at top of ram(s). Make certain the shims are installed in their original location. For correct shimming see "Secondary Cylinder Shim".
- Connect hydraulic line(s) to mast lift cylinder(s) and tighten securely.

CYLINDERS

Cylinder Removal and Assembly



- Install cylinder cover(s) on mast and tighten mounting screws securely.
- Remove lifting device from mast.
- Remove chocks.
- Connect battery and remove warning tag from the control handle.

TF Mast Lift Cylinders

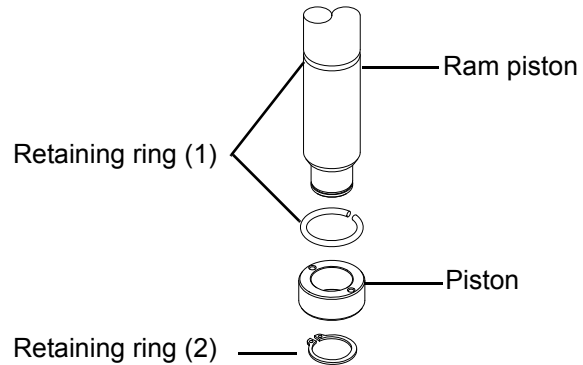
Removing the TF Mast Lift Cylinders

When excessive hydraulic oil is evident on the cylinder, where the ram exits the cap, one or more of the seals are bad and need to be replaced. The small rod diameter means that individual seals cannot be replaced in the field. For this reason, only pre-assembled caps are available as a spare part.

- Turn the key switch OFF. Remove the key and disconnect the battery.
- Attach warning tag to control handle to advise others that the truck is being serviced.
- Chock drive tire and outrigger load wheels.
- Remove cylinder cover from bottom of outer mast.
- Disconnect the hydraulic supply line to the mast lift cylinder. Seal connections to minimize oil loss and prevent hydraulic system contamination.
- Remove retaining ring and shims from the top of the mast lift cylinder.
- Before removing the cylinder bracket from outer mast, secure the cylinder to the mast to prevent it from falling when the bracket is removed and the mast is raised. Make certain the device used to secure the cylinder is capable of withstanding the weight of the cylinder. Then remove the cylinder bracket from the outer mast.
- Attach lifting device to the mast. Now raise the mast and install the lift cylinder(s).
- Lower mast to collapsed height.
- Air that may have entered the system must be bled from the system. Follow the appropriate procedure outlined under "Cylinder Bleeding and Flushing".

- Carry out a drift test. See "Drift Test".

Seal replacement



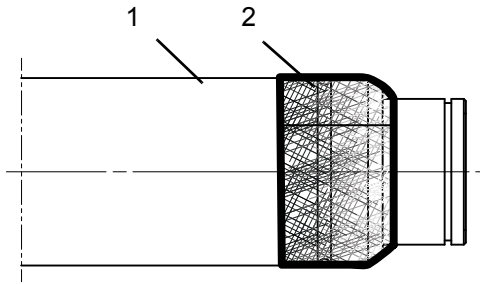
11104

- Loosen the cap and unscrew it from the cylinder tube.
- Pull the cylinder pipe down from off the ram.
- Remove the retaining ring (1) from the piston rod and discard it. The retaining ring must be replaced on assembly.
- Pull down the cap over the ram.
- Remove bleed screw from cap. Then remove seal from bleed screw and discard seal.
- Remove wiper, seal, guide, backring and o-ring from cap and discard.
- Remove the retaining ring (2) and piston from ram. Discard piston.
- Inspect contact surfaces on the ram and cylinder cap. If scoring is present, the ram must be replaced. Wash all metal components with a suitable solvent and dry them with dry, clean compressed air.
- Apply a thin layer of hydraulic oil to all the seals to be fitted.
- Install new wiper, seal, guide, backring and o-ring in cap. Use care when installing to avoid damaging the components.



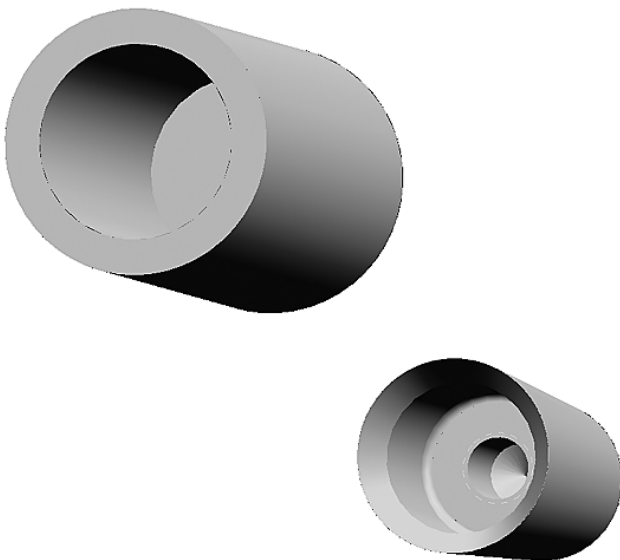
CYLINDERS

Cylinder Removal and Assembly



MS-3300-034

- Install new seal on bleed screw. Then install bleed screw in cap and torque to 5 – 6 Nm.
- Secure the groove in the ram (1) with wide PVC insulating tape. The tap must overlap the neck.



MS-3300-035

- Apply a thin layer of hydraulic oil to the ram and carefully push the cap up onto the ram.
- Remove the insulating tape without any remains.

NOTE

The retaining ring (1, Fig. 11104) must only be fitted with special tool, part no. 814743. The use of any other tools such as pliers etc. will permanently damage the retaining ring as well as damaging the cylinder pipe wall.

- Using the special tool part number 814743 (Fig. MS-3300-035) install a new retaining ring part number 811267 in the groove of the ram.
- Then install a new piston on the bottom of the ram and secure it with the retaining ring previously removed (2, Fig. 11104).
- Apply a thin layer of hydraulic oil to the ram.
- Carefully push the cylinder tube over the piston onto the ram.
- Screw the cap onto the cylinder tube and torque to 120 - 140 Nm.
- Install mast lift cylinders following procedure outlined under "Installing TF Mast Lift Cylinders."

Installing TF Mast Lift Cylinders

- Attach lifting device to the mast. Now raise the mast and install the lift cylinder. Install cylinder bracket and tighten screws securely to secure cylinder to mast. Repeat this step, if necessary, on the other cylinder.
- Carefully lower mast and align ram(s) with mounting hole(s) in mast. Continue lowering mast to collapsed height.
- Install shims and retaining rings at top of ram(s). Make certain the shims are installed in their original location. For correct shimming see "Secondary Cylinder Shim".
- Connect hydraulic line(s) to mast lift cylinder(s) and tighten securely.
- The cylinder covers also act as the buckle supports for the cylinders. It is therefore essential to observe the following installation procedure.
 - Mount the cylinder covers and manually tighten the screws.
 - Extend the lift cylinder by approx. 50mm to ensure good positioning in the receptacles.
 - Bring the cylinder covers into contact with the cylinder pipes.
 - Tighten the mounting screws.
- Remove lifting device from mast.
- Remove chocks.

CYLINDERS

Cylinder Removal and Assembly



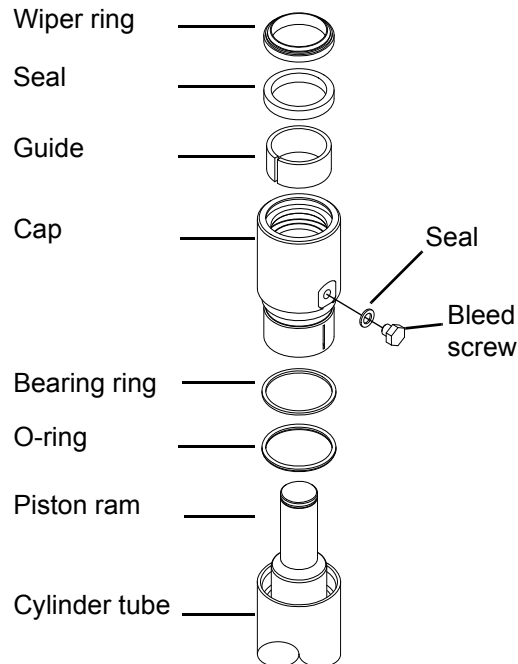
- Connect battery and remove warning tag from the control handle.
- Air that may have entered the system must be bled from the system. Follow the appropriate procedure outlined under "Cylinder Bleeding and Flushing".
- Carry out a drift test. See "Drift Test".

TF Free Lift Cylinder

Seal replacement

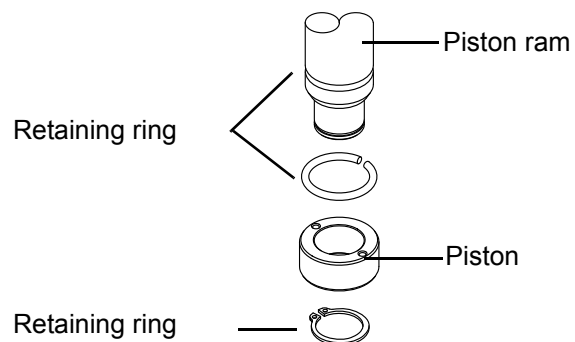
When excessive hydraulic oil is evident on the cylinder, where the ram exits the cap, one or more of the seals are bad and need to be replaced. It is recommended that all the seals in the cylinder be replaced whenever the cylinder is removed and disassembled for seal replacement. Follow the procedure outlined below to remove cylinder and replace seals.

- Turn the key switch OFF. Remove the key and disconnect the battery.
- Attach warning tag to control handle to advise others that the truck is being serviced.
- Chock drive tire and outrigger load wheels.
- Remove forks.
- Using a lifting device, raise fork carriage until lift chains are slack. Then place wood blocks under each side of carriage and lower carriage onto blocks.
- Disconnect hydraulic line to fork carriage cylinder. Seal connections to minimize oil loss and prevent hydraulic system contamination.
- Disconnect lift chain from tensioner on fork carriage and pull chain through yoke assembly.
- Remove screws that secure the free lift cylinder to inner mast and carefully remove the cylinder. Make certain to save shims that were between mast and free lift cylinder.
- Remove retaining ring used to secure yoke assembly to the free lift cylinder piston rod. Then remove yoke assembly.



11105

- Remove cap from cylinder tube.
- Remove bleed screw from cap. Then remove seal from bleed screw and discard seal.



11106

- Remove wiper, seal, guide, backring and o-ring from cap and discard.
- Carefully remove ram from cylinder tube. Do not allow ram to come in contact with any sharp edges.
- Remove retaining rings and piston from ram. Discard piston.



CYLINDERS

Cylinder Removal and Assembly

- Inspect contact surfaces on the ram and cylinder cap. Heavily scored components must be replaced. After all parts have been disassembled and inspected, thoroughly wash all metal parts and blow dry with clean compressed air.
- Apply a thin layer of hydraulic oil to all the seals to be fitted.
- Install retaining ring in groove on ram. Then install new piston on bottom of ram and secure it with retaining ring previously removed.
- Install ram in cylinder tube. Use care when installing ram to avoid contact with sharp edges. Make certain ram is properly seated in tube.
- Install new wiper, seal, guide, backring and o-ring in cap. Use care when installing to avoid nicking the components.
- Install new seal on bleed screw. Then install bleed screw in cap and tighten securely.
- Install cap on cylinder tube and tighten securely. Use care when installing cap to prevent sharp edges from damaging the new seals.

Installing Carriage Cylinder

- Install free lift cylinder and secure it to inner mast using screws and shims previously removed. Tighten screws securely. For correct shimming see "Free Lift Cylinder Shims".
- Install yoke assembly on ram and secure it with retaining ring previously removed.
- Insert lifting chain through yoke assembly and connect chain to tensioner in fork carriage. Make certain chain is not twisted.
- Connect hydraulic supply line to free lift cylinder and tighten connections securely.
- Using lifting device, raise fork carriage and remove blocks from under carriage. Then lower carriage completely and remove lifting device.
- Install forks.
- Remove chocks.
- Connect battery and remove warning tag from the control handle.

- Air that may have entered the system must be bled from the system. Follow the appropriate procedure outlined under "Cylinder Bleeding and Flushing".
- Carry out a drift test. See "Drift Test".

Cylinder Bleeding and Flushing

Hydraulic circuits need to be flushed after repair of lift cylinders and bled of all air. Before bleeding and flushing, all hydraulic ports must be checked for leaks. In addition you must ensure that all filters, where applicable, are fitted and that there is sufficient hydraulic fluid in the reservoir for flushing and bleeding. Hydraulic system must be pressurized during the flushing and bleeding procedures.

Bleeding - Mast Lift Cylinders

- Slowly raise forks to approximately 1220 mm (4 ft.).
- Slowly open R.H. mast lift cylinder bleed screw and bleed air from cylinder until a solid stream of hydraulic fluid flows out of bleed screw hole. Tighten bleed screw securely.
- Repeat steps 1 and 2 on the L.H. mast lift cylinder.
- Flush cylinders following procedure outlined below.

Bleeding - Free Lift Cylinder (if applicable)

- Slowly elevate carriage in free lift to approximately 1220 mm (4 ft.).
- Slowly open fork carriage cylinder bleed screw and bleed air from cylinder until a solid stream of hydraulic fluid flows out of bleed screw hole.
- Tighten bleed screw securely.
- Flush cylinder following procedure outlined below.

Flushing – Mast Lift Cylinders and Free Lift Cylinders (if applicable)

- Raise the forks to lift the fork carriage beyond the free lift height.
- With carriage raised, visually inspect cylinders for any leaks.

CYLINDERS

Cylinder Removal and Assembly



- Actuate control valve to lower carriage through stage and free lift while visually checking operation and staging.
- Raise and lower carriage rapidly for a minimum of 10 cycles to flush system.

Drift Test

All drift tests should be conducted with a capacity load (refer to capacity plate for the rated capacity of your truck). The material used for the test load must be evenly stacked within the limits of a four foot square pallet and must be secured to the fork carriage with the forks spread to their maximum width.



CAUTION

Never stand or work under a suspended load

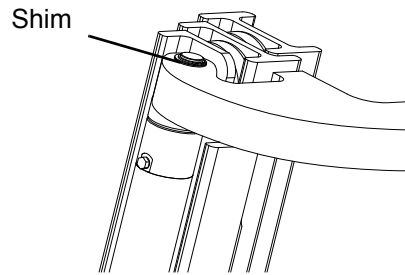
Fully extend the mast with maximum rated load. The load may not drift down more than 50 mm within 5 minutes.

Occasionally internal leaks in the cylinder may cause the fork assembly to lower slowly. However, this may also be due to leaks in the check valves, pilot valves etc. In this case flush the system by raising and lowering the fork carriage several times to remove any foreign bodies from the valve seats. Then repeat the drift test.

Cylinder Shimming

Lift Cylinder Shims

- Add as many shims (Fig. M8 3130-001) between the retaining ring on the top of the lift cylinder and top brace of the inner mast as possible. At fully extended mast the cylinder bottom shall not lift up from its seat. Should this happen, remove a equivalent quantity of shims.

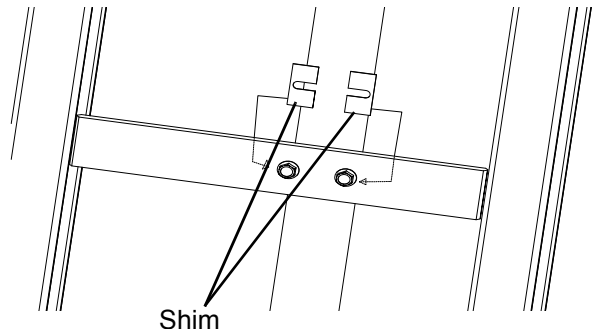


M8-3130-001

- Adjust side plates so, that there is no rattling of the side cylinders during driving/lifting.

Free Lift Cylinder Shims

- The free lift cylinder can be adjusted so that its installation angle can be set correctly. This is done by adding shims between the cylinder and the middle cross brace of the inner mast. (Figure M8-3130-002)



M8-3130-002

- In general, 2 shims 811812 must be used. Add or remove shims as required so that the free lift cylinder is vertically aligned. The chain should have a min. distance to the fork carriage of 3mm when passing the yoke.
- The cylinder bottom always must have fully contact with the lower cylinder mount of the inner mast. This can be adjusted with the cylinder fixing screws and the slotted holes of the mid cross brace of the inner mast.



CYLINDERS

Cylinder Removal and Assembly

HYDRAULIC CYLINDERS

General

All the cylinders used on the mast are plunger cylinders.

When the forks are raised the lift cylinder with the larger cross-section operates first, as the operation takes place at low pressure.

All lift cylinders are fitted with lowering restrictor throttles which prevent the mast from suddenly lowering in the event of a line break. Throttle valves in the valve manifold control the lowering speed.



CAUTION

Observe the safety regulations when handling hydraulic oil.

Pay particular attention when working on hydraulic cylinders. All work surfaces must be free of dirt and oil. Check the seals and seal surfaces carefully before assembling. Remove any nicks and damage to edges over which the seals pass. Apply a thin coating of acid-free oil to the seals before assembly.

Simplex mast cylinder

Removal

1. Secure the truck to prevent it from rolling away
2. Remove power by disconnecting the battery.
3. Remove the battery
4. Attach a suitable lifting device to the centre of the inner mast.
5. Remove the hydraulic line through the frame opening in the battery compartment.
6. Seal the connections.
7. Rebound the retaining ring on the piston rod
8. Raise the inner mast until the cylinder is clear.
9. Remove the two mounting screws from the cylinder bracket and lift the cylinder out of the bottom support.

Lift Cylinder

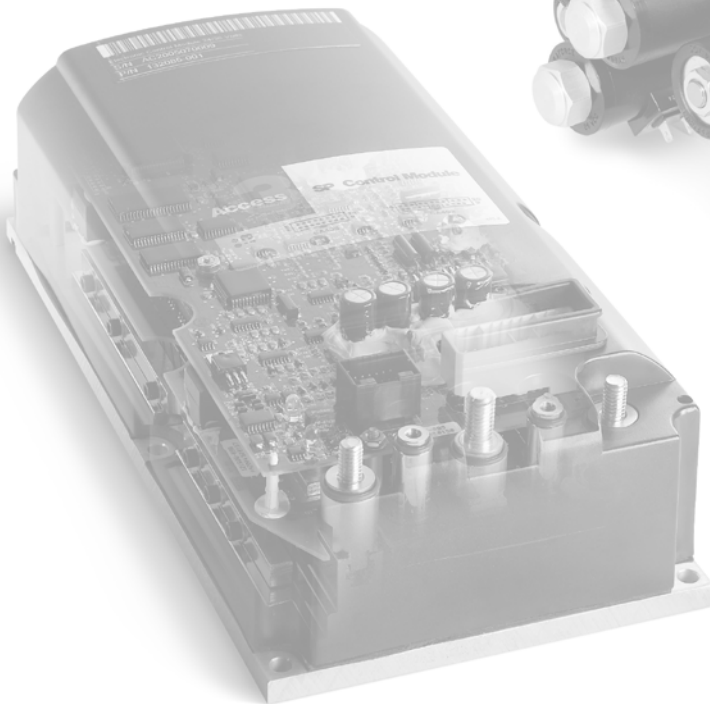
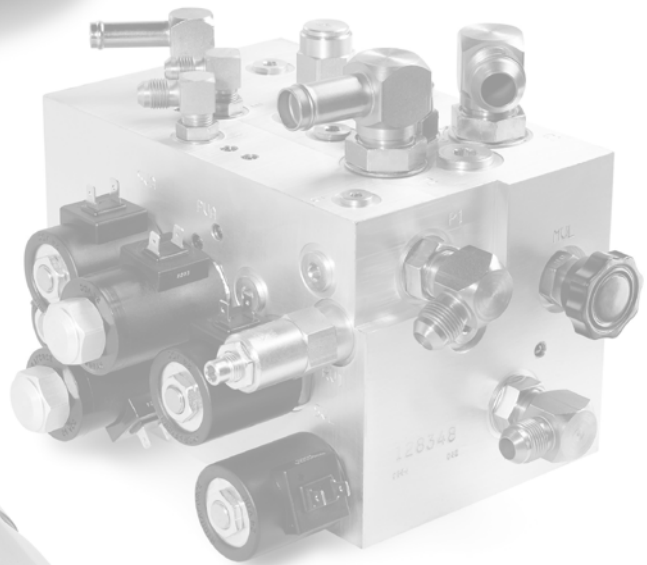
Removal

- 1 Prevent the truck from rolling away.
- 2 Fully lower the truck.
- 3 Remove power by disconnecting the battery.
- 4 Prepare a suitable collecting basin.
- 5 Remove the hydraulic line from the lift cylinder and seal the ports.
- 6 Raise the fork carriage slightly until the lift chain is discharged and support the fork carriage.
- 7 Remove the lift chain from the fork carriage and guide it over the pulley.
- 8 Remove the mounting screws from the retaining clamp.
- 9 Lift the lift cylinder out of the centring hole.
- 10 Remove the pulley from the lift cylinder.



Notes:

CROWN



PLATFORM



Notes:



PLATFORM

Folding Platform

Folding Platform

Mechanical Adjustment

(see Fig. MS-4223-035)



WARNING

Safety-critical setting The platform should always fold up when the driver exits.

Up to serial no. 5A132186

The platform switch is actuated and the maximum travel speed reduced.

From serial no. 5A132188

The platform switch is actuated and travel is deacti-

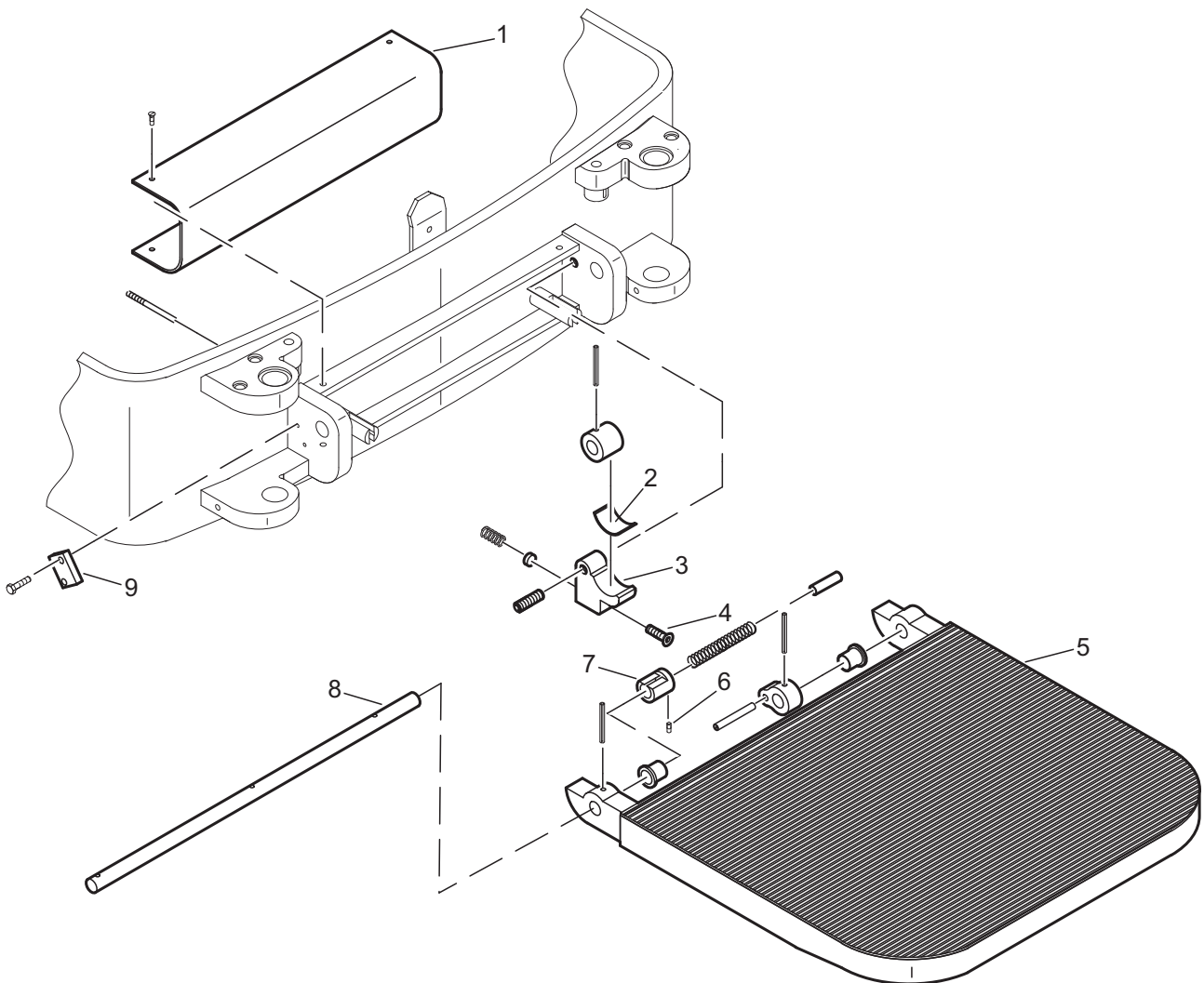
vated to No Drive Mode (platform logic module) or maximum speed is reduced to walkie mode (platform logic module), depending on position of the side restraints.

- Remove the panel (1).

NOTE

The brake arm (3) and the brake lining (2) brake the platform (5) when it folds up. Adjust the braking pattern so that the platform will automatically fold up, albeit still cushioned, from any position. The critical point is at a platform angle of approx. 45° above the horizontal.

- Turn the screw (4) in to increase the friction, and turn it out to decrease the friction.



MS-4223-035

PLATFORM

Folding Platform



Adjusting the Platform Switch (PLS)

This switch transmits a signal to the traction controller. The traction controller switches to a higher, maximum speed for platform mode if the platform is tilted down.

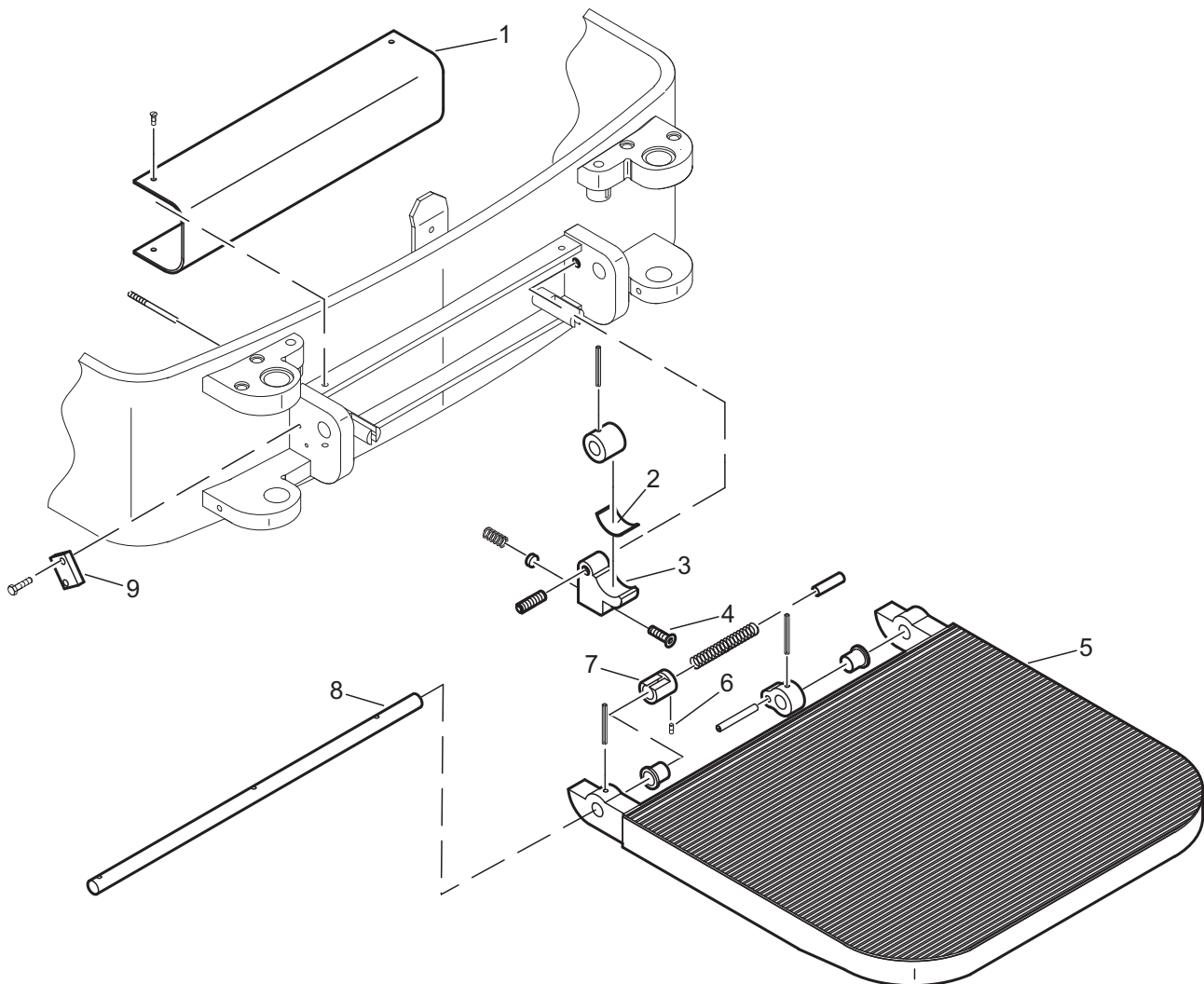
The adjusting ring (7) actuates the switch lever of the platform switch (9). A screw (6) secures the adjusting ring to the shaft (8) to prevent it from twisting.



WARNING

Safety-critical setting. The platform should always fold up when the driver exits. The PLS should apply within 10°.

- Remove the panel (1).
- Loosen the screw (6).
- When the platform is fully lowered turn the adjusting ring (7) until it actuates the switch. Actuation of the switch should take place between 0° (fully lowered platform) and max. 10° raised platform. The switch should not be actuated above 10°.
- Tighten the screw (6) again and check the setting.



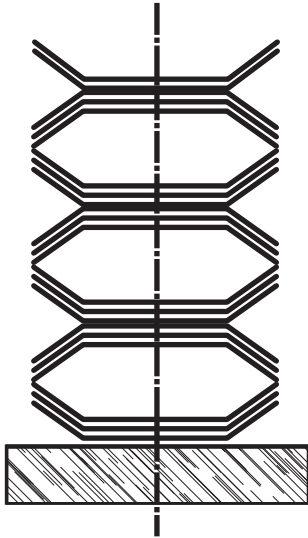
MS-4223-035

Platform Cushioning

Layering the disk springs

(see Fig. MS17-101)

You can ensure maximum operational lift and spring qualities of the platform by layering the disk springs in 6 packets of 3 springs and one of 2 springs.



MS17-101

Side restraint

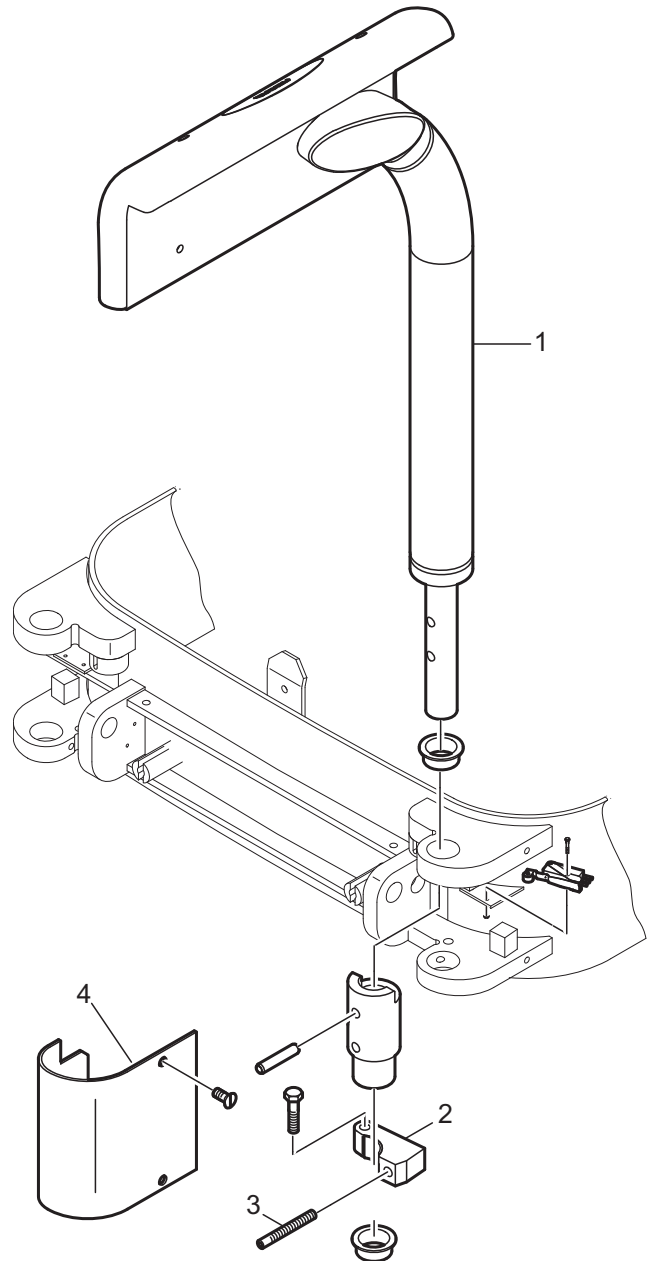
Mechanical Adjustment

The brake (2) setting determines the force required to fold the side restraint (1) in and out.

NOTE

Adjust the brake so that the restraints can be moved with medium force.

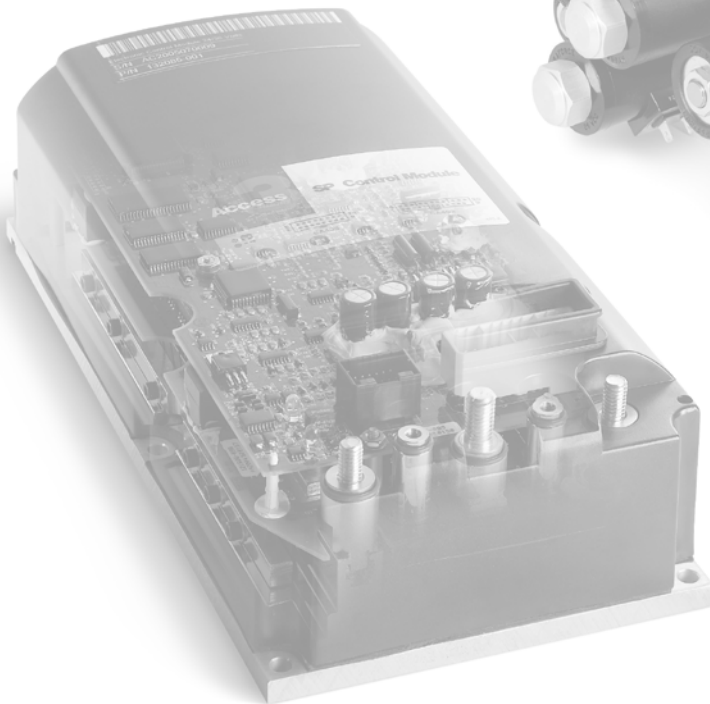
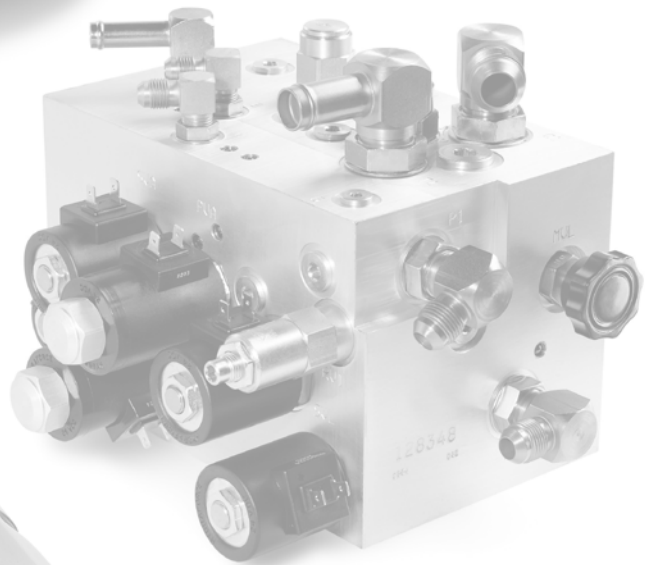
- Remove the panel (4).
- Turn the screw (3) in to increase the necessary force, and turn it out to decrease the force.



M1546



Notes:



SCHEMATIC DIAGRAMS



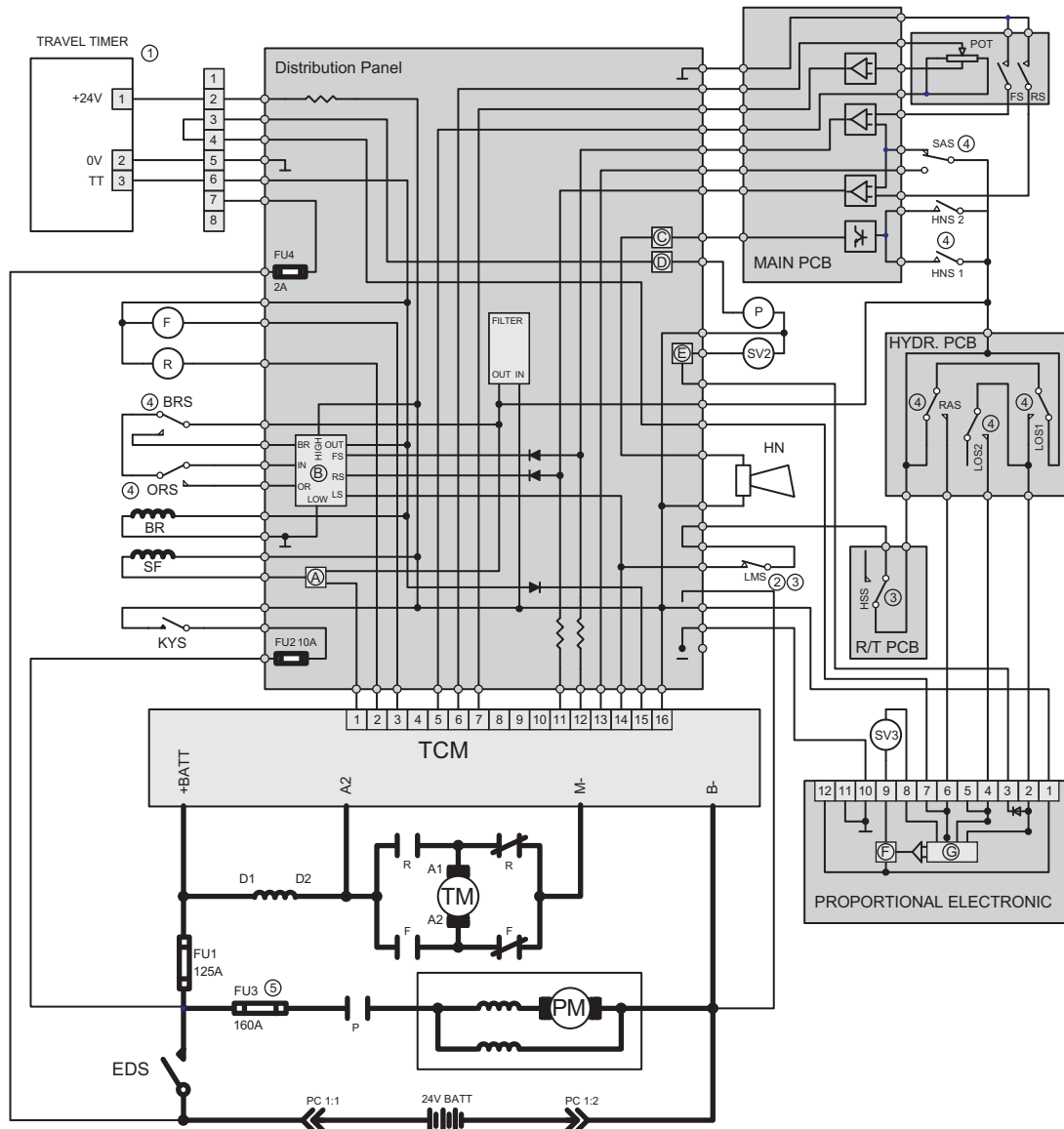
Notes:



SCHEMATIC DIAGRAMS

WE / WS up to serial no. 5A132186

Schematic Diagram, Standard



813488_2C_1

For key refer to following page

SCHEMATIC DIAGRAMS

WE / WS up to serial no. 5A132186



Key to Fig. 813488_2C_1 (see page 217)

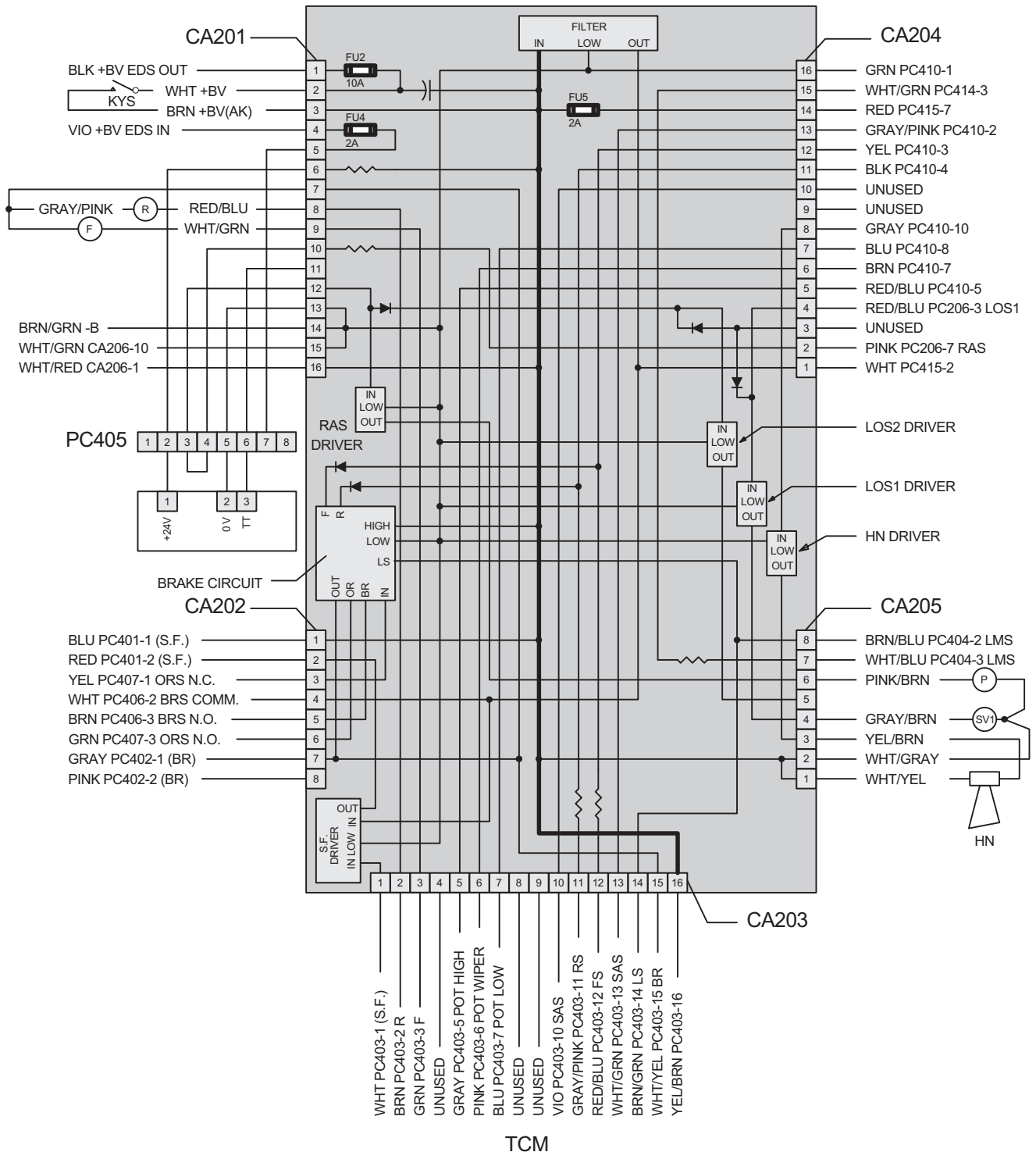
- | | | | |
|------|--|---|---|
| 1 | Travel Timer | 2 | Forks higher than 250 - 2300 mm (depends on mast type):
LMS open |
| 3 | Reduced speed: HSS and / or LMS open | 4 | Active: RAS, BRS, ORS, SAS, HNS, LOS1 & LOS2 are
closed |
| 5 | For North American truck only: FU3 = 125 A | | |
|
 | | | |
| A | Shunt Field Driver | B | Brake Circuit |
| C | Horn Driver | D | RAS Driver |
| E | LOS1 Driver | F | Proportional Driver |
| G | PWM Logic | | |



SCHEMATIC DIAGRAMS

WE / WS up to serial no. 5A132186

Distribution Panel, Standard



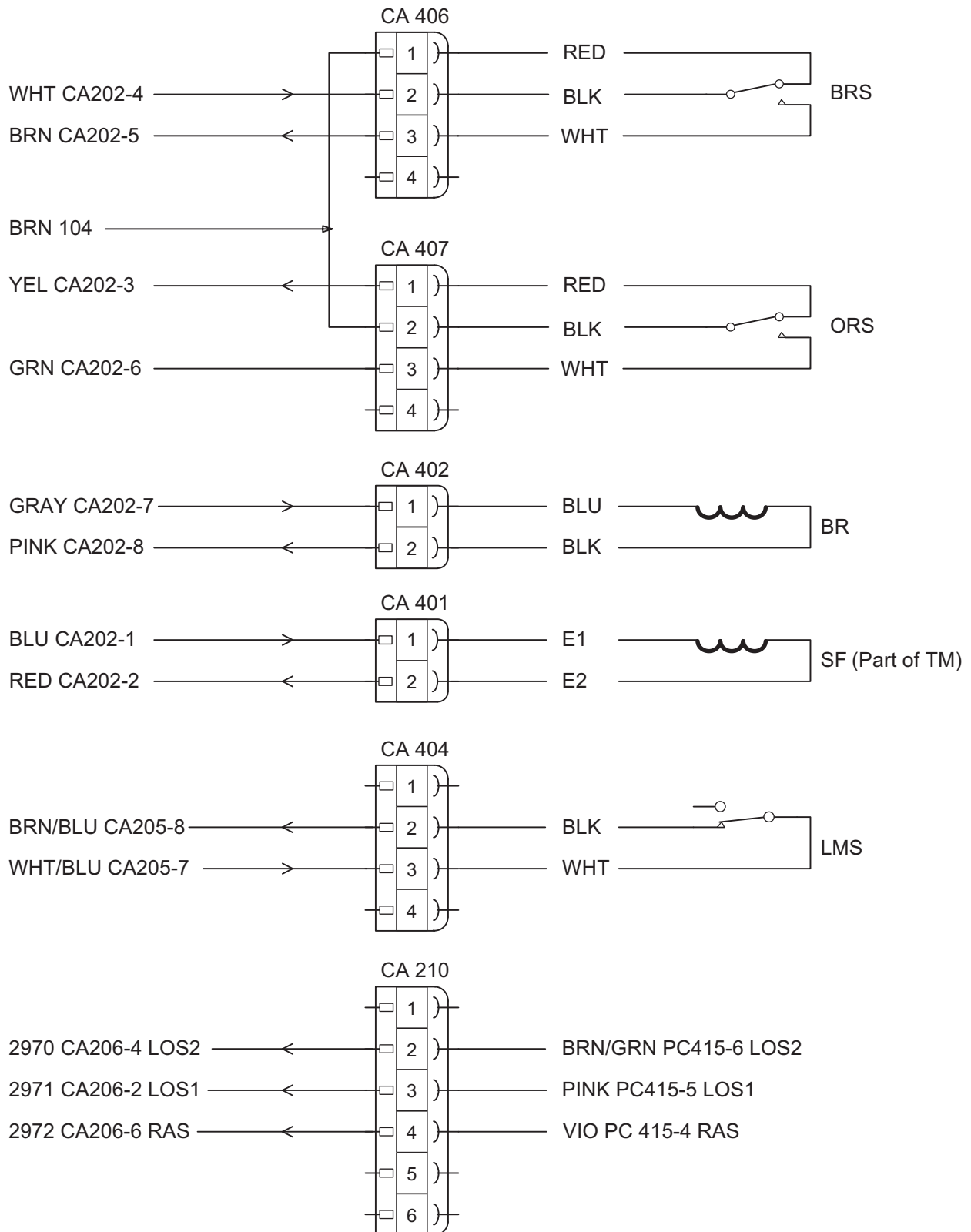
813488_2C_2



SCHEMATIC DIAGRAMS

WE / WS up to serial no. 5A132186

Brake Circuit, Standard



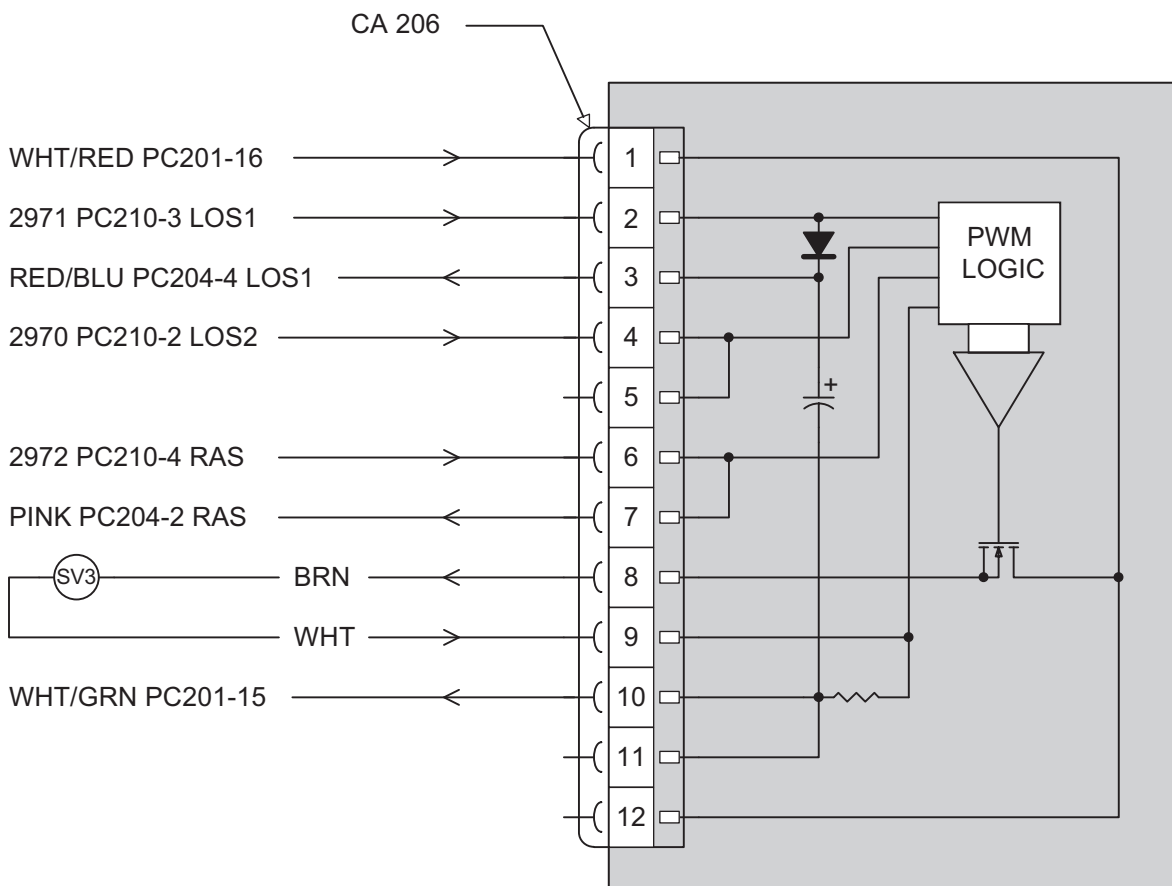
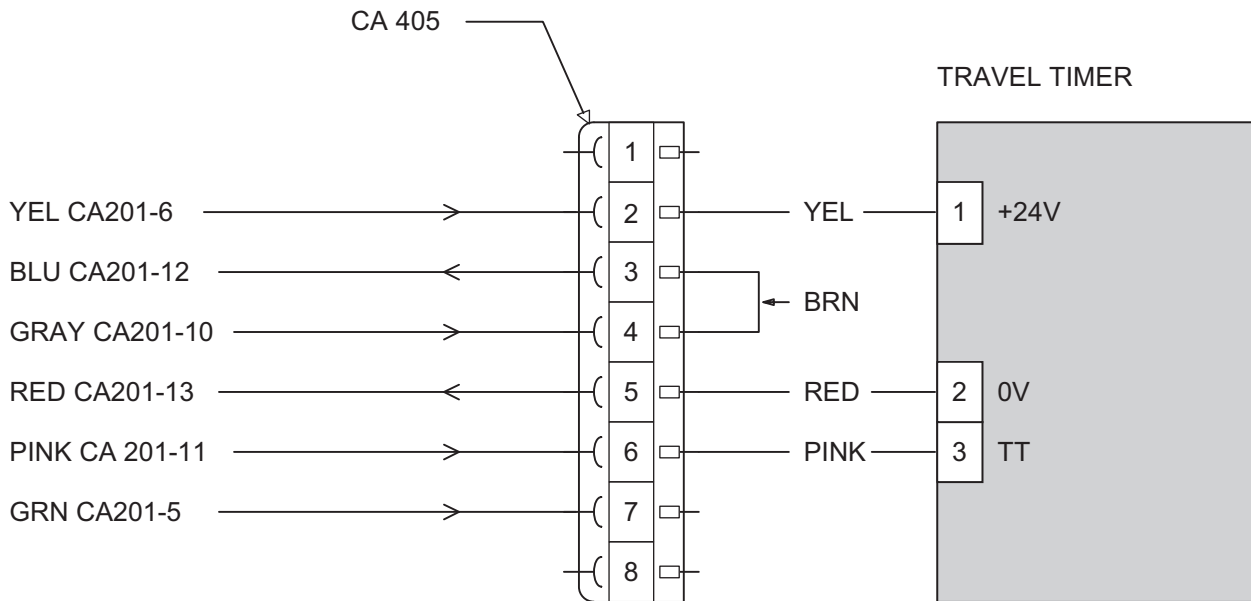
813488_2C_4

SCHEMATIC DIAGRAMS

WE / WS up to serial no. 5A132186



Instrument & Proportional Electronic Circuit, Standard



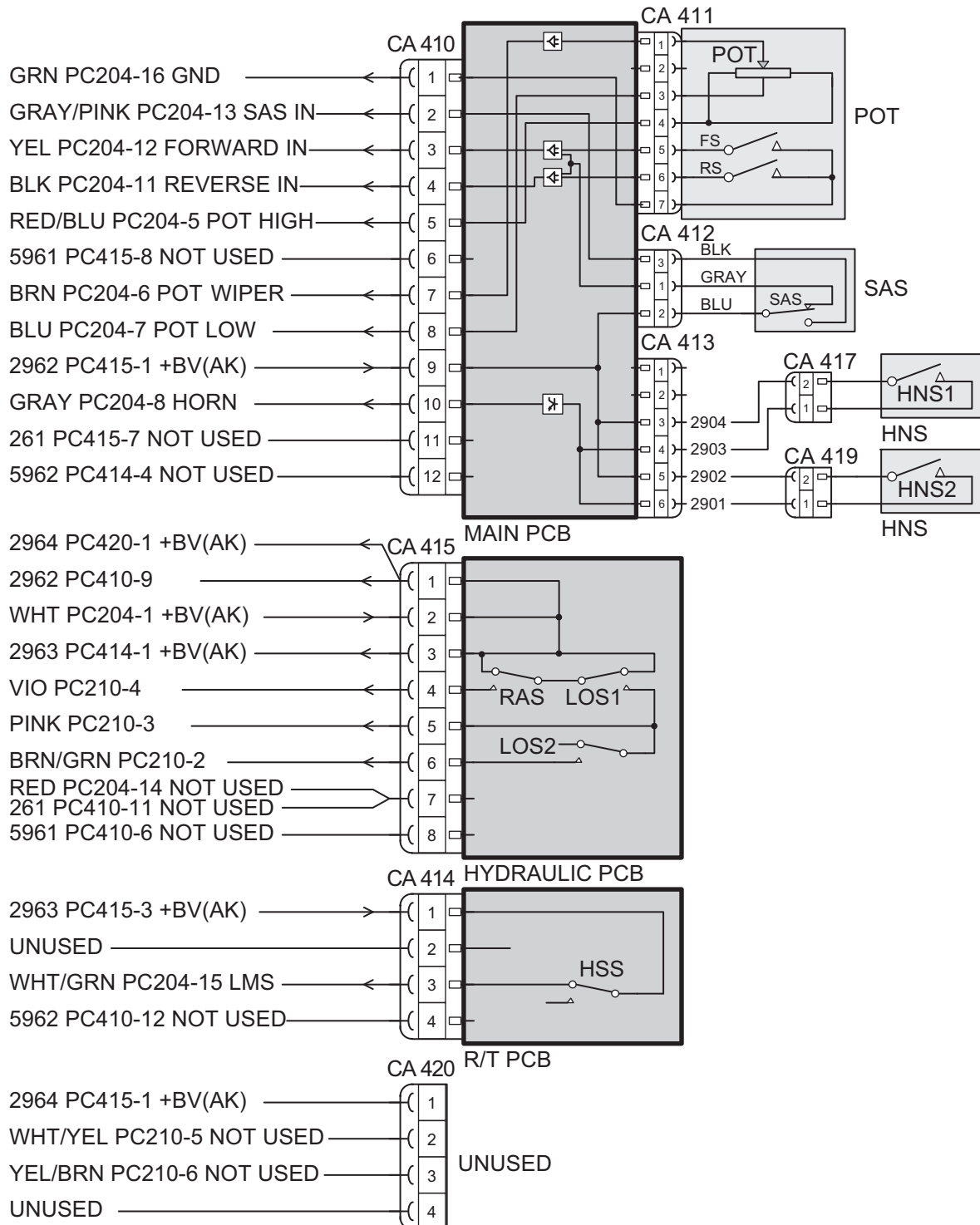
813488_2C_5.



SCHEMATIC DIAGRAMS

WE / WS up to serial no. 5A132186

Control Handle Circuit, Standard



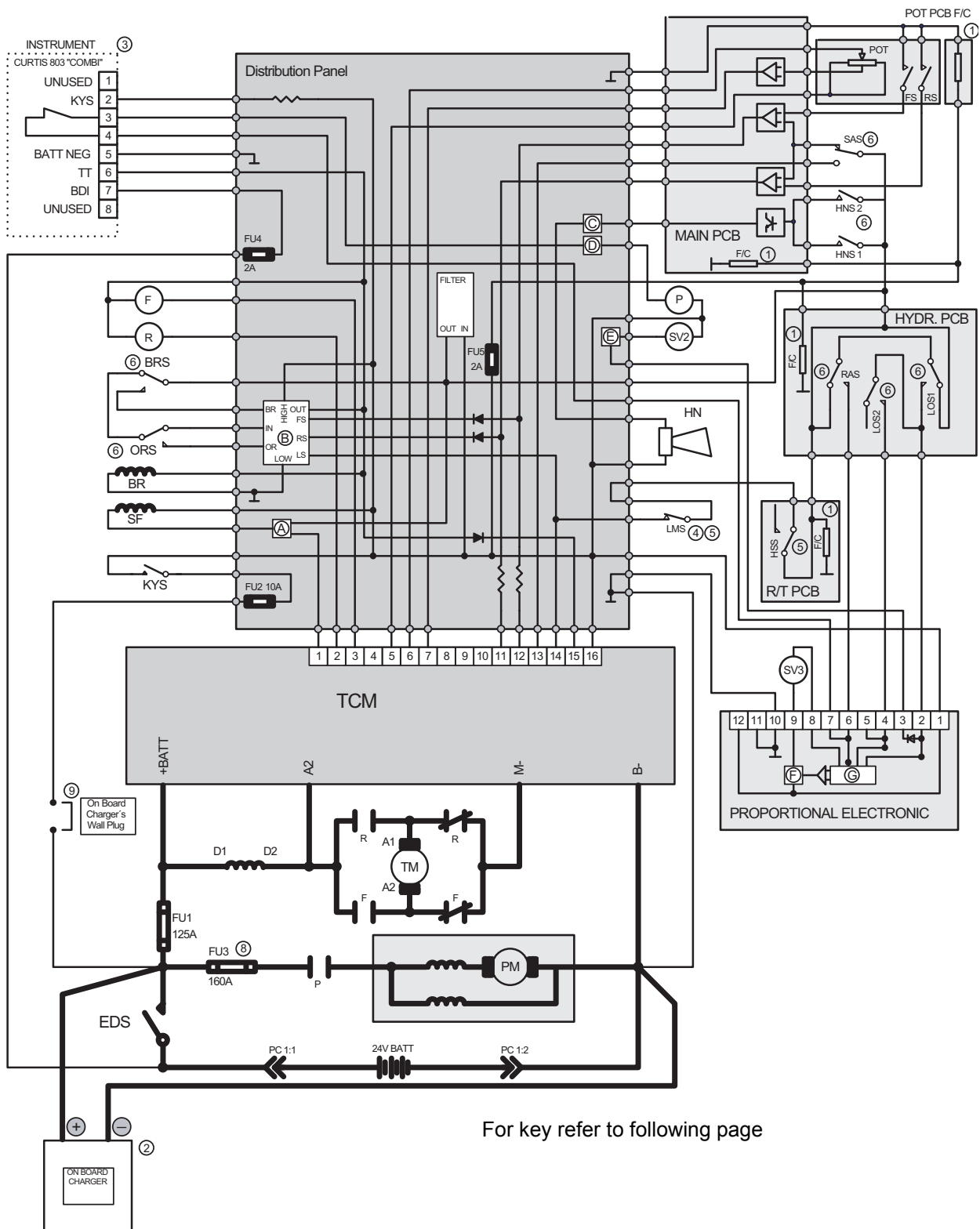
813488_2C_6

SCHEMATIC DIAGRAMS

WE / WS up to serial no. 5A132186



Schematic Diagram, Options



813489_2C_1



SCHEMATIC DIAGRAMS

WE / WS up to serial no. 5A132186

Key to Fig. 813488_2C_1 (see page 217)

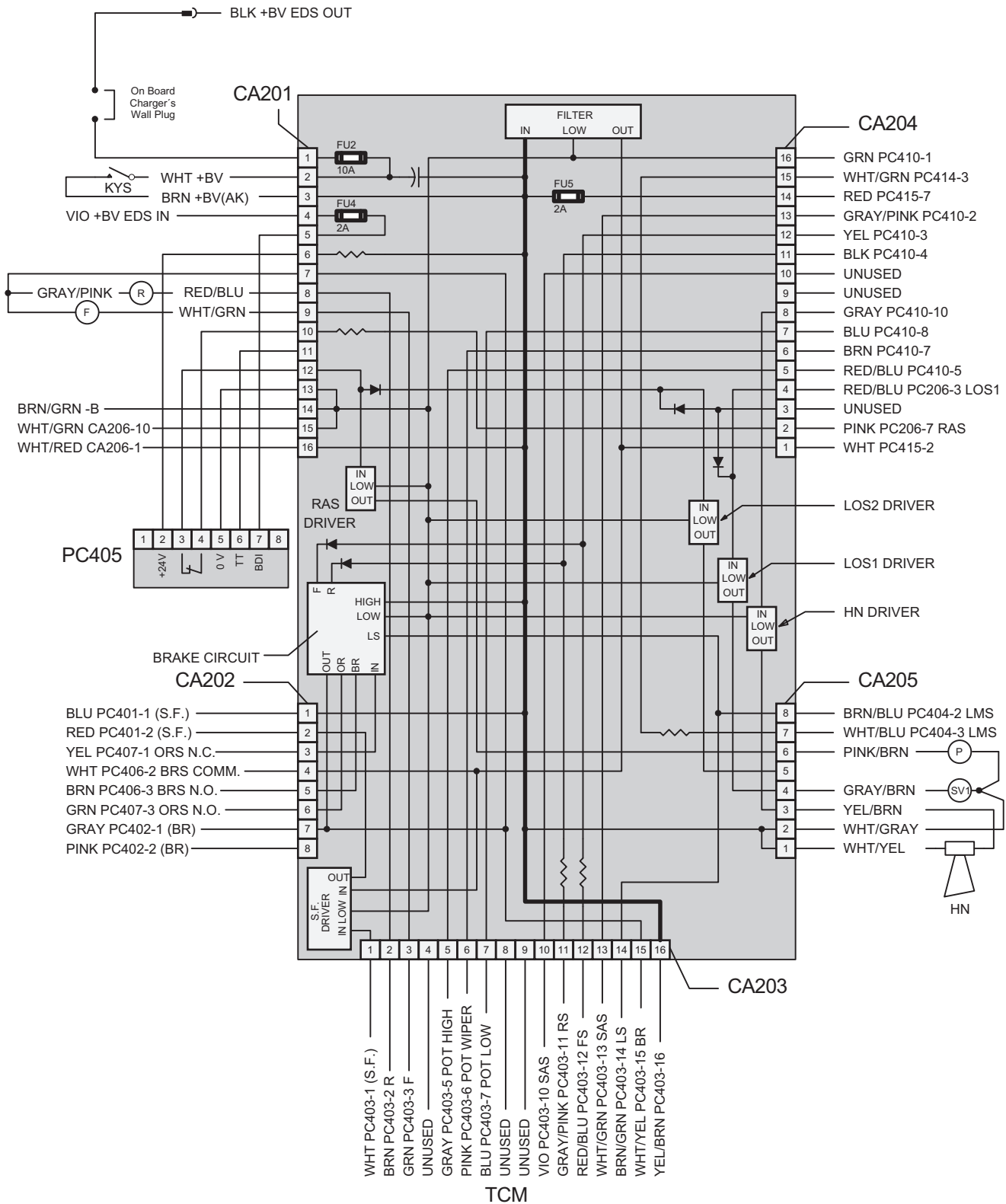
- | | | | |
|---|--------------------------------------|---|---|
| 1 | F / C package connection | 2 | On board charger connection |
| 3 | Curtis 803, Unigage | 4 | Forks higher than 250-2300 mm (depends on mast type):
LMS open |
| 5 | Reduced speed: HSS or / and LMS open | 6 | Active: RAS, BRS, ORS, SAS, HNS, LOS1 & LOS2 are
closed |
| 7 | F / C package: active below 5°C | 8 | For North American truck only: FU3 = 125A |
| A | Shunt Field Driver | B | Brake Circuit |
| C | Horn Driver | D | RAS Driver |
| E | LOS1 Driver | F | Proportional Driver |
| G | PWM Driver | | |

SCHEMATIC DIAGRAMS

WE / WS up to serial no. 5A132186



Distribution Panel, Options



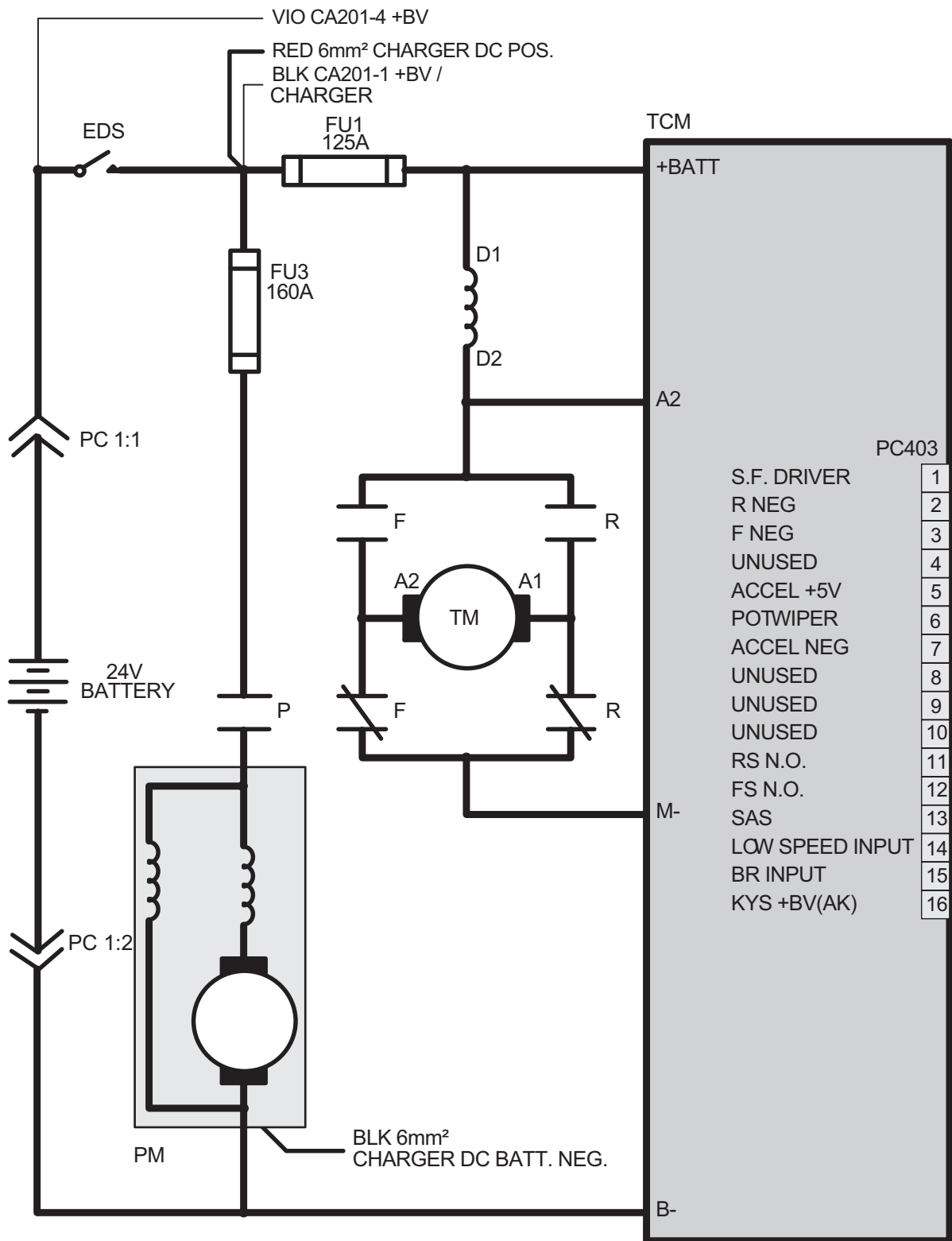
813489_2C_2



SCHEMATIC DIAGRAMS

WE / WS up to serial no. 5A132186

Traction Controller - Power Side, Options



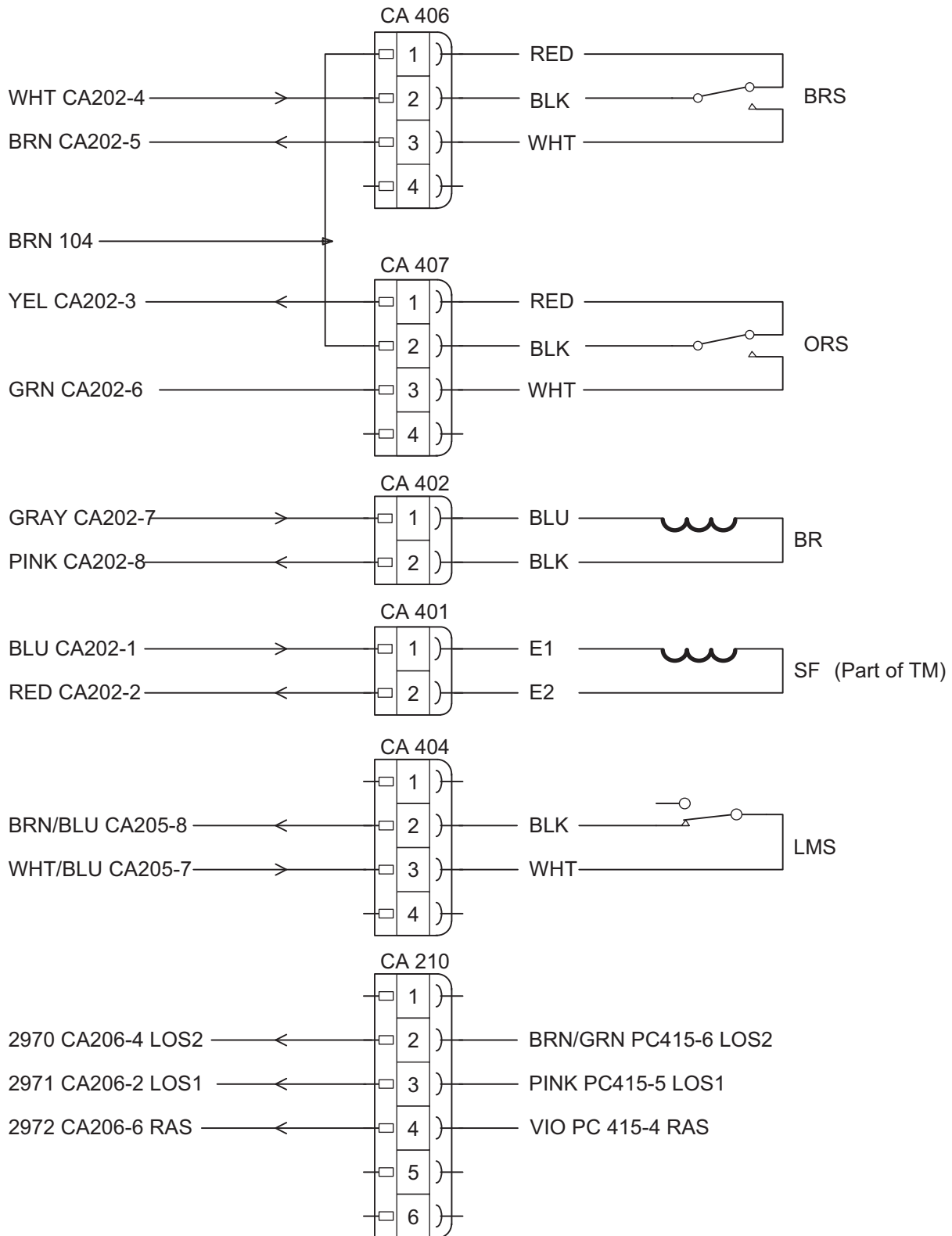
813489_2C_3

SCHEMATIC DIAGRAMS

WE / WS up to serial no. 5A132186



Brake Circuit, Options



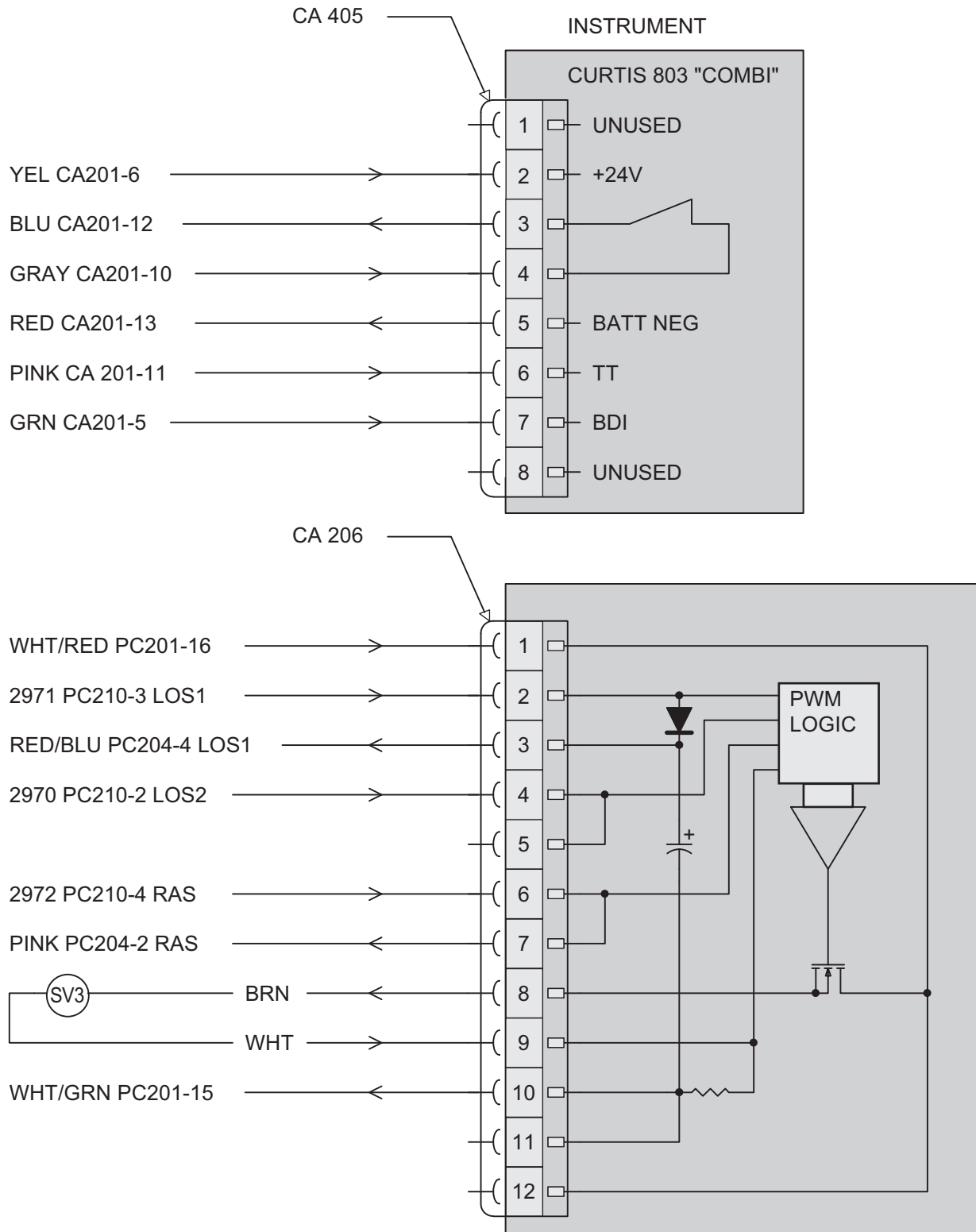
813489_2C_4



SCHEMATIC DIAGRAMS

WE / WS up to serial no. 5A132186

Instrument & Proportional Electronic Circuit, Options



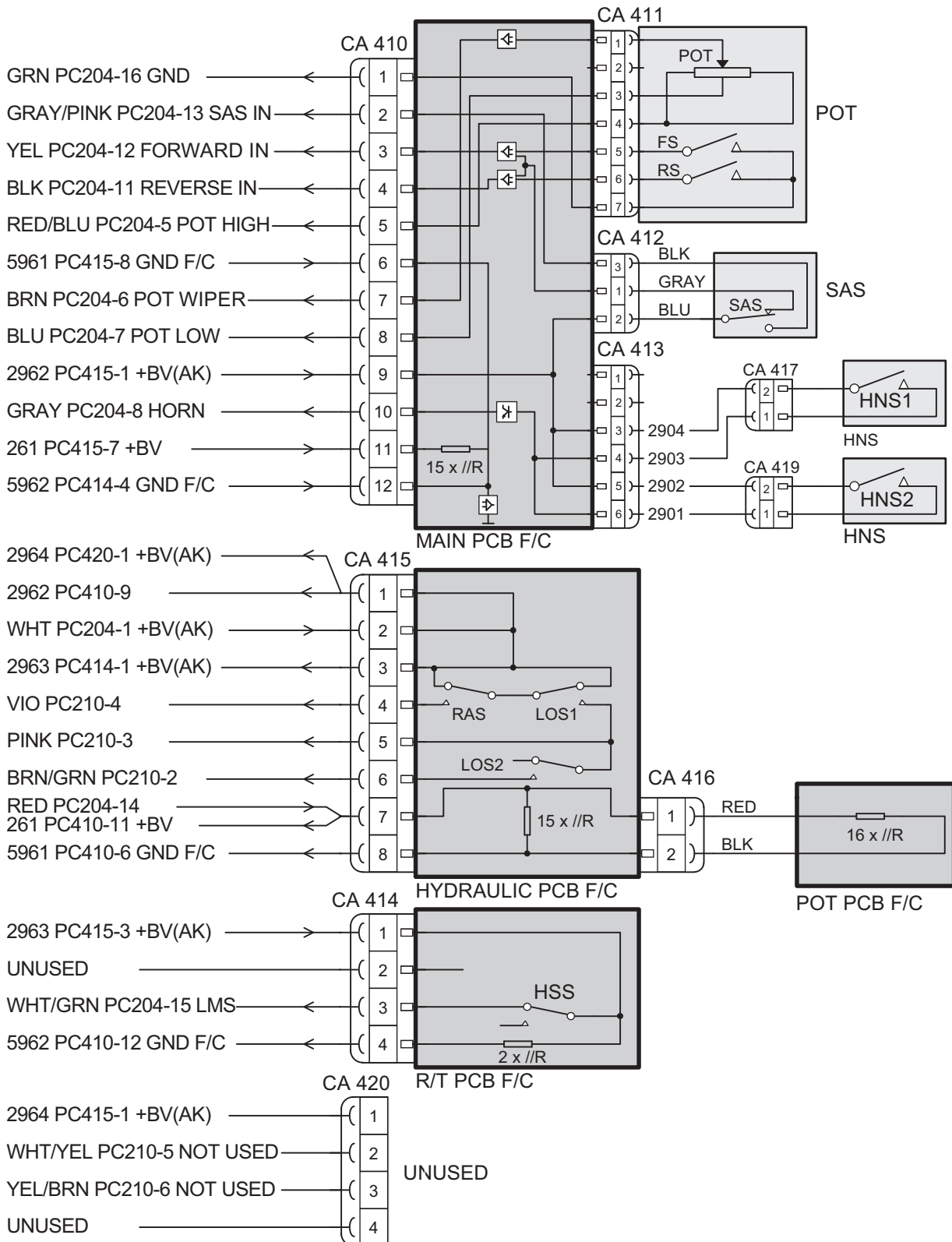
813489_2C_5

SCHEMATIC DIAGRAMS

WE / WS up to serial no. 5A132186



Control Handle Circuit, Options



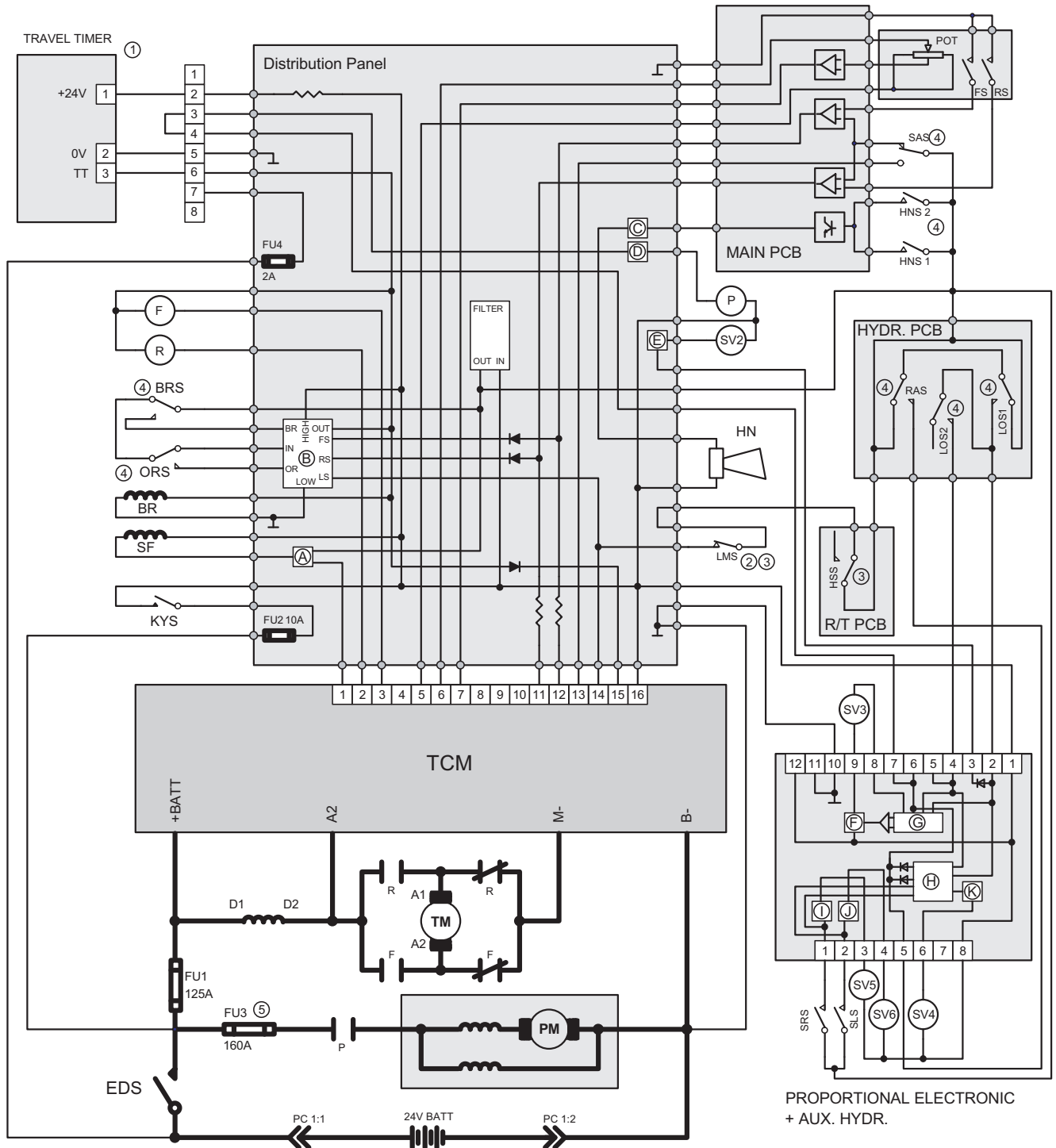
813489_2C_6



SCHEMATIC DIAGRAMS

WE / WS up to serial no. 5A132186

Schematic Diagram, Auxiliary Hydraulics



813511_2C_1

For key refer to following page

SCHEMATIC DIAGRAMS

WE / WS up to serial no. 5A132186



Key to Fig. 813511_2C_1 (see page 231)

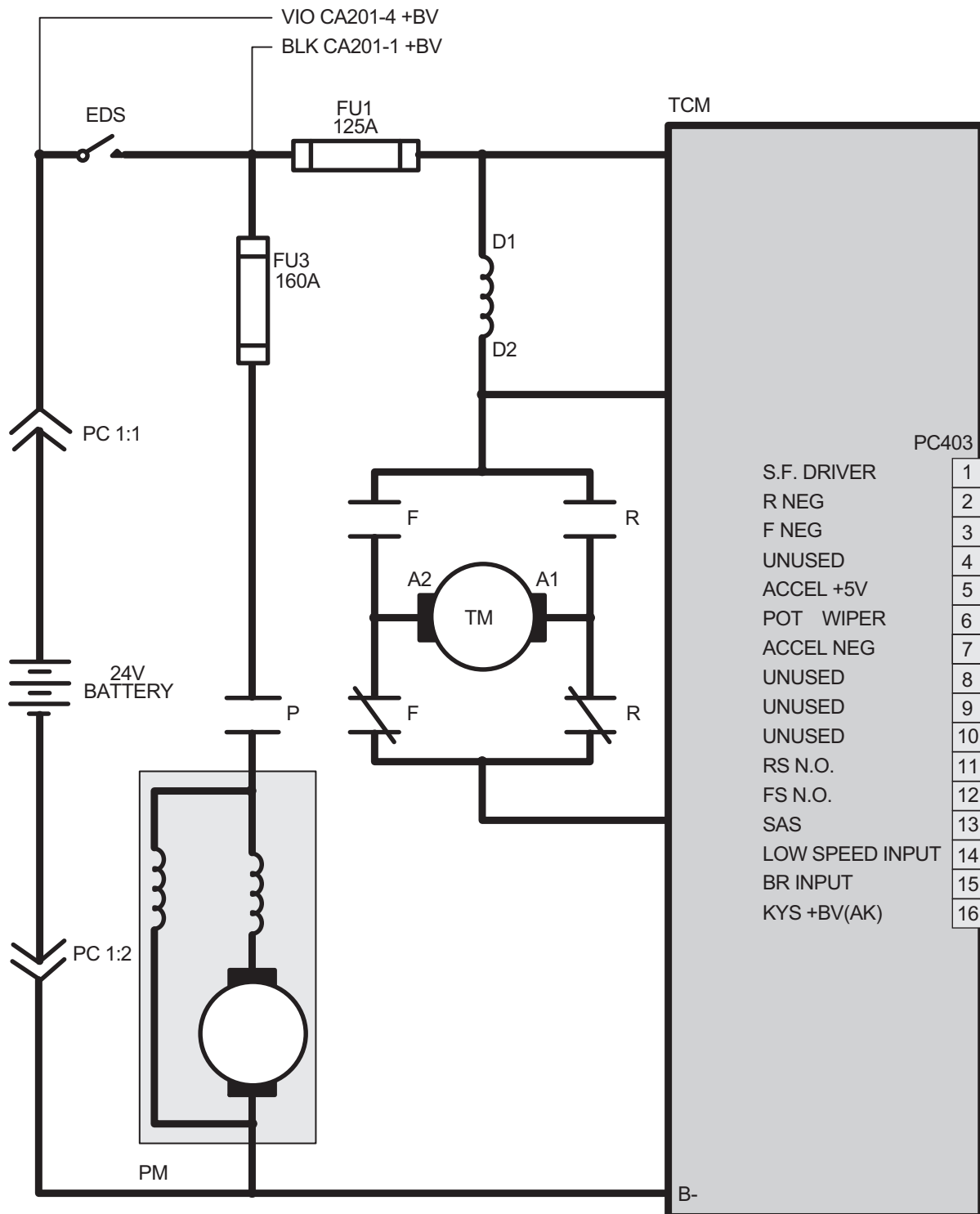
A	Shunt Field Driver	B	Brake Circuit
C	Horn Driver	D	RAS Driver
E	LOS 1 Driver	F	Proportional Driver
G	PWM Logic	H	Priority Logic
I	Side Shift Right Switch Driver	J	Side Shift Left Switch Driver
K	Change Over Valve Driver		

SCHEMATIC DIAGRAMS

WE / WS up to serial no. 5A132186



Traction Controller, Auxiliary Hydraulics



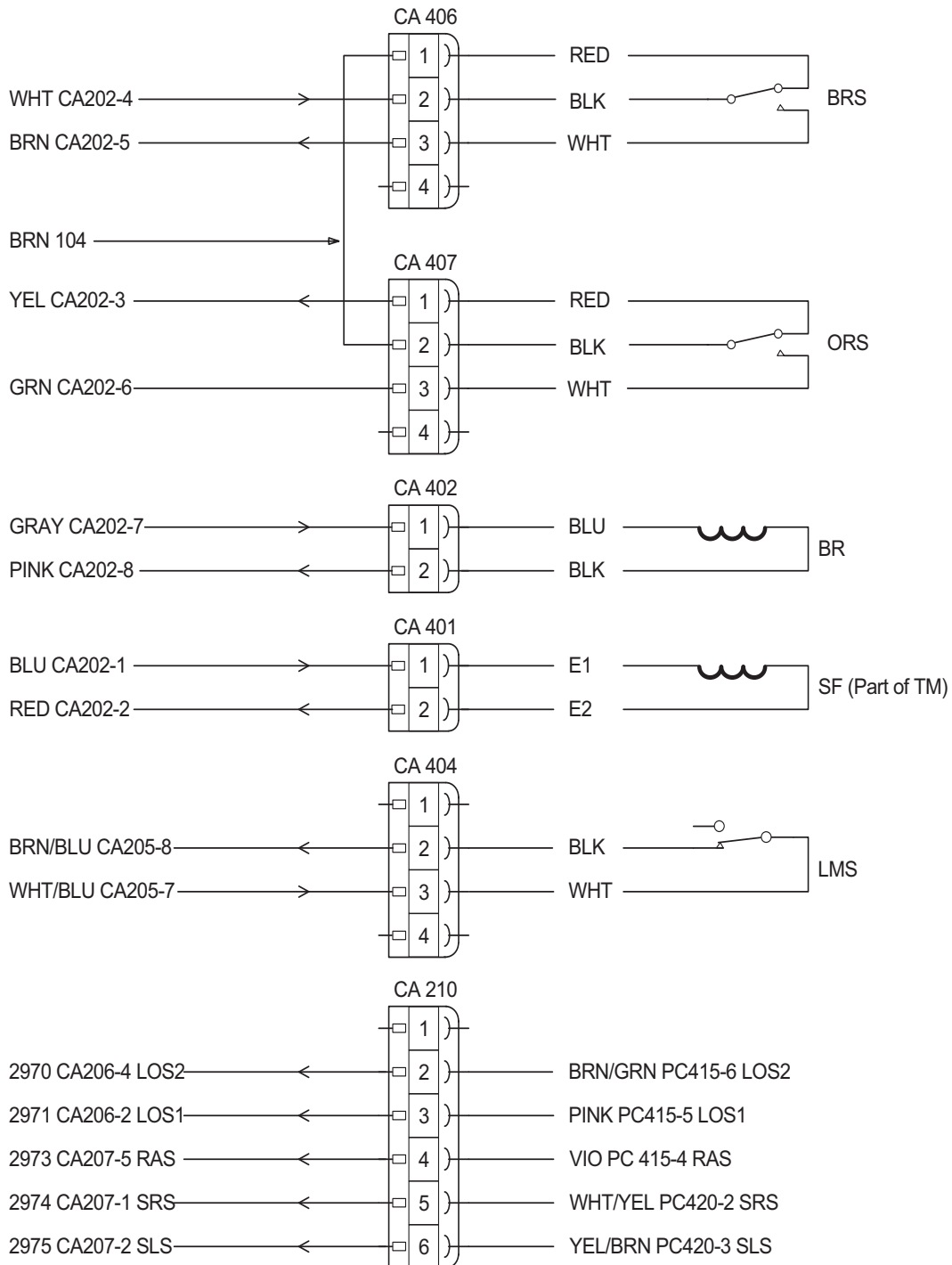
813511_2C_3



SCHEMATIC DIAGRAMS

WE / WS up to serial no. 5A132186

Brake Circuit, Auxiliary Hydraulics



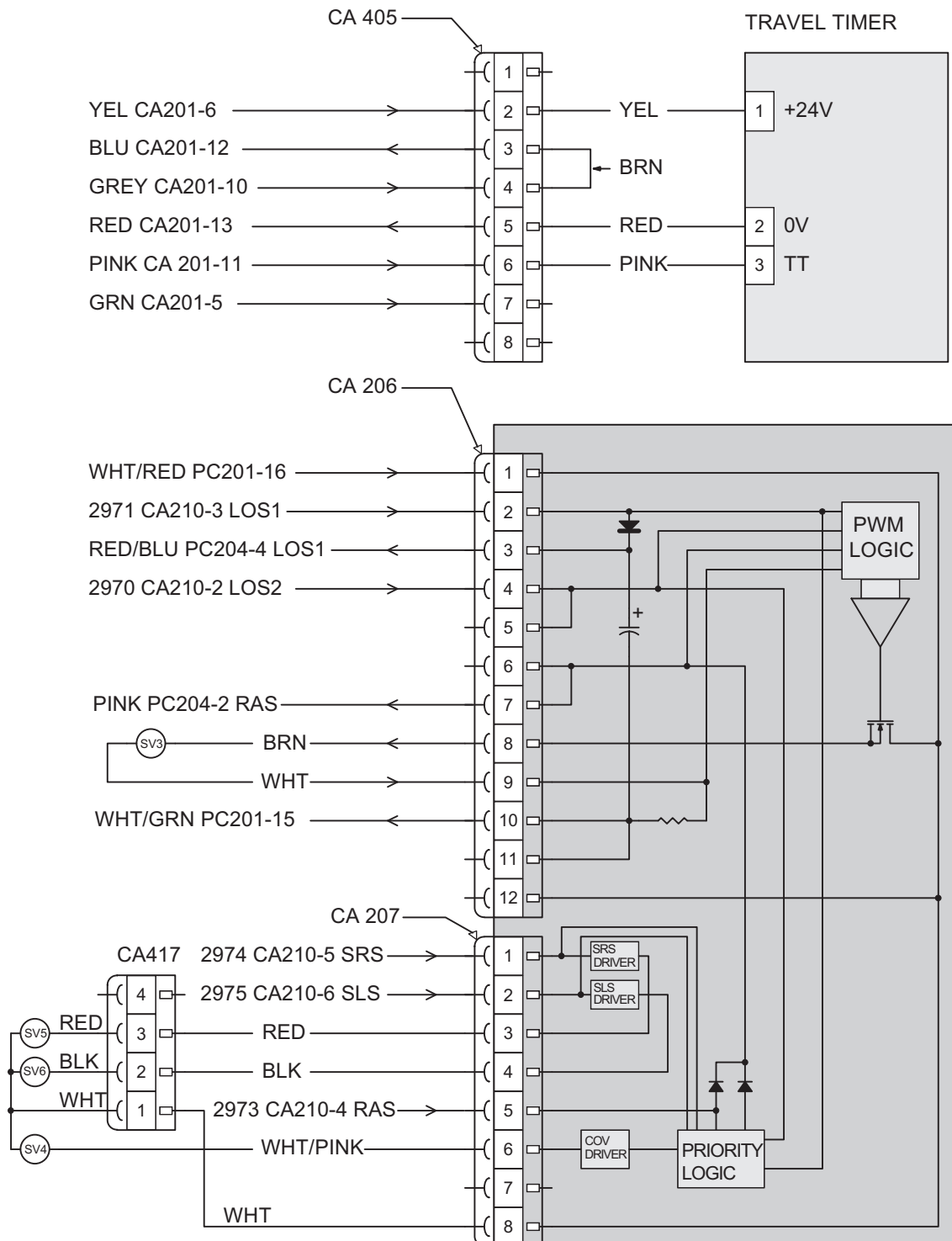
813511_2C_4

SCHEMATIC DIAGRAMS

WE / WS up to serial no. 5A132186



Instrument & Prop. Electronics & Sideshift Circuit



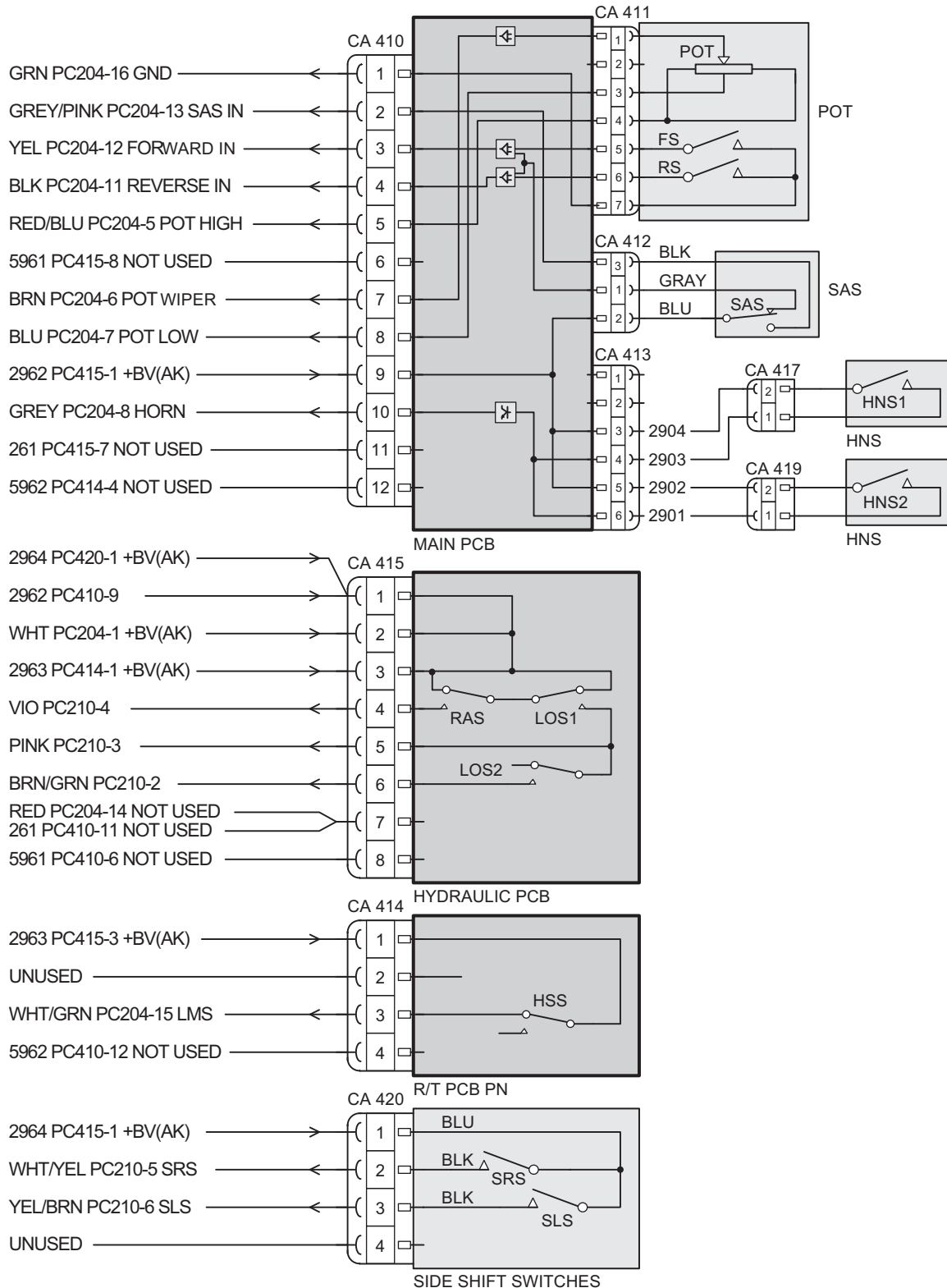
813511_2C_5



SCHEMATIC DIAGRAMS

WE / WS up to serial no. 5A132186

Control Handle Circuit, Auxiliary Hydraulics



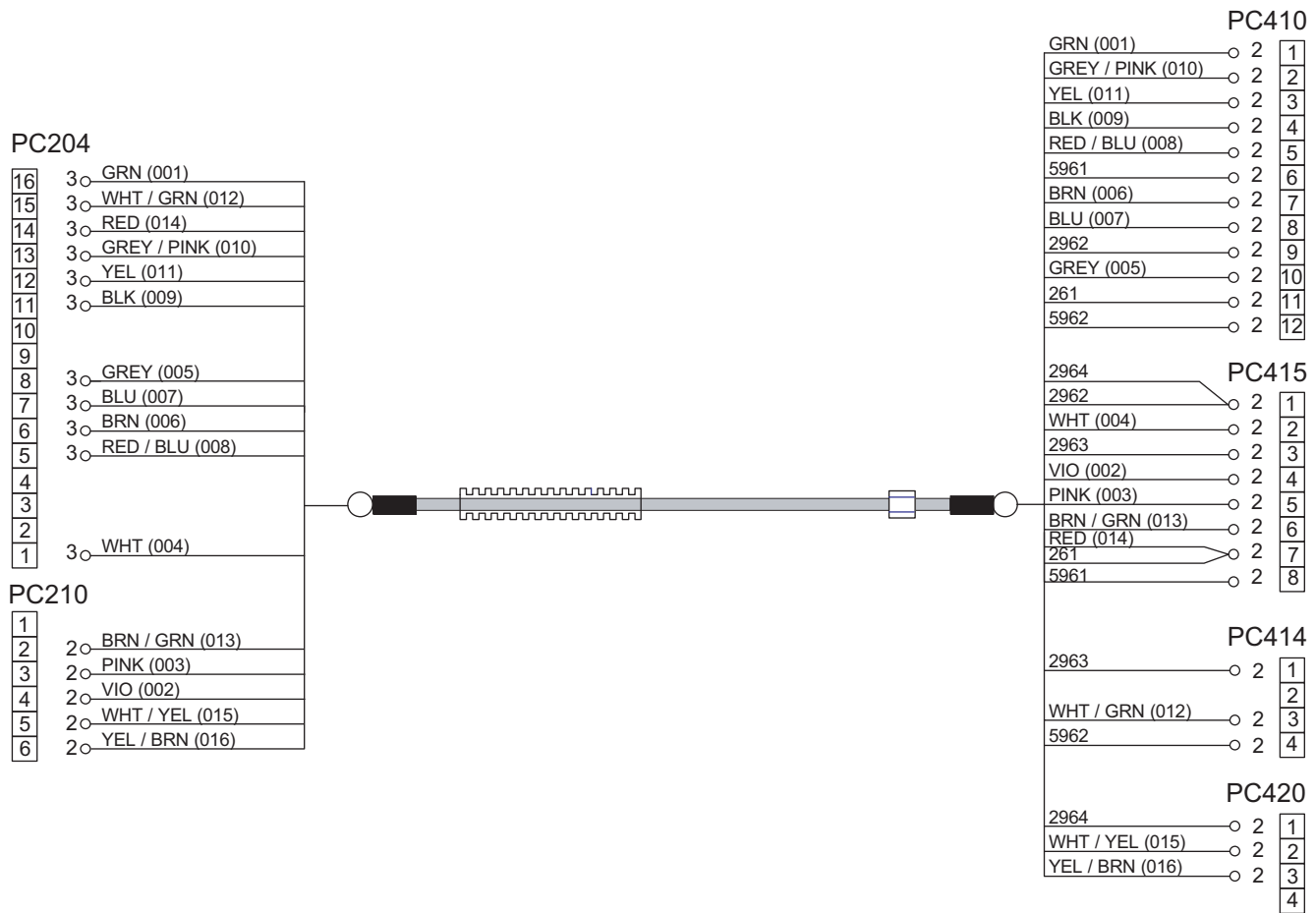
813511_2C_6

SCHEMATIC DIAGRAMS

WE / WS up to serial no. 5A132186



Control Handle Wire Harness



813426_2C

Connector housing

Housing	Order Number
PC204	803452-002
PC210	803450-007
PC410	803450-009
PC414	803450-020
PC415	803450-008
PC420	803450-006

Contact pins

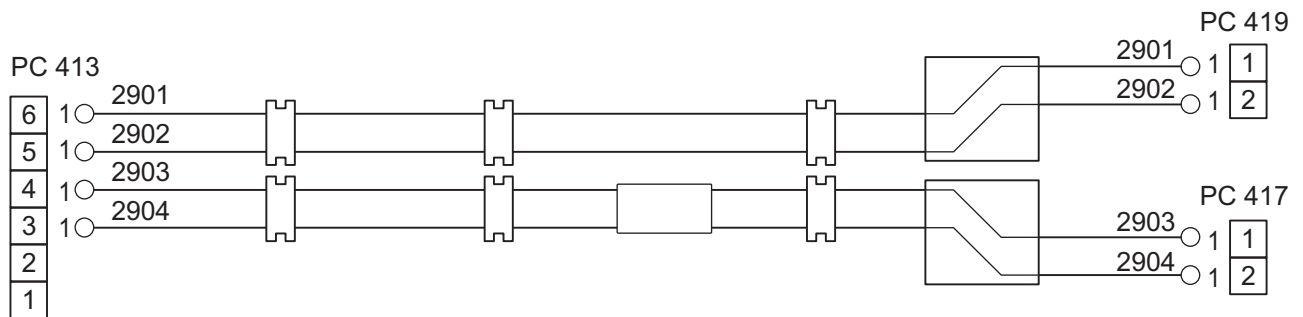
Item No.	Order Number
2	116858
3	803452-005



SCHEMATIC DIAGRAMS

WE / WS up to serial no. 5A132186

Horn Harness



811931_2E_1

Connector housing

Housing	Order Number
PC413	803450-021
PC419	803450-023
PC417	803450-023

Contact pins

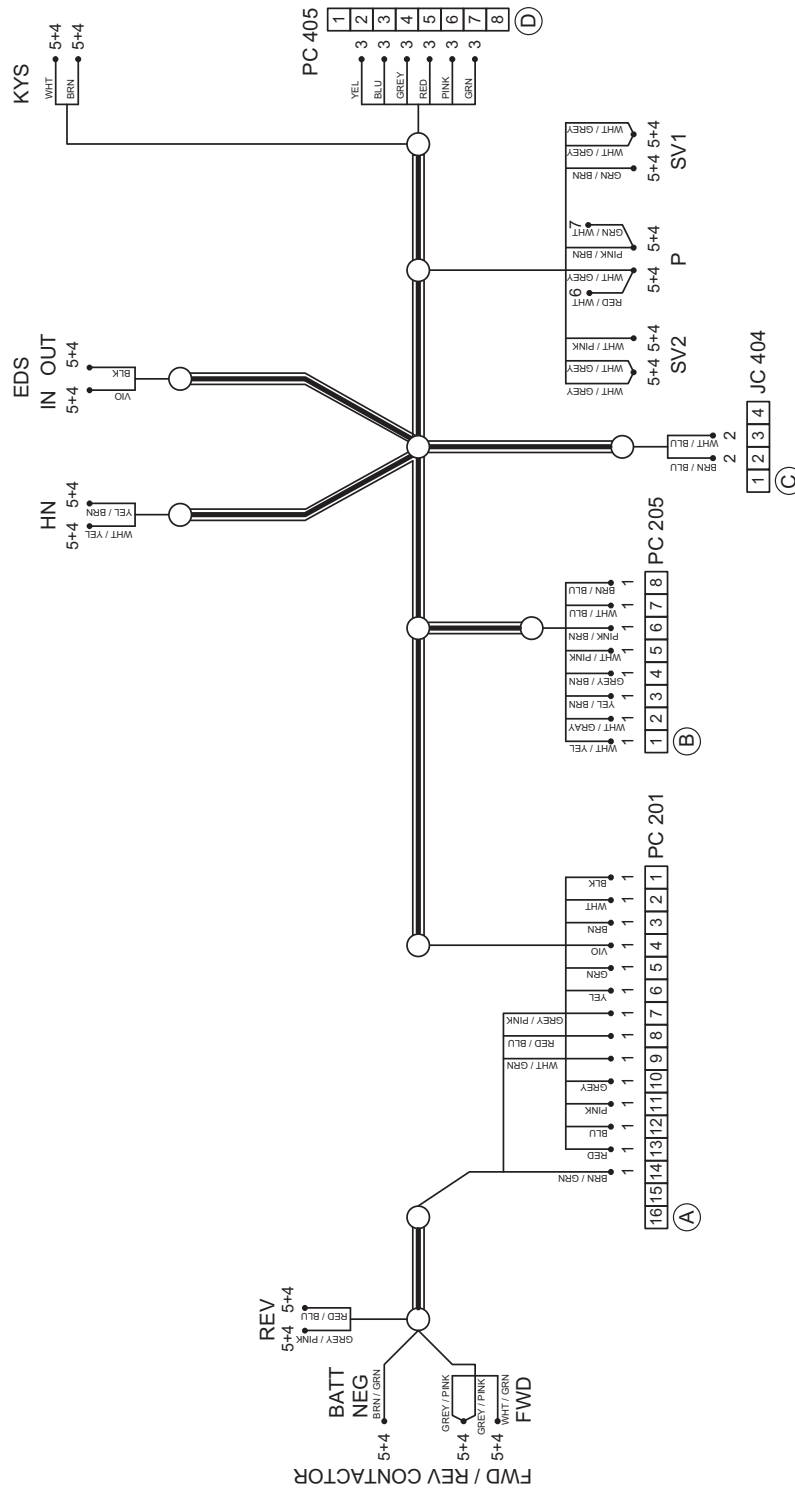
Item No.	Order Number
2	803450-022
3	803450-024

SCHEMATIC DIAGRAMS

WE / WS up to serial no. 5A132186



Main Harness, Standard



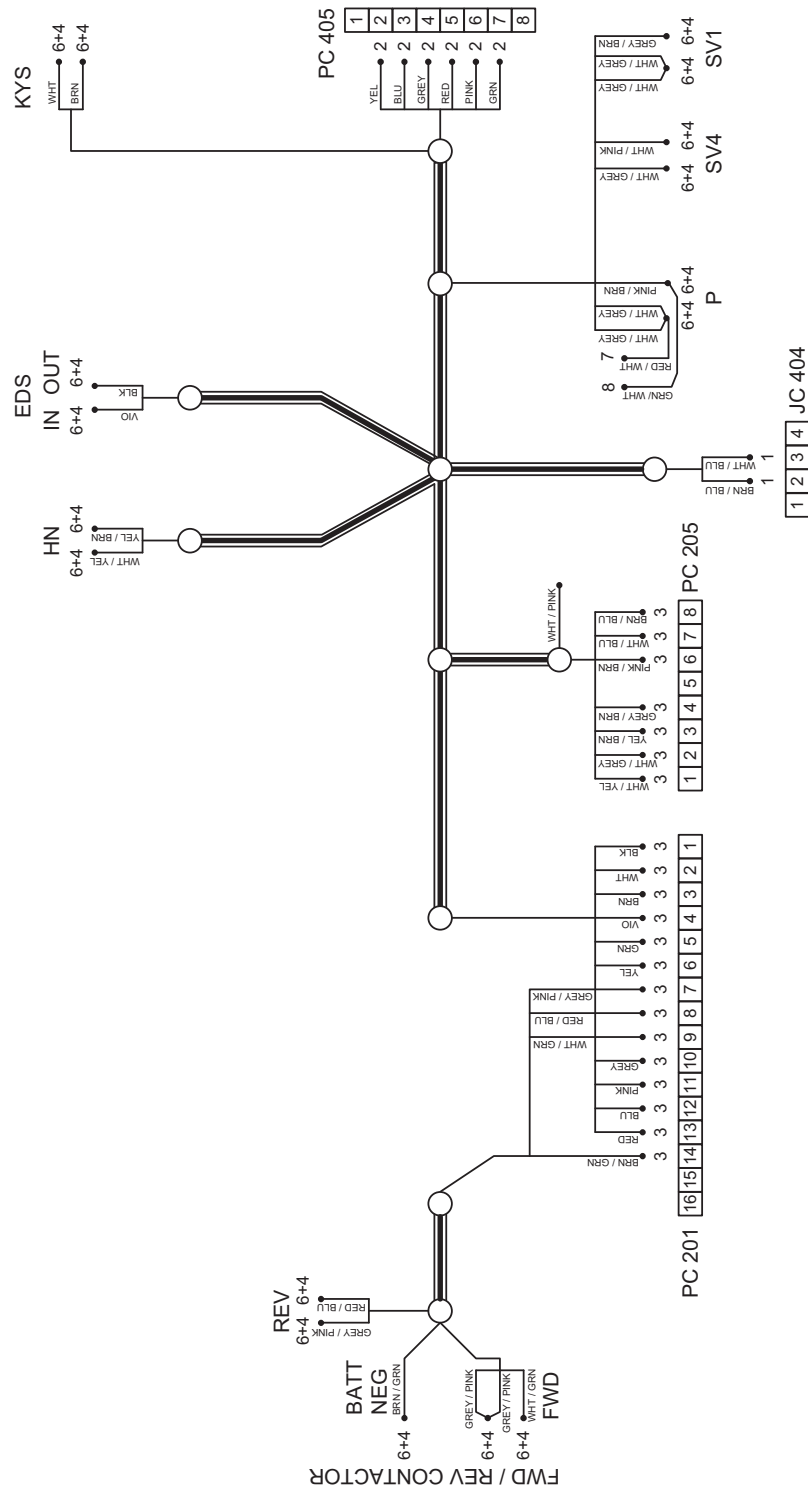
803459_2L_1



SCHEMATIC DIAGRAMS

WE / WS up to serial no. 5A132186

Main Harness, Auxiliary Hydraulics



807229_2D

See next page for tables

SCHEMATIC DIAGRAMS

WE / WS up to serial no. 5A132186



Connector housing

Housing	Order Number
PC201	803452-002
PC205	803452-001
JC404	803450-002
PC405	803450-008

Contact pins

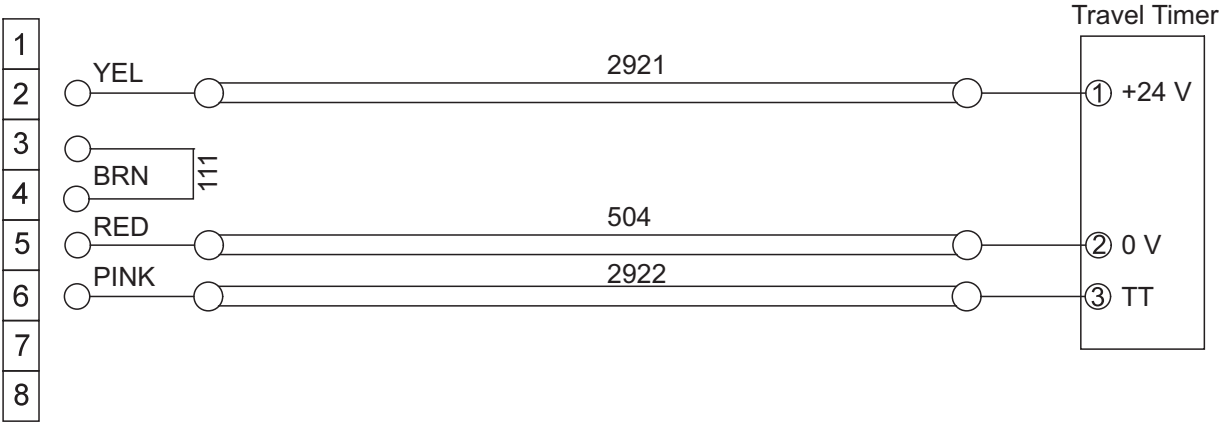
Item No.	Order Number
1	803450-010
2	116858
3	803452-005
4	062007-021
6	803448-003
7	062007-050
8	062007-063
1	803450-010



SCHEMATIC DIAGRAMS
WE / WS up to serial no. 5A132186

Hourmeter Harness

PC405



803545_2C

Connector housing

Housing	Order Number
PC405	803450-004

Contact pins

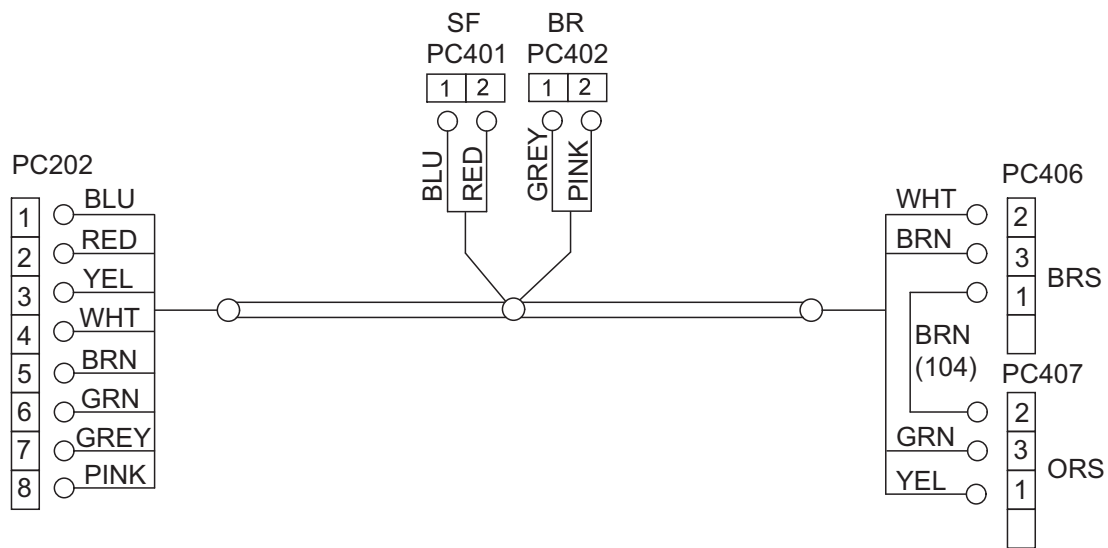
Item No.	Order Number
---	062007-043

SCHEMATIC DIAGRAMS

WE / WS up to serial no. 5A132186



Harness, Brake



803460_2F

Connector housing

Housing	Order Number
PC202	803452-001
PC406 PC407	803450-002
PC401	803450-005 803450-001
PC402	803450-001 803450-005

Contact pins

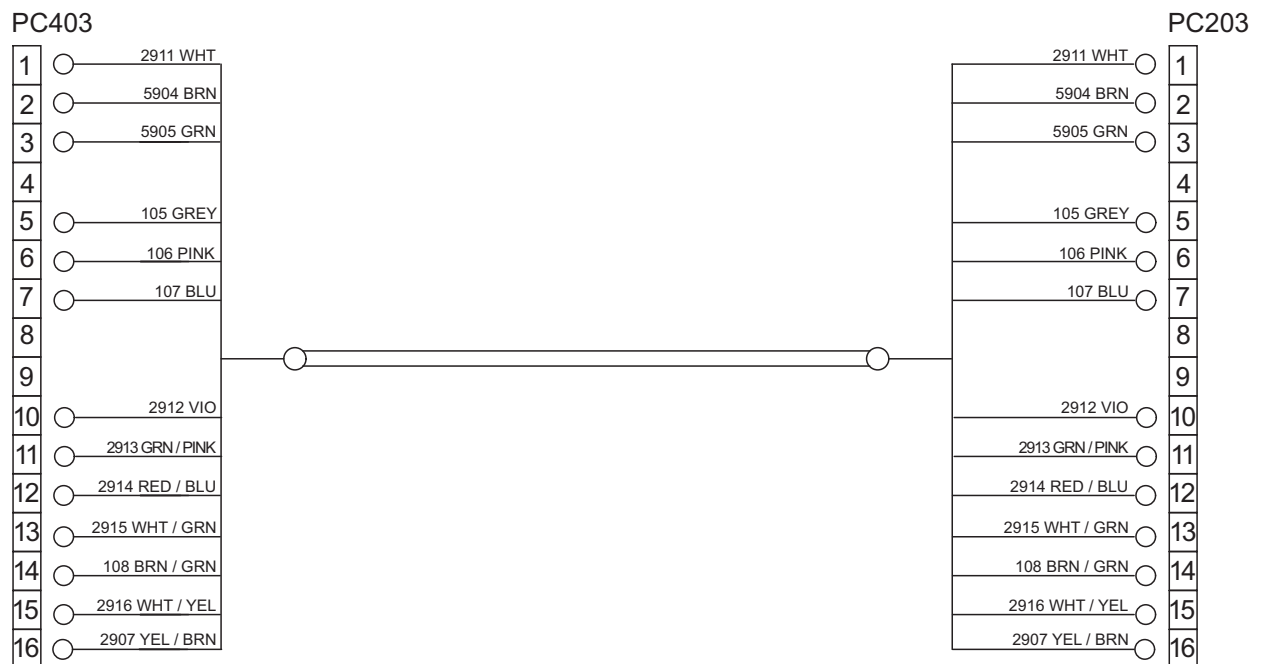
Item No.	Order Number
1	803450-010
2	803452-006
3	803452-005
4	116858



SCHEMATIC DIAGRAMS

WE / WS up to serial no. 5A132186

Harness, Control Module



803462_2D

Connector housing

Housing	Order Number
PC203	803452-002
PC403	116851

Contact pins

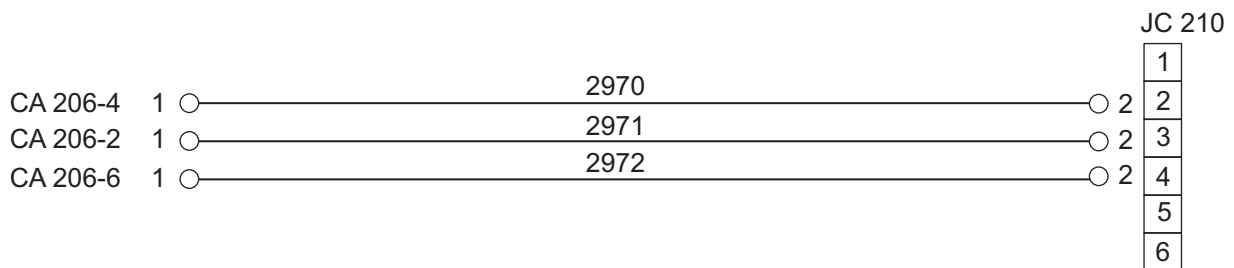
Item No.	Order Number
1	116858
2	803452-005

SCHEMATIC DIAGRAMS

WE / WS up to serial no. 5A132186



Proportional Hydraulics Connector Lead, Standard



813472_2A

Connector housing

Housing	Order Number
LC210	803450-003

Contact pins

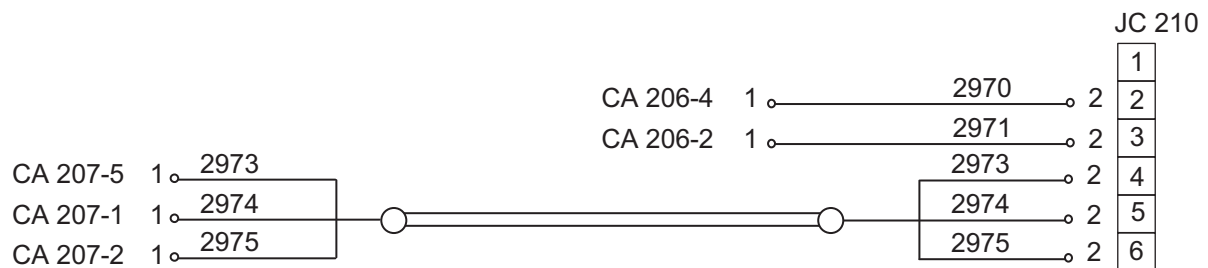
Item No.	Order Number
1	803452-005
2	803450-010



SCHEMATIC DIAGRAMS

WE / WS up to serial no. 5A132186

Proportional Hydraulics Connector Lead, Standard, Auxiliary Hydraulics



813473_2A

Connector housing

Housing	Order Number
JC210	803450-003

Contact pins

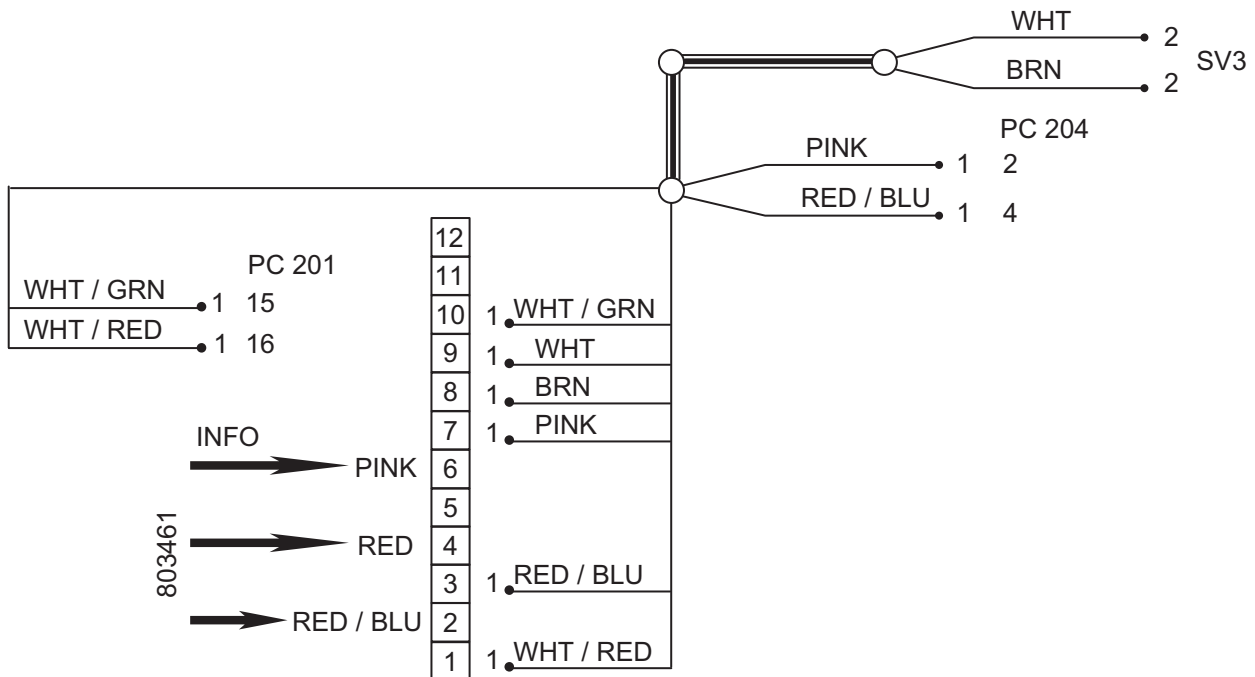
Item No.	Order Number
1	803452-005
2	803450-010

SCHEMATIC DIAGRAMS

WE / WS up to serial no. 5A132186



Harness, Proportional Valve



804368_2B

Connector housing

Housing	Order Number
PC206	803452-007

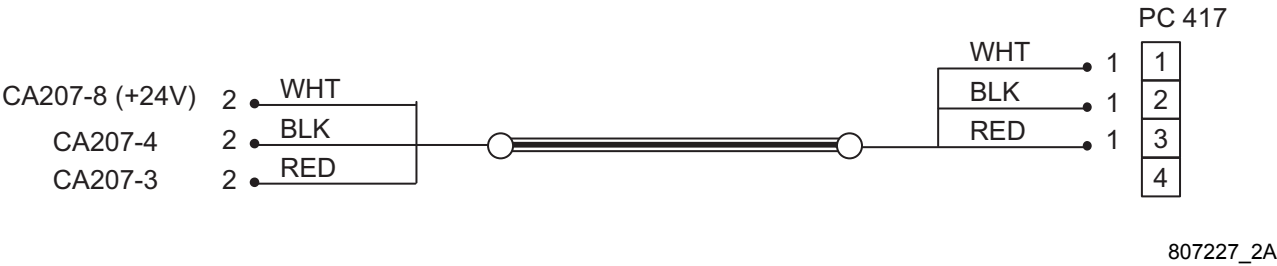
Contact pins

Item No.	Order Number
1	803452-005
2	062007-021



SCHEMATIC DIAGRAMS
WE / WS up to serial no. 5A132186

Harness, Auxiliary Hydraulics



Connector housing

Housing	Order Number
PC417	803450-006

Contact pins

Item No.	Order Number
1	116858
2	803452-006

SCHEMATIC DIAGRAMS

WE / WS up to serial no. 5A132186

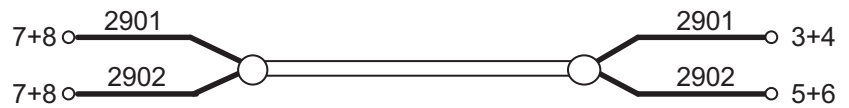


Harness, On-board charger

810528-001
Ground Lead



810528-002



810528_XB

Contact pins

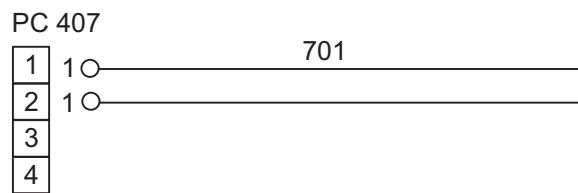
Item No.	Order Number
1	062007-044
2	062007-003
3	062007-021
4	803488-003
5	803448-004
6	803448-005
7	062007-043
8	803452-005
9	062007-051



SCHEMATIC DIAGRAMS

WE / WS up to serial no. 5A132186

ORS Jumper



808133_2A

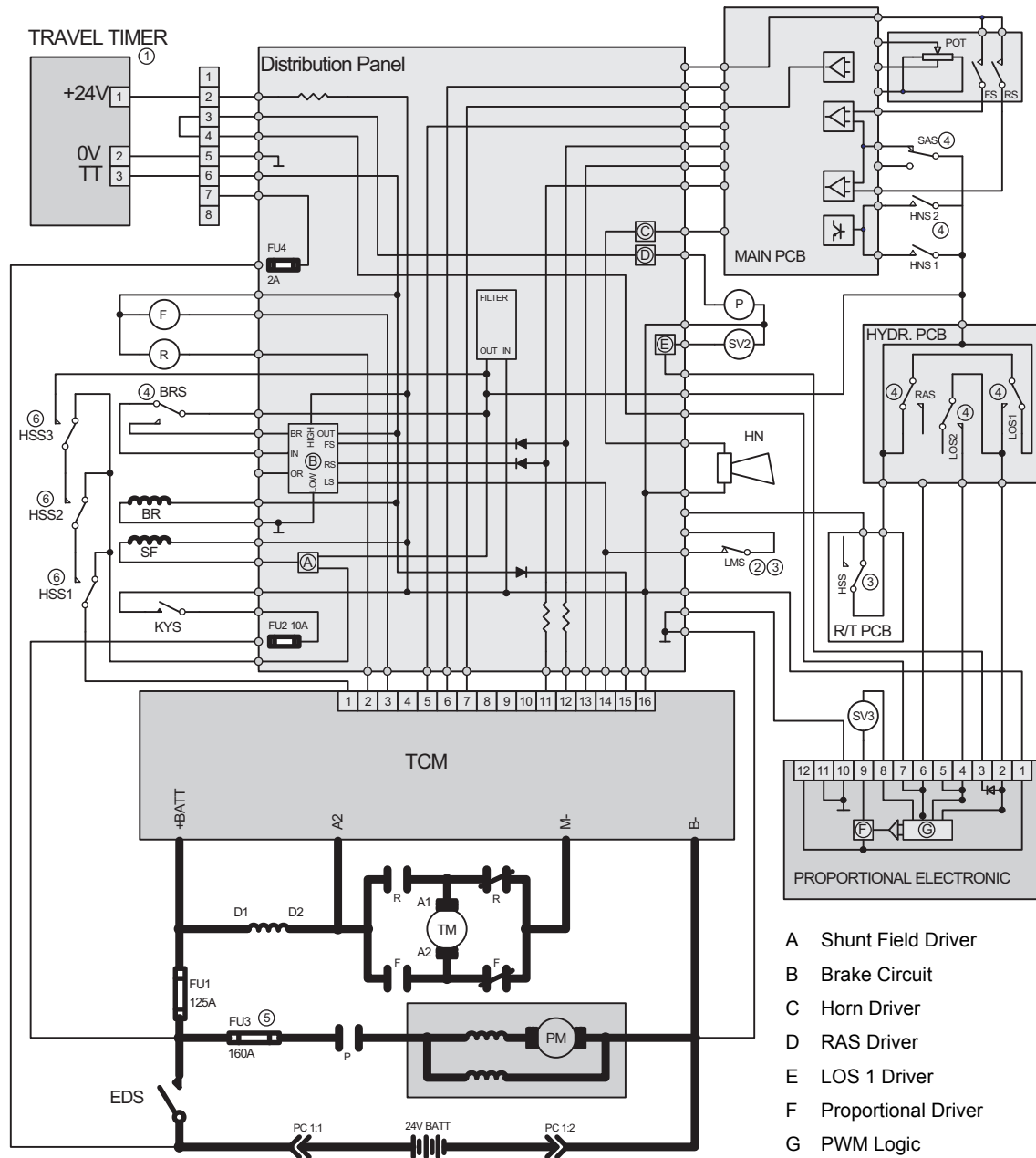
Connector housing

Housing	Order Number
PC407	803450-006

Contact pins

Item No.	Order Number
1	803450-006

Schematic Diagram, Standard



813519_2B_1

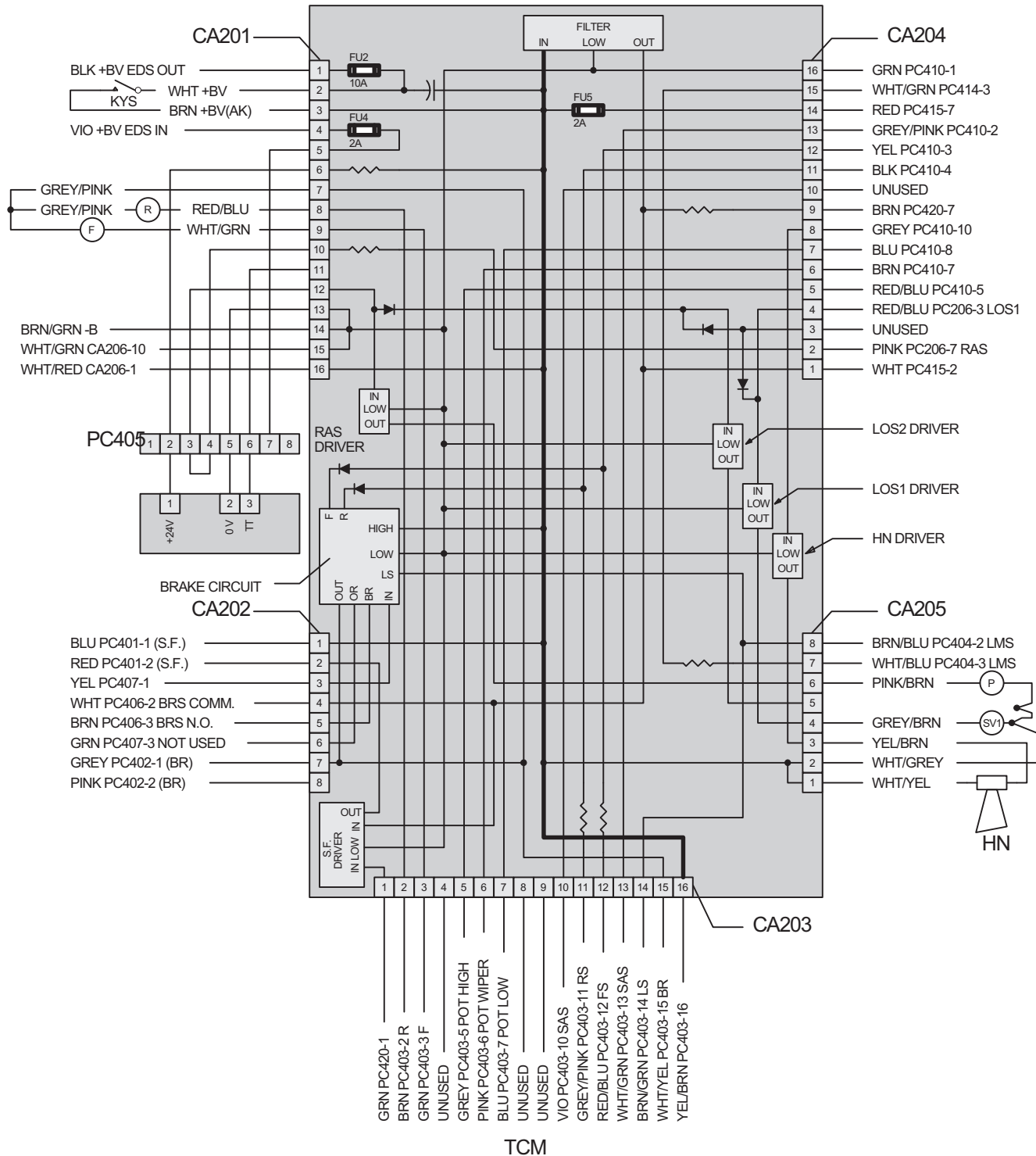
- | | |
|---|--|
| 1 Travel Timer | 2 Forks higher than 250 - 2300 mm (depends on mast type): LMS open |
| 3 Reduced speed: HSS and / or LMS open | 4 Active: RAS, BRS, ORS, SAS, HNS, LOS1 & LOS2 are closed |
| 5 For North American truck only: FU3 = 125A | 6 Walkie Mode: HSS3&/or HSS2 &/or HSS1 open |

SCHEMATIC DIAGRAMS

WE S / WS S up to serial no. 5A132186



Distribution Panel, Standard



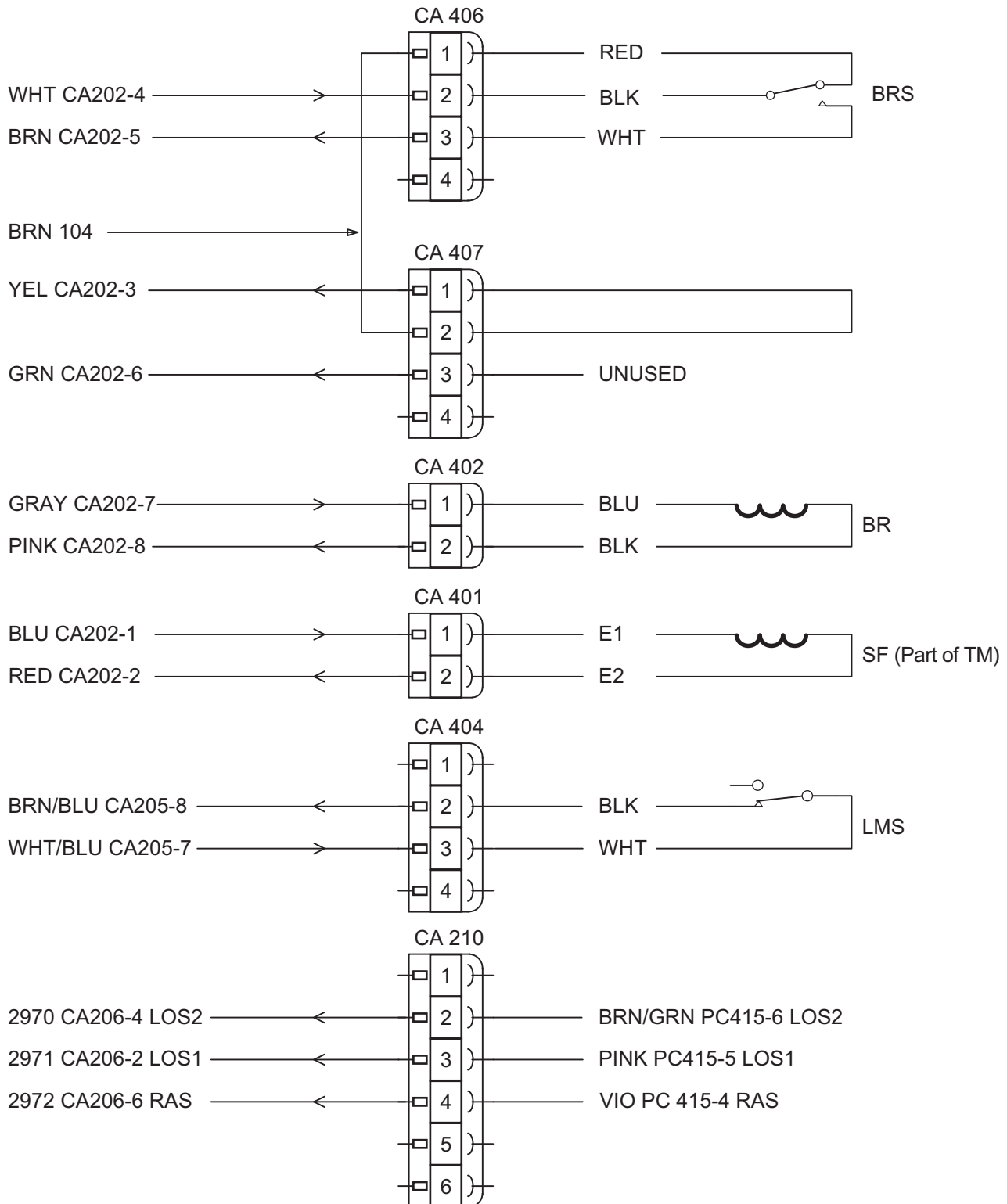
813519_2B_2

SCHEMATIC DIAGRAMS

WE S / WS S up to serial no. 5A132186



Brake Circuit, Standard



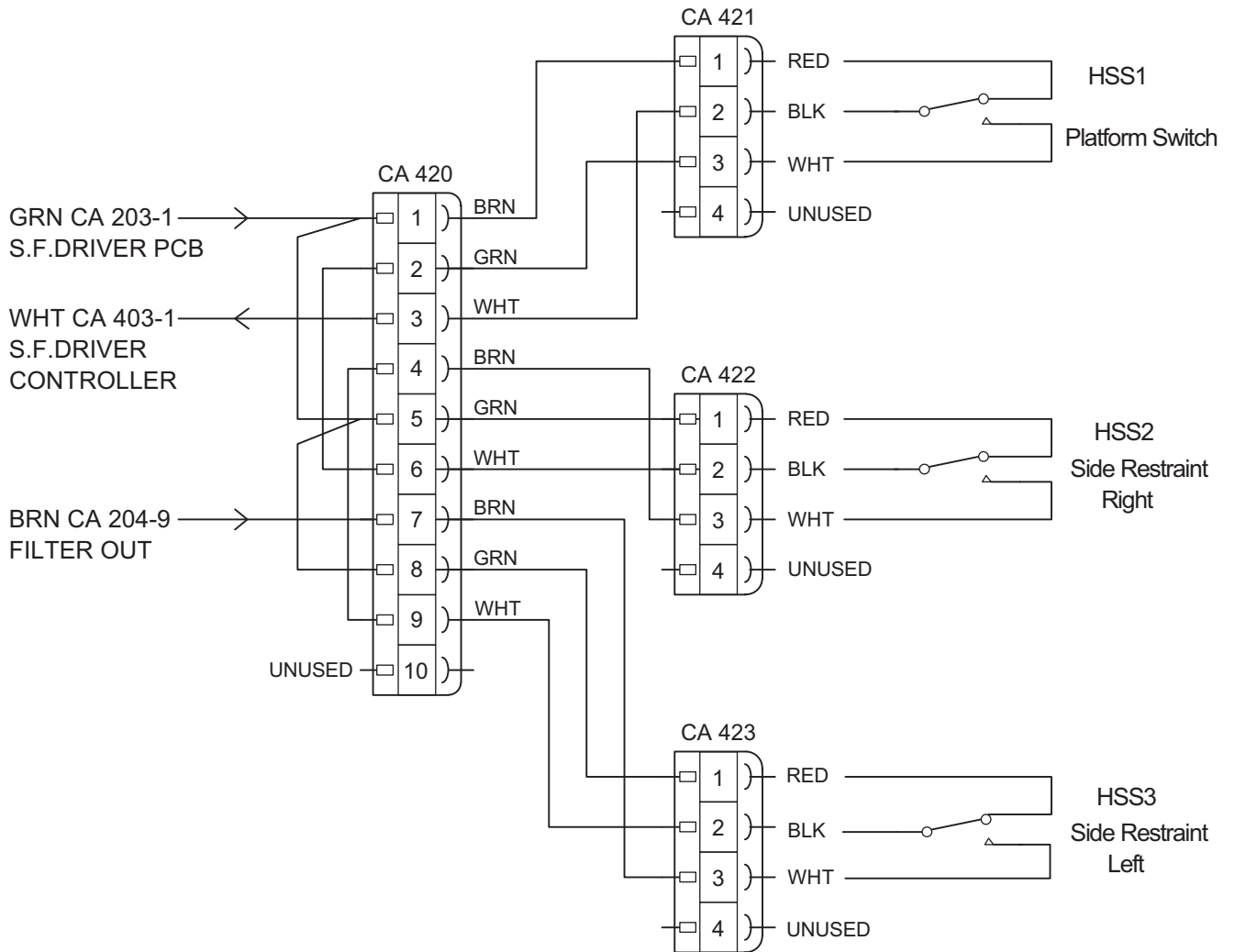
813519_2B_4



SCHEMATIC DIAGRAMS

WE S / WS S up to serial no. 5A132186

Walkie / Rider Circuit, Standard



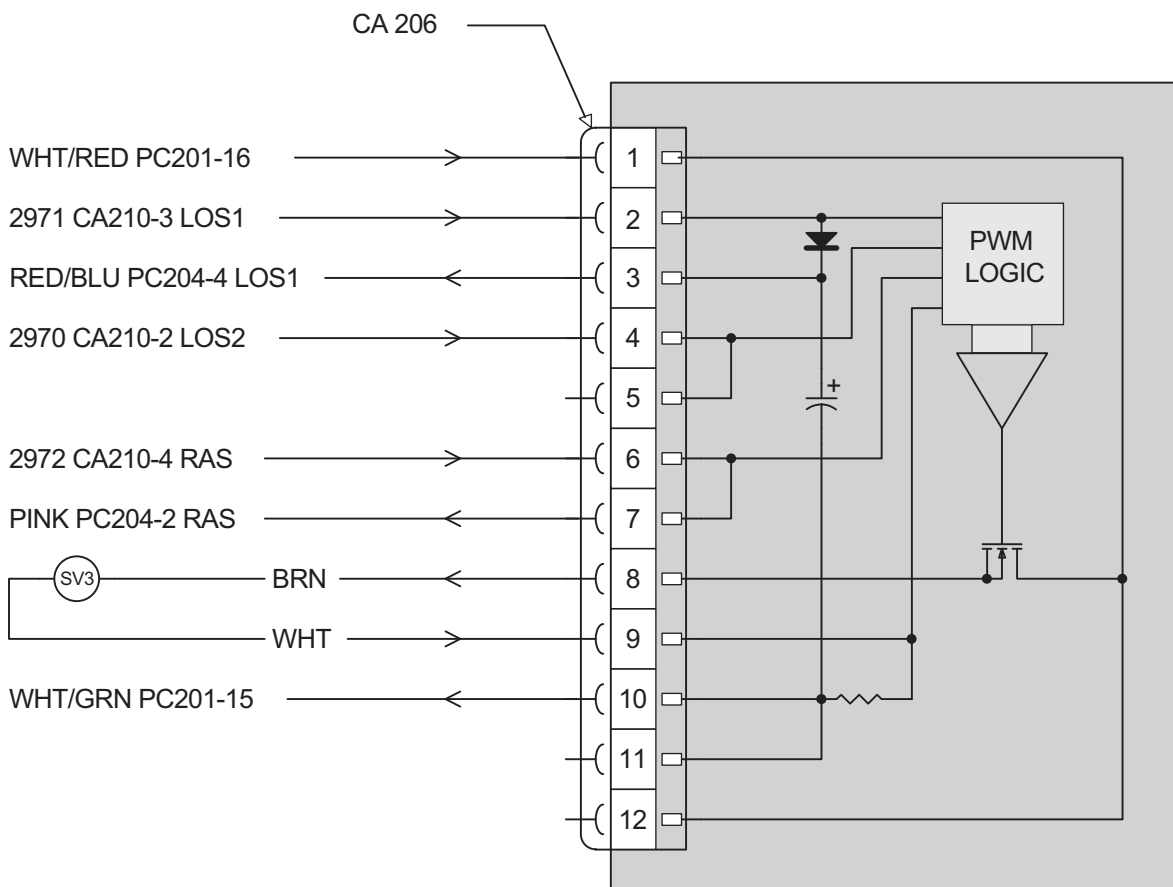
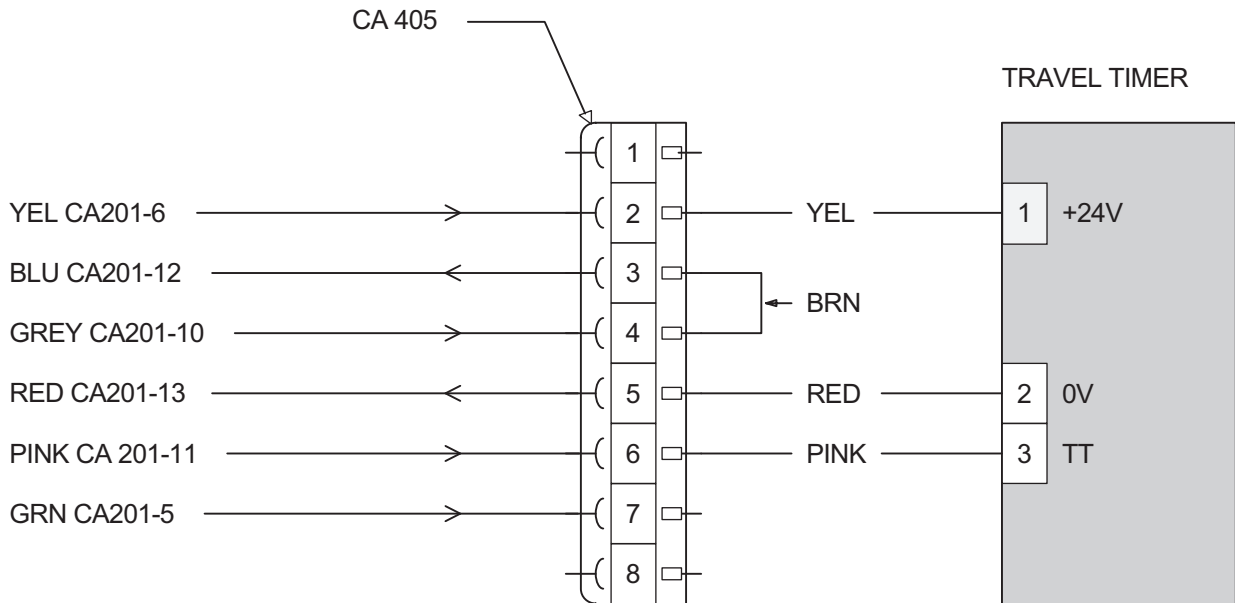
813519_2B_5

SCHEMATIC DIAGRAMS

WE S / WS S up to serial no. 5A132186



Instrument & Proportional Electronic Circuit, Standard



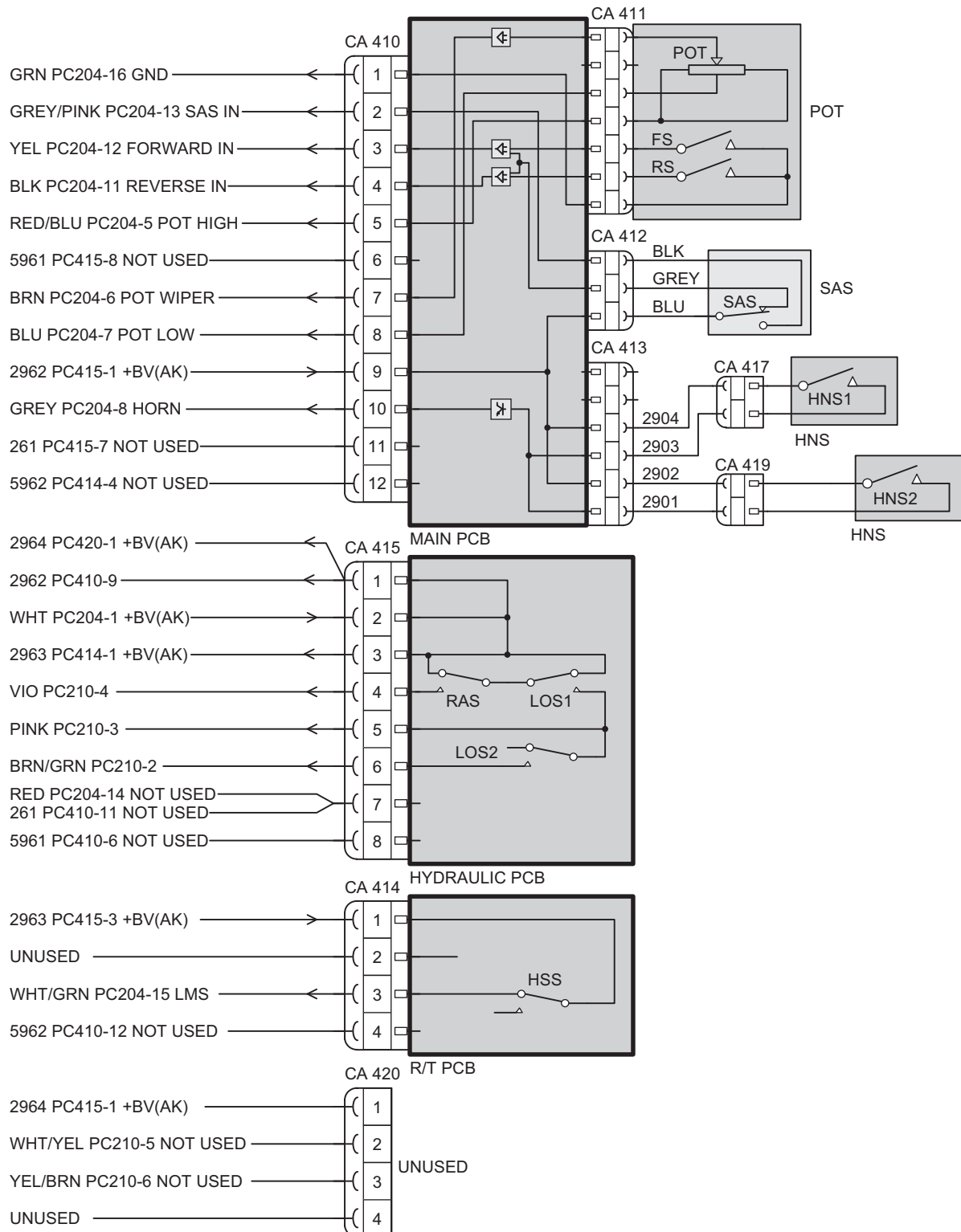
813519_2B_6



SCHEMATIC DIAGRAMS

WE S / WS S up to serial no. 5A132186

Control Handle Circuit, Standard



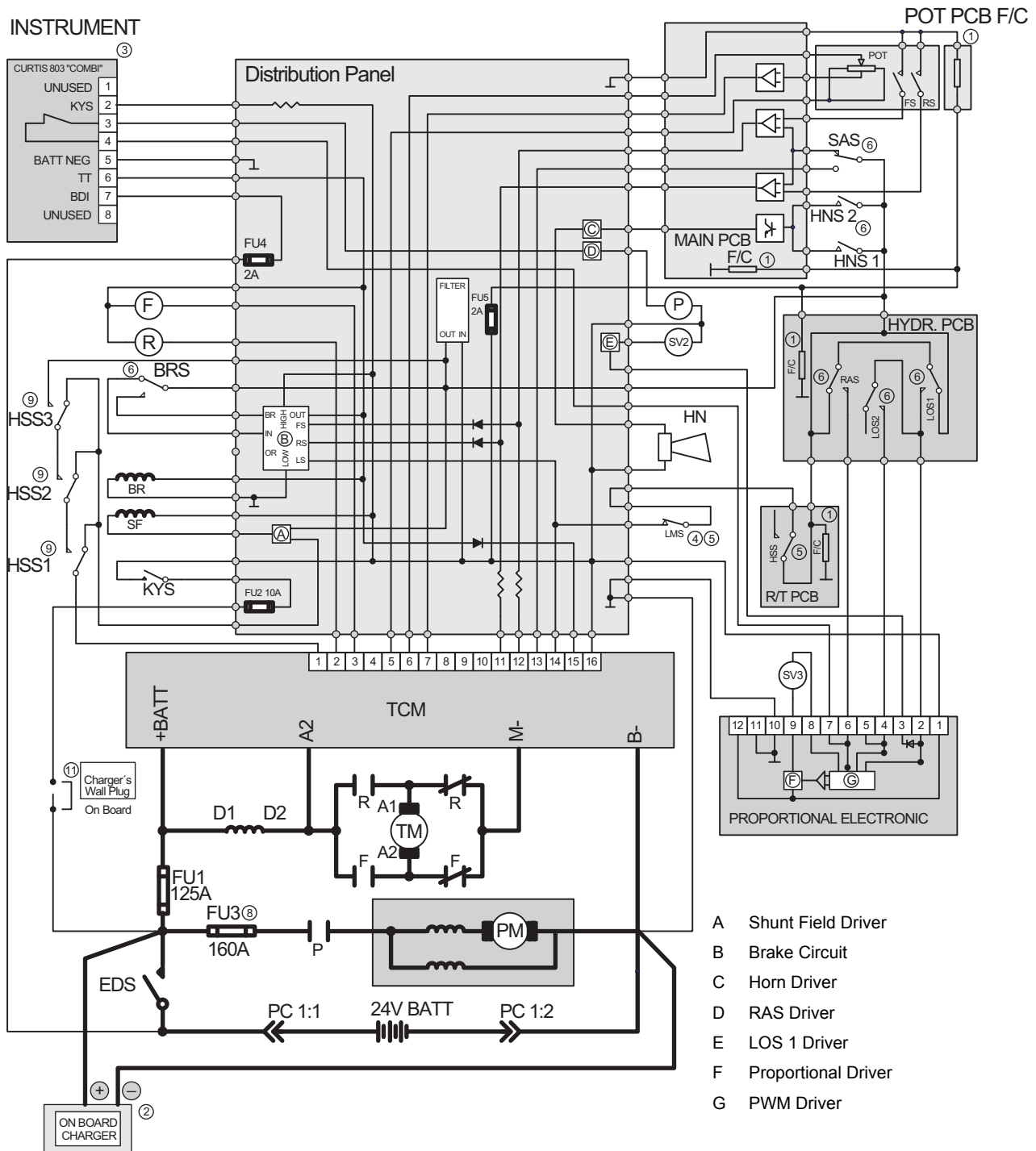
813519_2B_7

SCHEMATIC DIAGRAMS

WE S / WS S up to serial no. 5A132186



Schematic Diagram, Option



813520_2B_1

For key refer to following page



SCHEMATIC DIAGRAMS

WE S / WS S up to serial no. 5A132186

Key to Fig. 813520_2B_1 (see page 260)

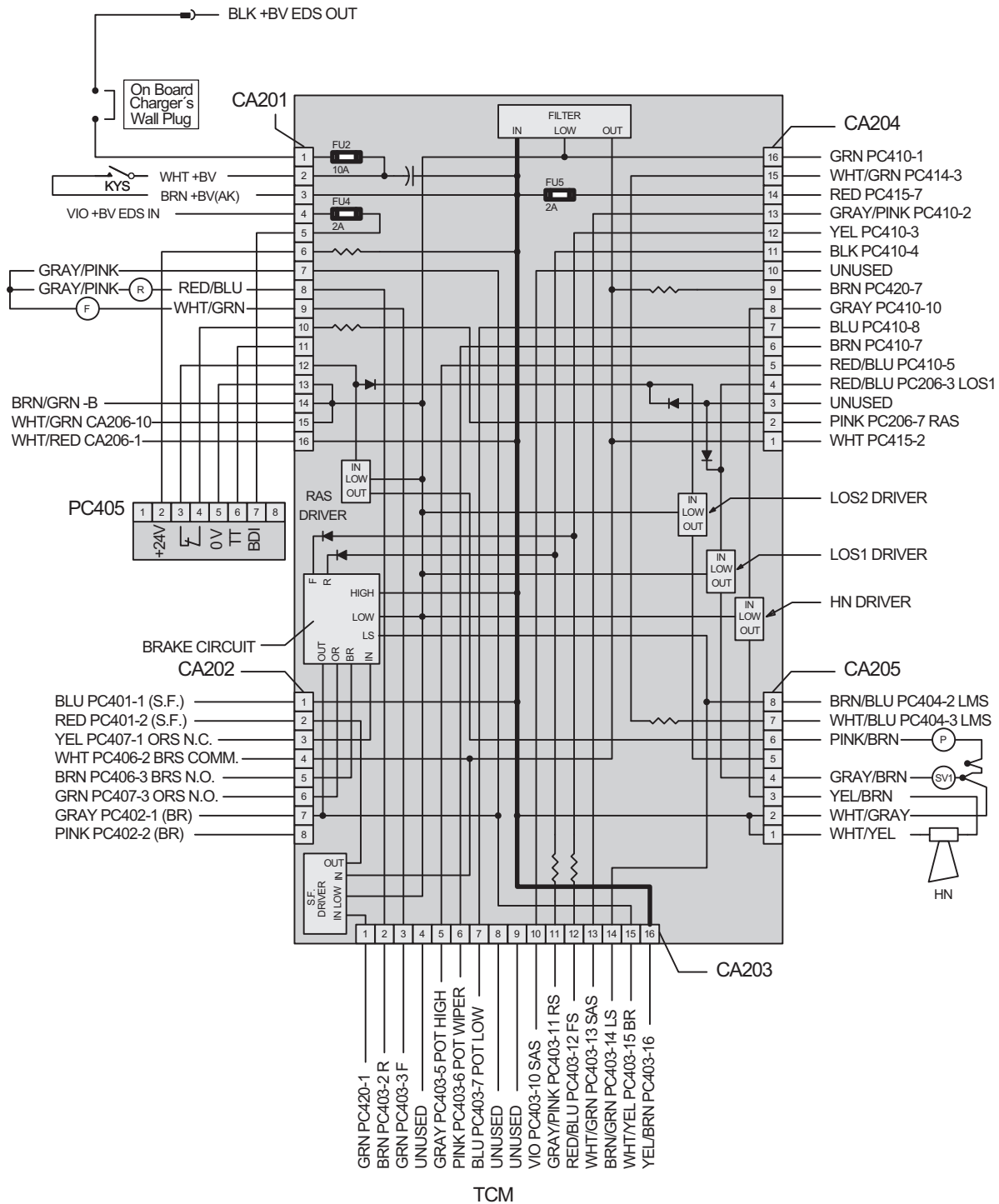
- | | | | |
|----|--|----|---|
| 1 | F / C package connection | 2 | On board charger connection |
| 3 | Curtis 803, Unigage | 4 | Forks higher than 250-2300 mm (depends on mast type):
LMS open |
| 5 | Reduced speed: HSS or / and LMS open | 6 | Active: RAS, BRS, SAS, HNS, LOS1 & LOS2 are closed |
| 7 | F / C package: active below 5 °C | 8 | For North American truck only: FU3 = 125A |
| 9 | Walkie Mode: HSS3 & / or HSS2 & / or HSS1 open | 10 | This is an overview drawing. For connections see pages 2-7 |
| 11 | For plug holder & LED connections, see 805835 | | |

SCHEMATIC DIAGRAMS

WE S / WS S up to serial no. 5A132186



Distribution Panel, Option



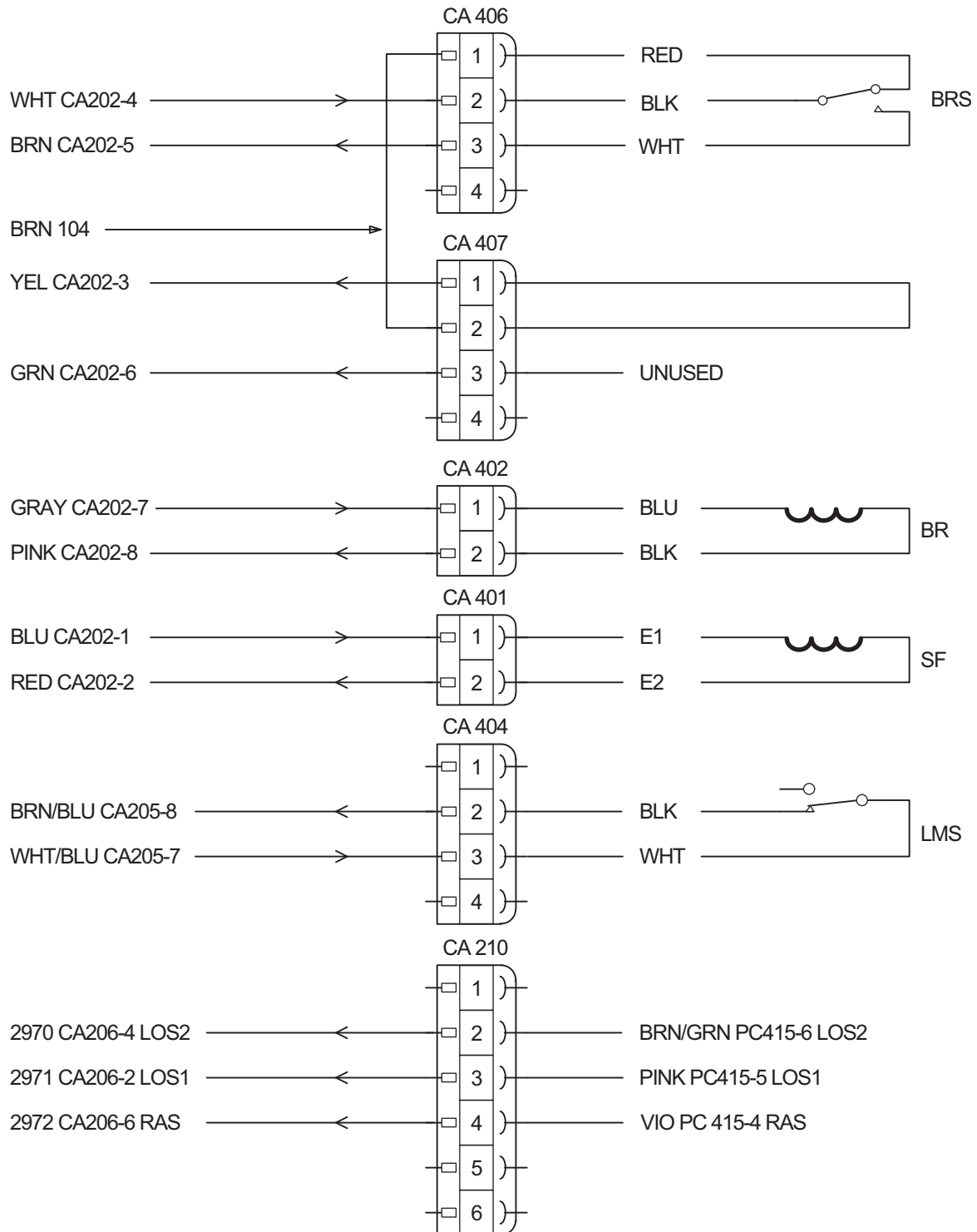
813520_2B_2

SCHEMATIC DIAGRAMS

WE S / WS S up to serial no. 5A132186



Brake Circuit, Option



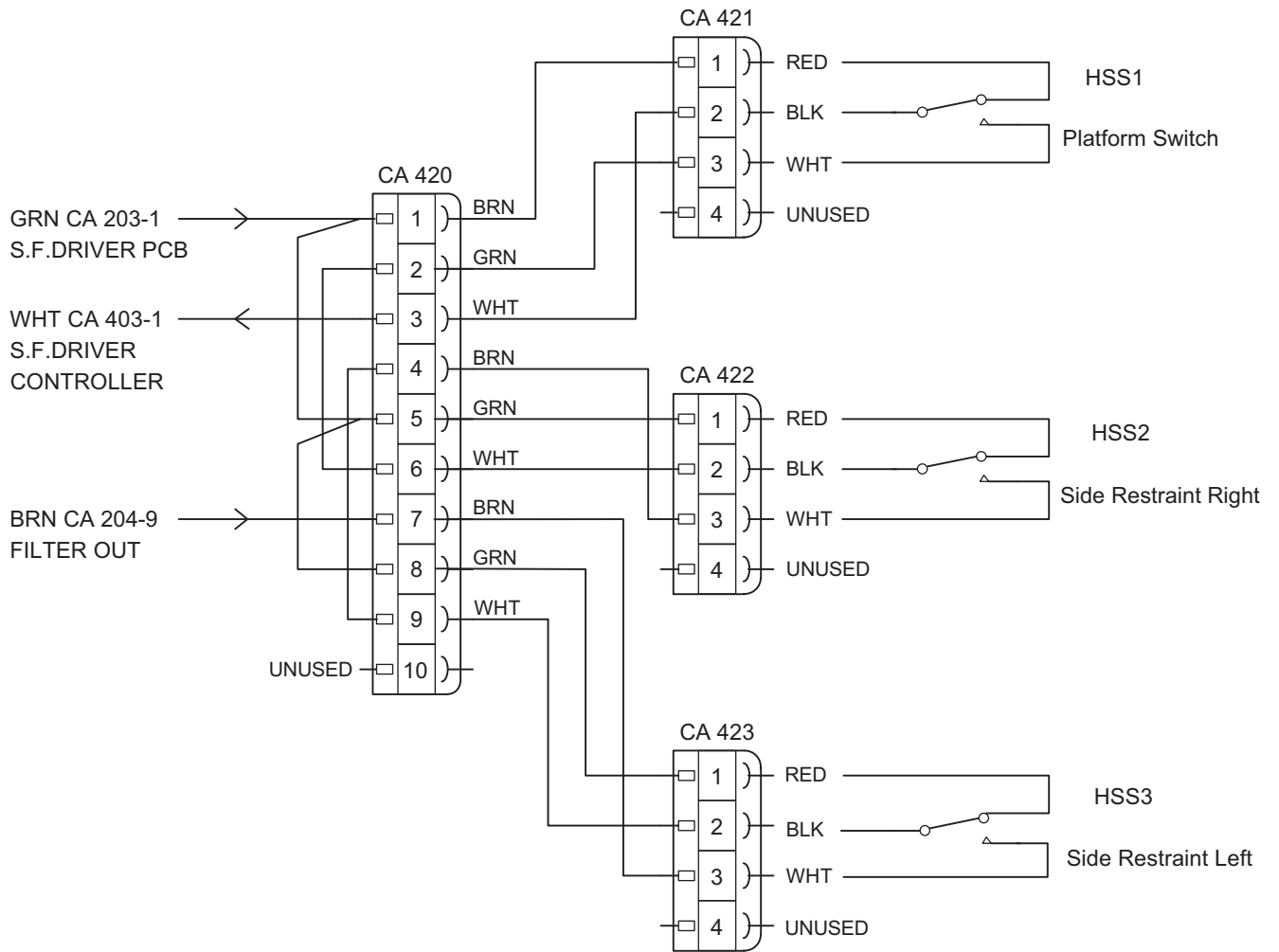
813520_2B_4



SCHEMATIC DIAGRAMS

WE S / WS S up to serial no. 5A132186

Walkie / Rider Circuit, Option



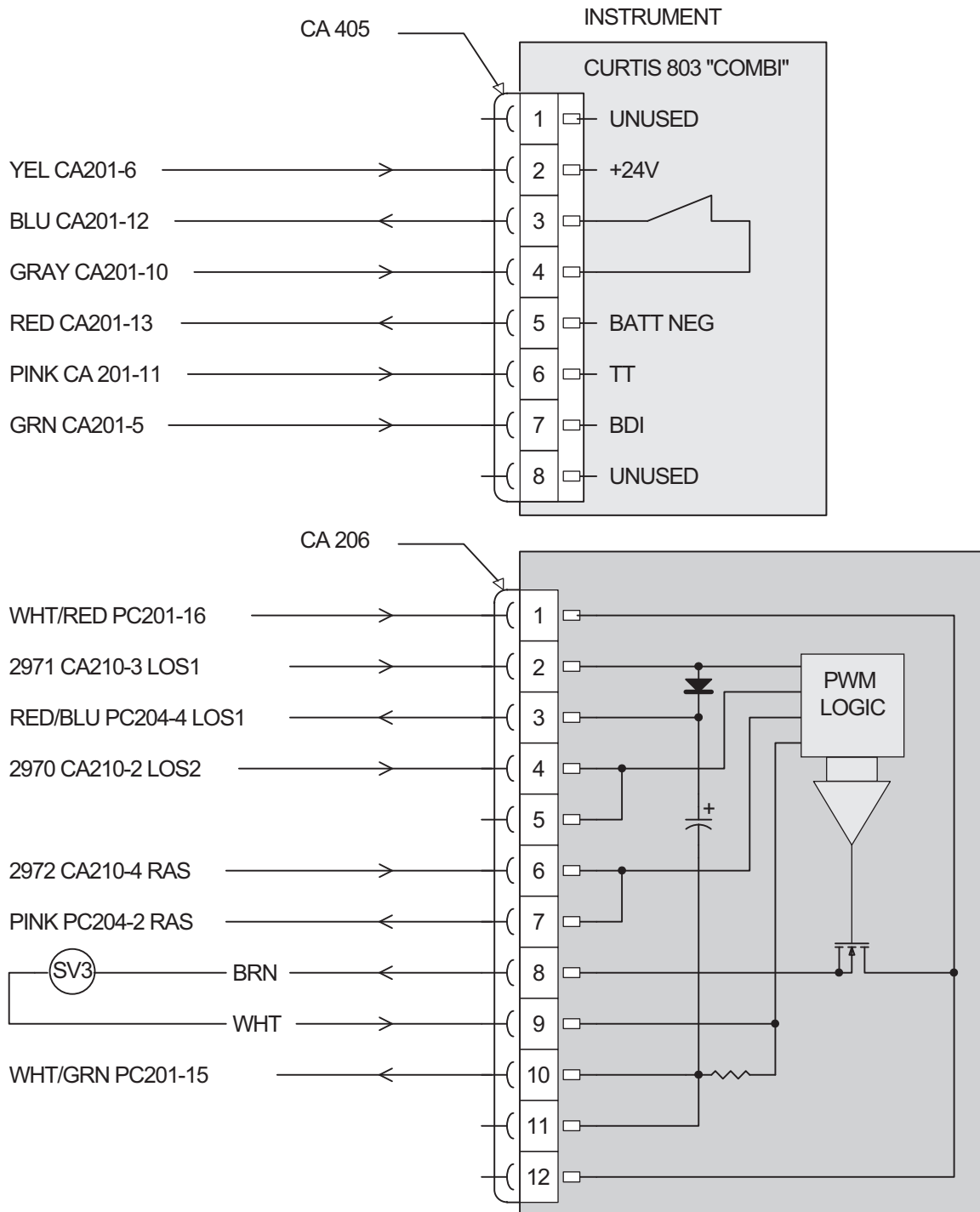
813520_2B_5

SCHEMATIC DIAGRAMS

WE S / WS S up to serial no. 5A132186



Instrument & Proportional Electronic Circuit, Option



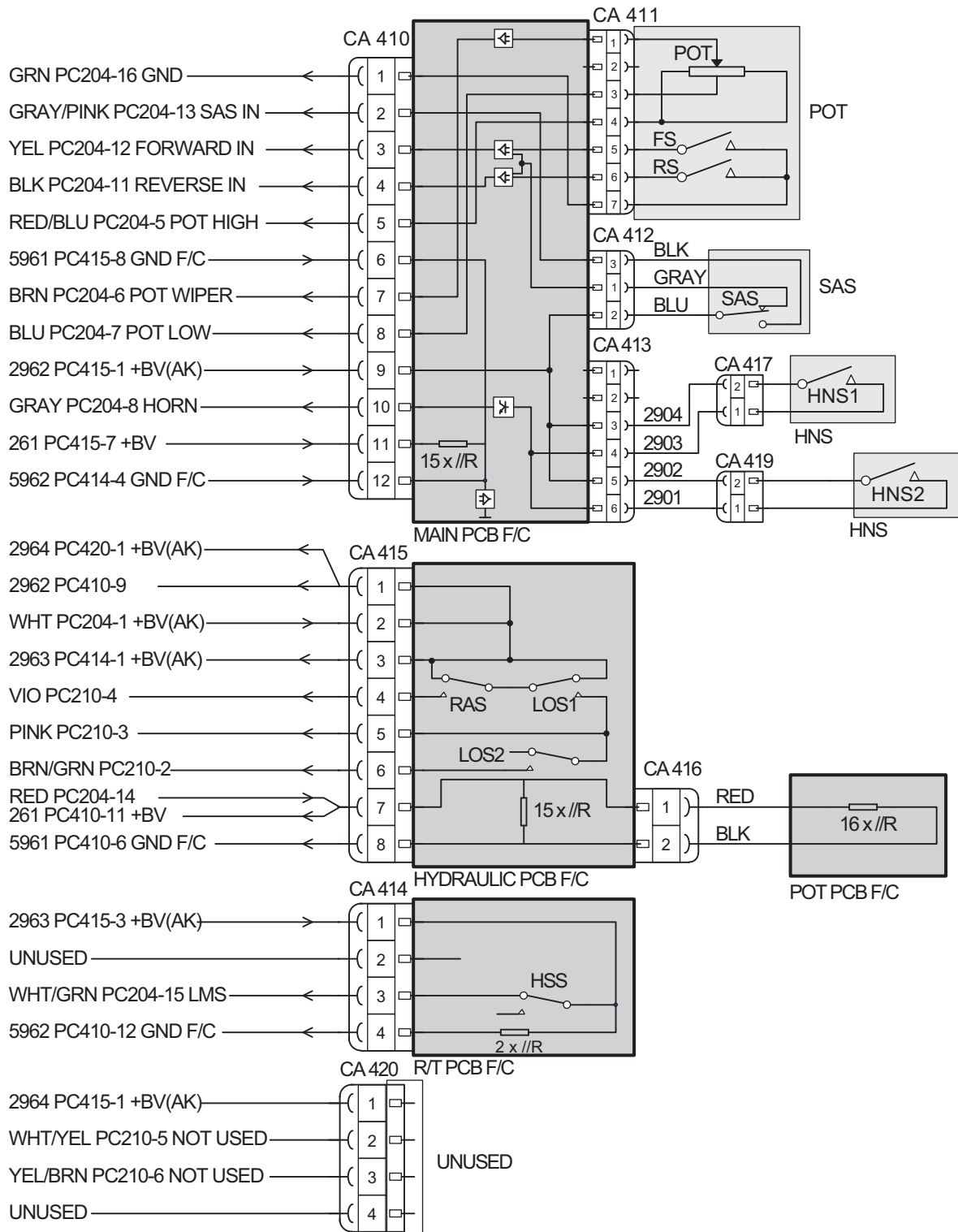
813520_2B_6



SCHEMATIC DIAGRAMS

WE S / WS S up to serial no. 5A132186

Control Handle Circuit, Option



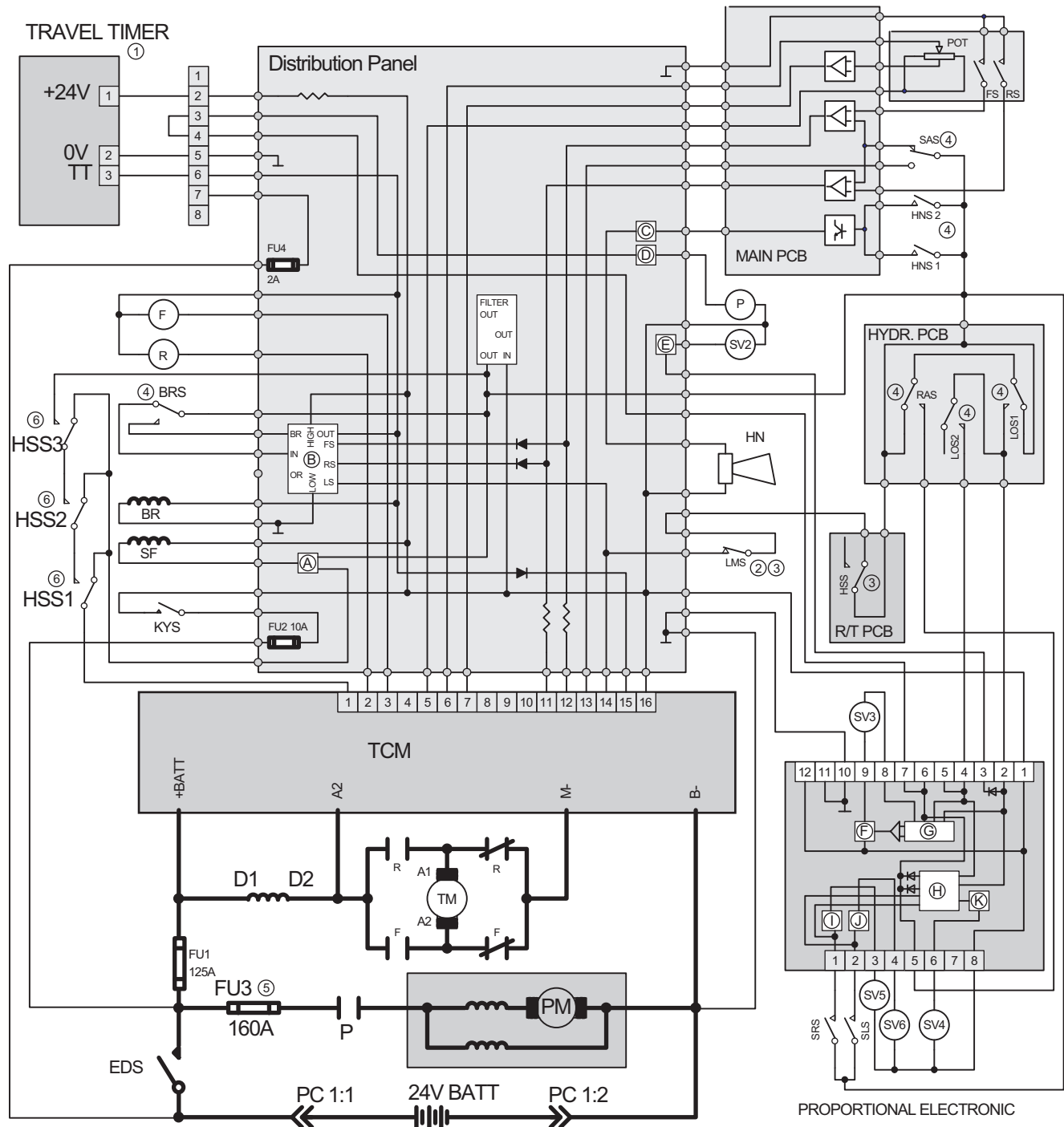
813520_2B_7

SCHEMATIC DIAGRAMS

WE S / WS S up to serial no. 5A132186



Schematic Diagram, Auxiliary Hydraulics



813716_2B_1

For key refer to following page



SCHEMATIC DIAGRAMS

WE S / WS S up to serial no. 5A132186

Key to Fig. (see Fig. 813716_2B_1) (see page 268)

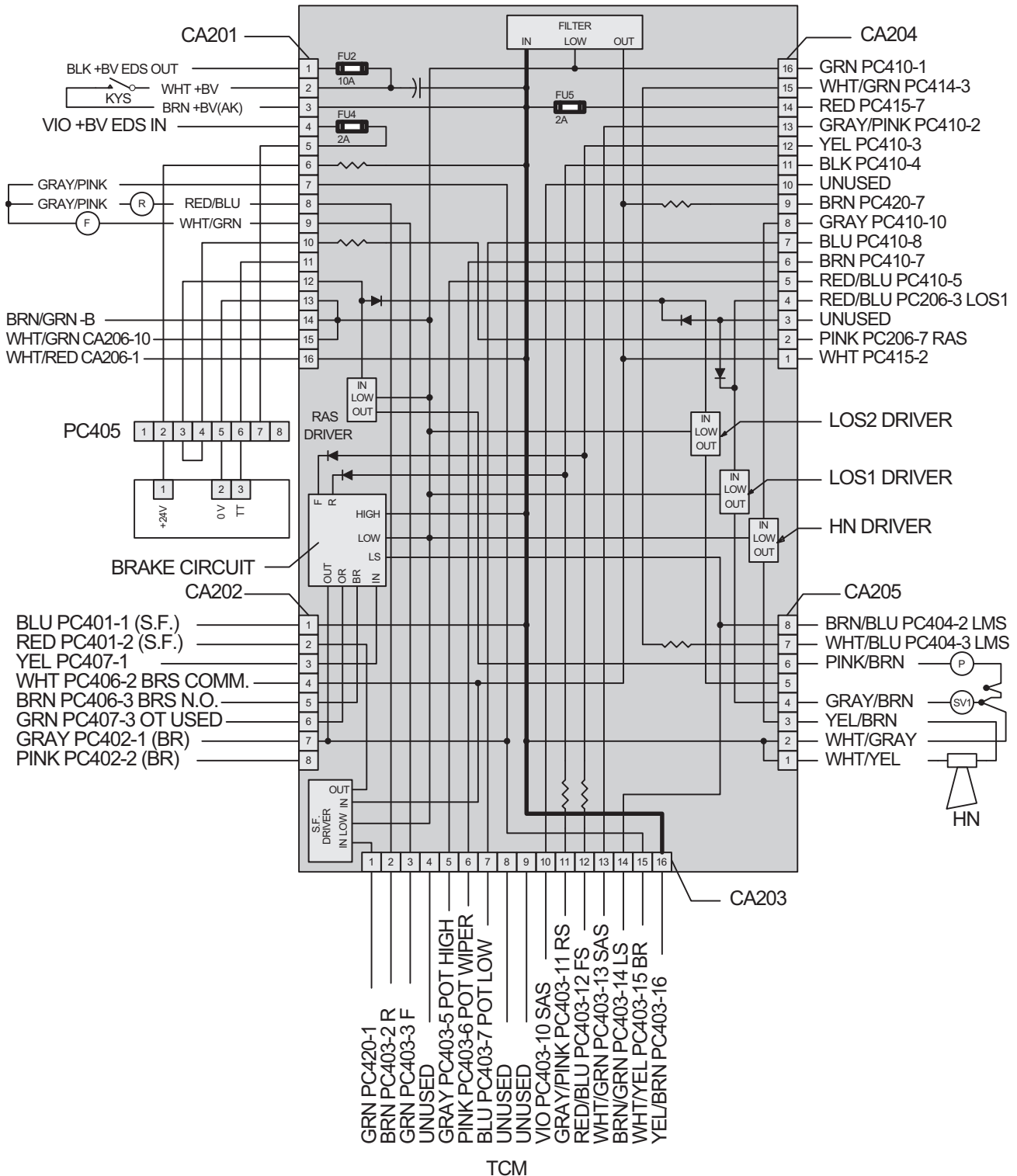
- | | | | |
|---|--|---|---|
| A | Shunt Field Driver | B | Brake Circuit |
| C | Horn Driver | D | RAS Driver |
| E | LOS1 Driver | F | Proportional Diver |
| G | PWM Logic | H | Priority Logic |
| I | Side Shift Right Switch Driver | J | Side Shift Left Switch Driver |
| K | Change Over Valve Driver | | |
| 1 | Travel Timer | 2 | Forks higher than 250-2300 mm (depends on mast type):
LMS open |
| 3 | Reduced speed: HSS or / and LMS open | 4 | Active: RAS, BRS, SAS, HNS, LOS1 & LOS2 are closed |
| 5 | For North American truck only: FU3 = 125 A | 6 | Walkie Mode: HSS3 & / or HSS2 & or Hss1 open |
| 7 | This is an overview drawing. | | |

SCHEMATIC DIAGRAMS

WE S / WS S up to serial no. 5A132186



Distribution Panel, Auxiliary Hydraulics



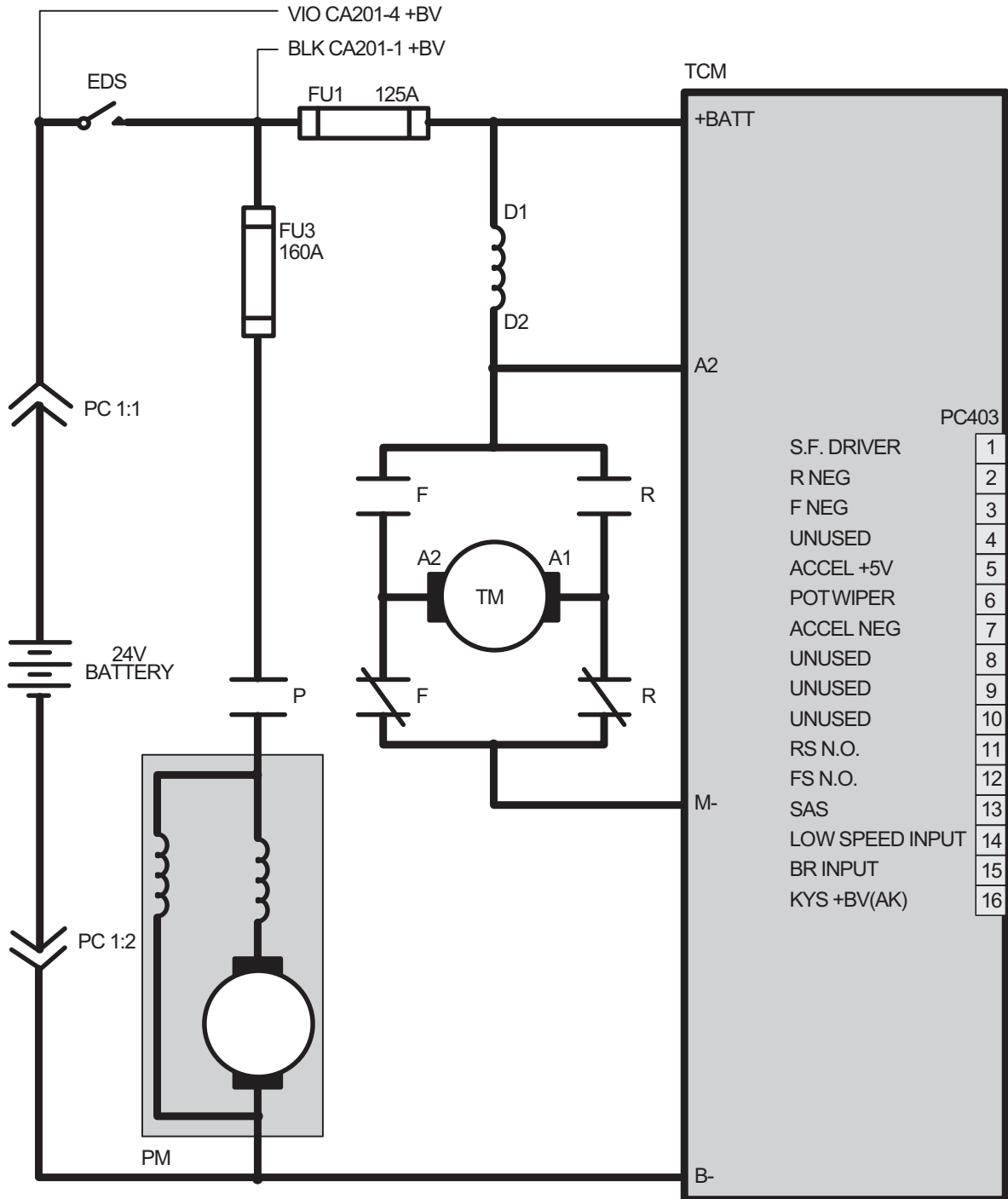
813716_2B_2



SCHEMATIC DIAGRAMS

WE S / WS S up to serial no. 5A132186

Traction Controller, Power Side, Auxiliary Hydraulics



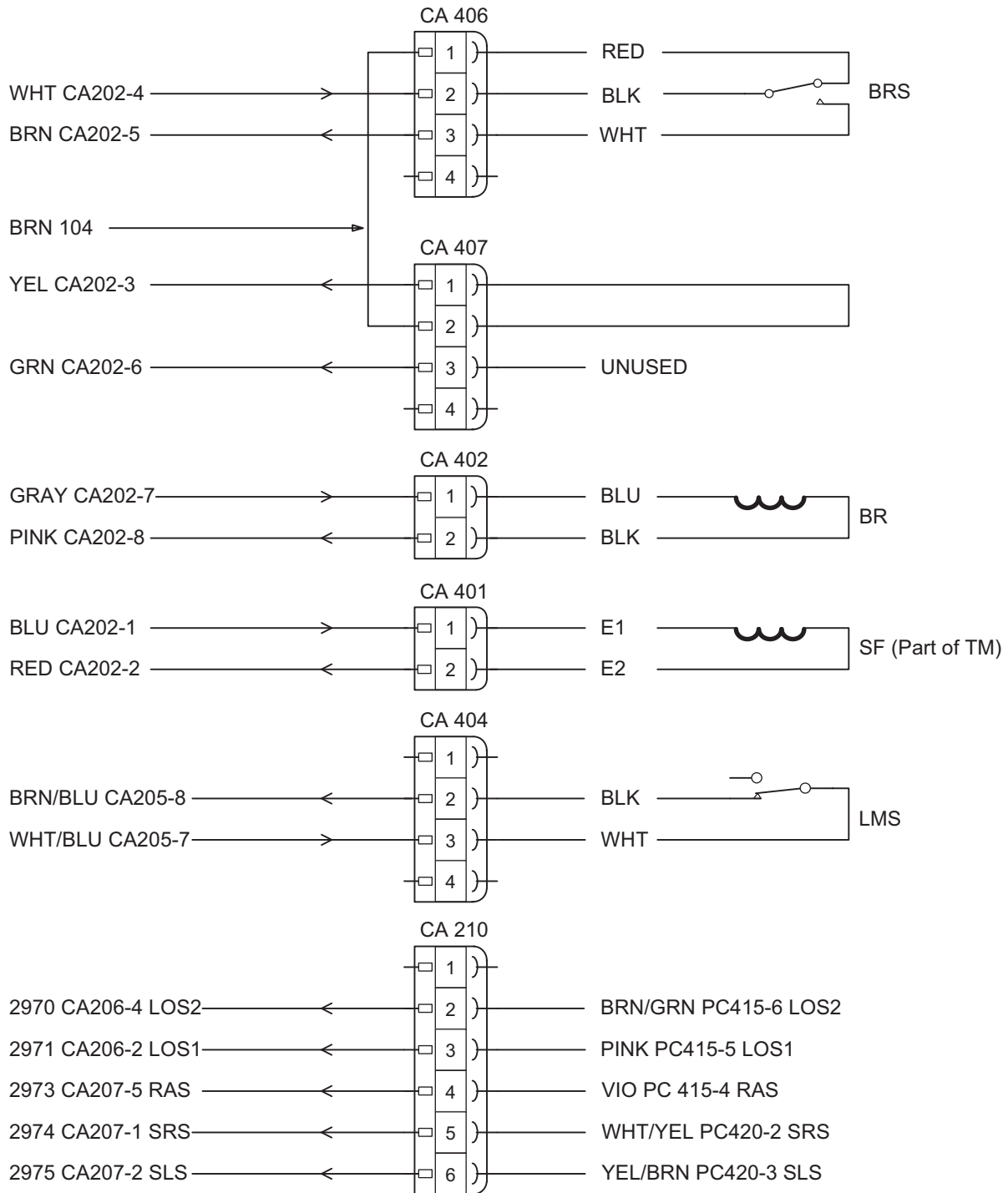
813716_2B_3

SCHEMATIC DIAGRAMS

WE S / WS S up to serial no. 5A132186



Brake Circuit, Auxiliary Hydraulics



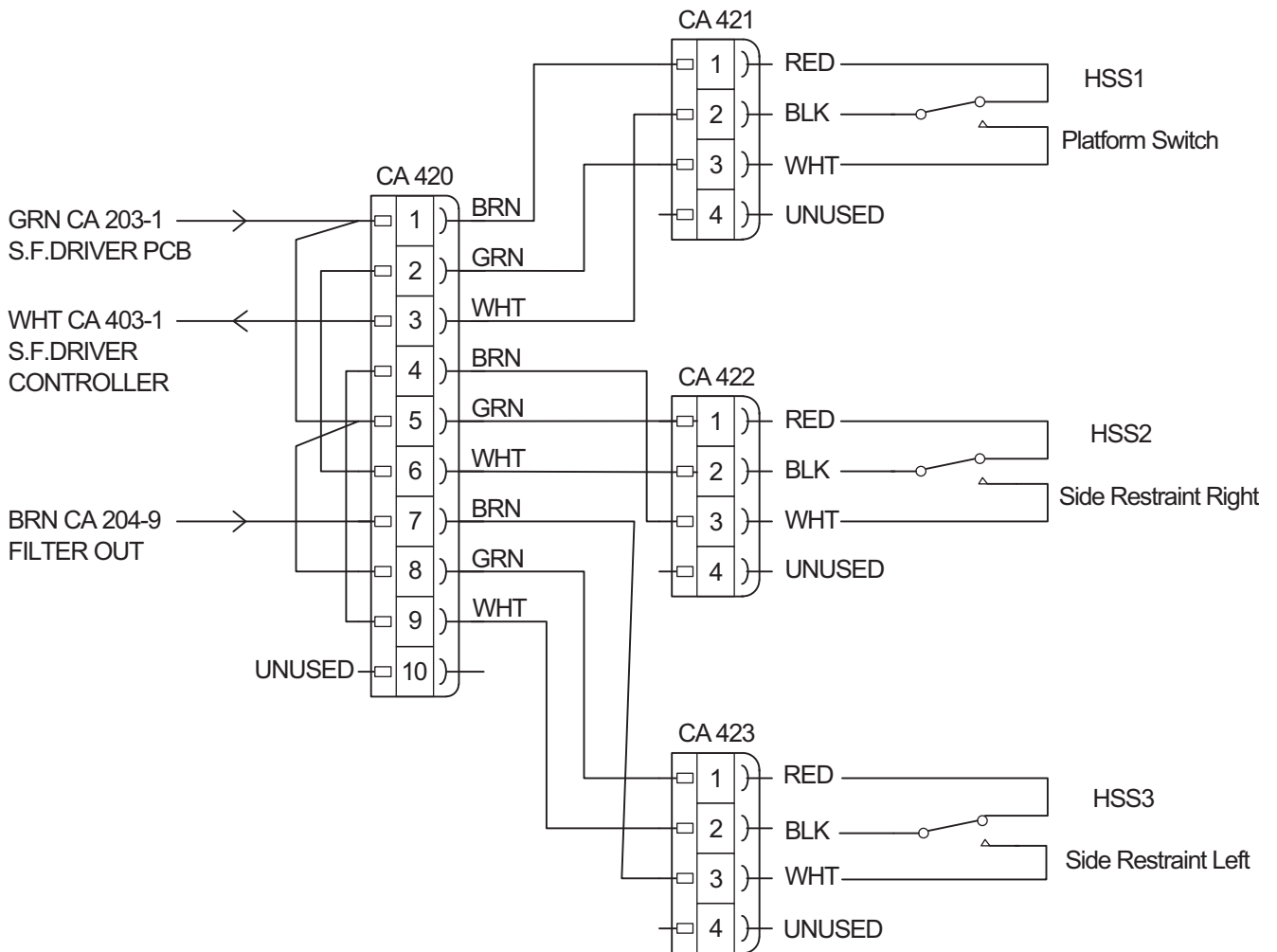
813716_2B_4



SCHEMATIC DIAGRAMS

WE S / WS S up to serial no. 5A132186

Walkie / Rider Circuit, Auxiliary Hydraulics



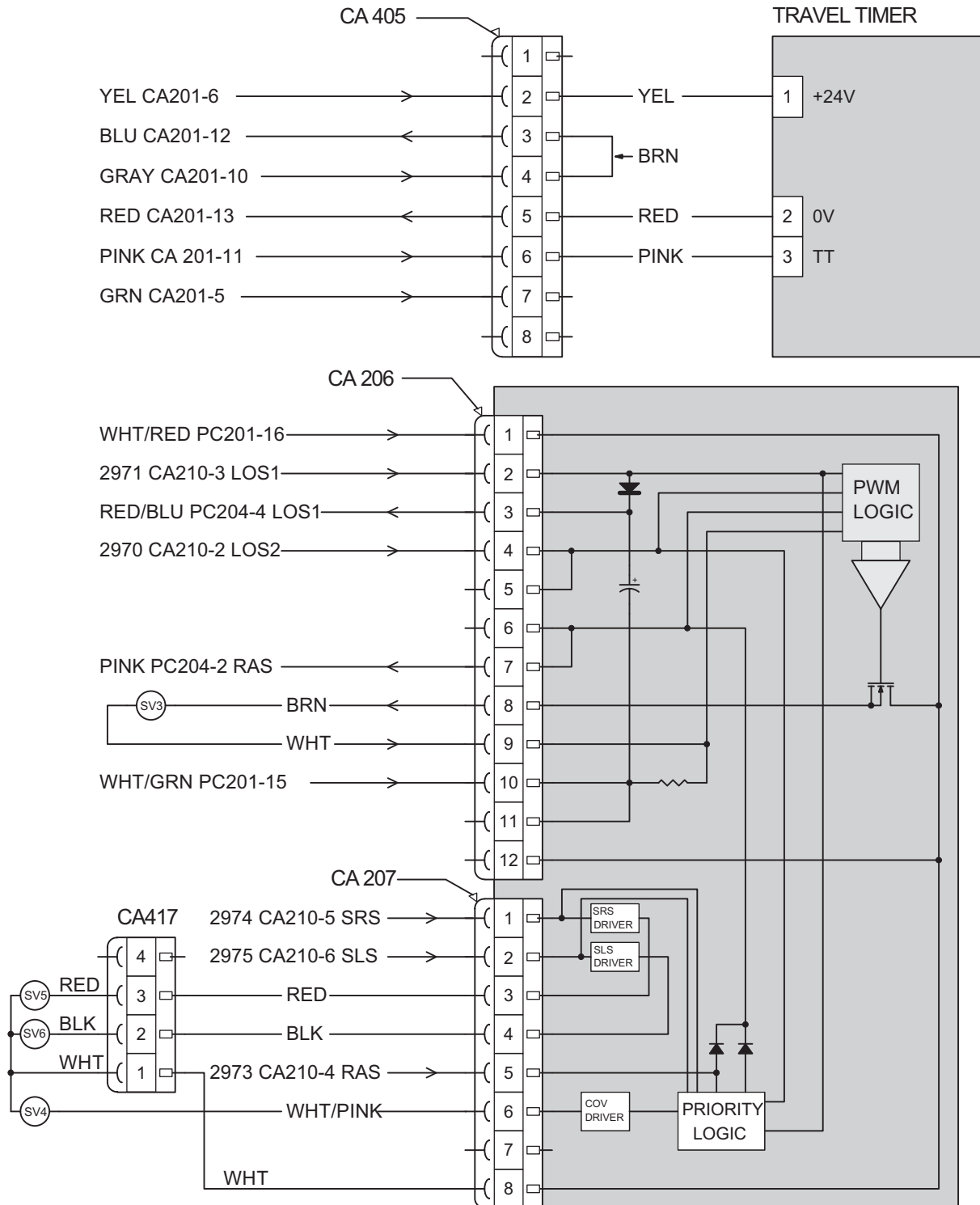
813716_2B_5

SCHEMATIC DIAGRAMS

WE S / WS S up to serial no. 5A132186



Instrument & Prop. Electronics & Sideshift Circuit, Auxiliary Hydraulics



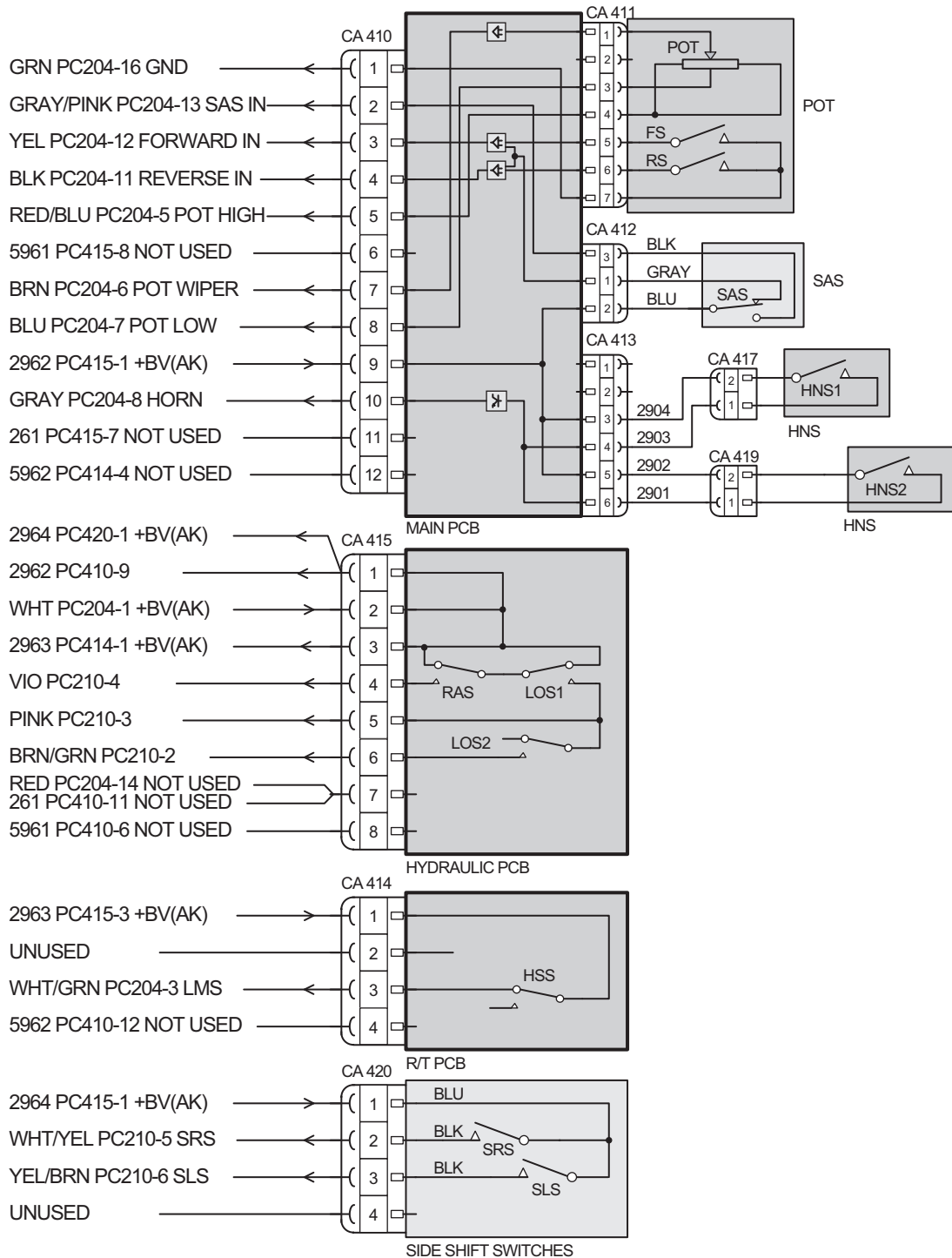
813716_2B_6



SCHEMATIC DIAGRAMS

WE S / WS S up to serial no. 5A132186

Control Handle Circuit, Auxiliary Hydraulics



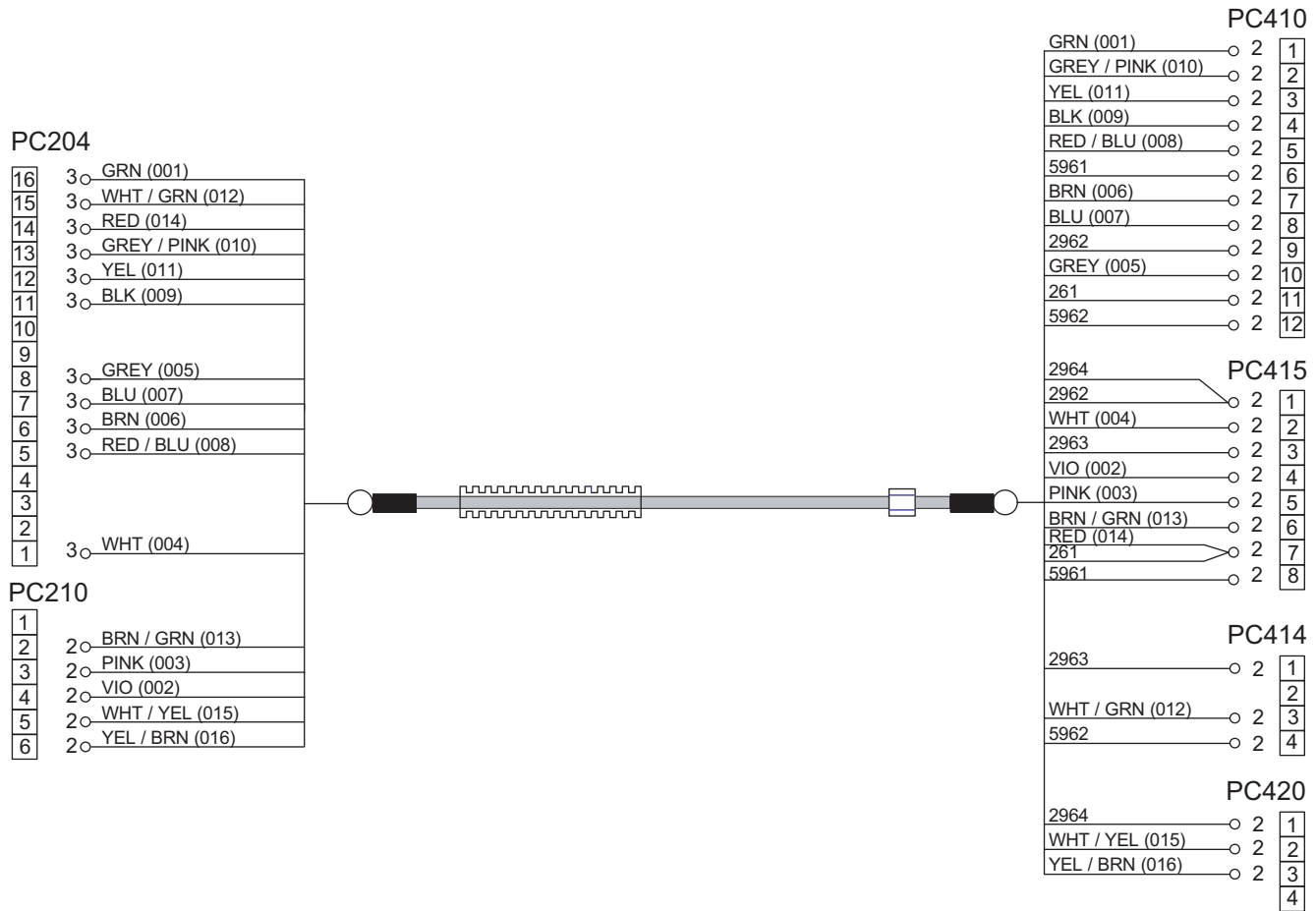
813716_2B_7

SCHEMATIC DIAGRAMS

WE S / WS S up to serial no. 5A132186



Control Handle Harness



813426_2C

Connector housing

Housing	Order Number
PC204	803452-002
PC210	803450-007
PC410	803450-009
PC414	803450-020
PC415	803450-008
PC420	803450-006

Contact pins

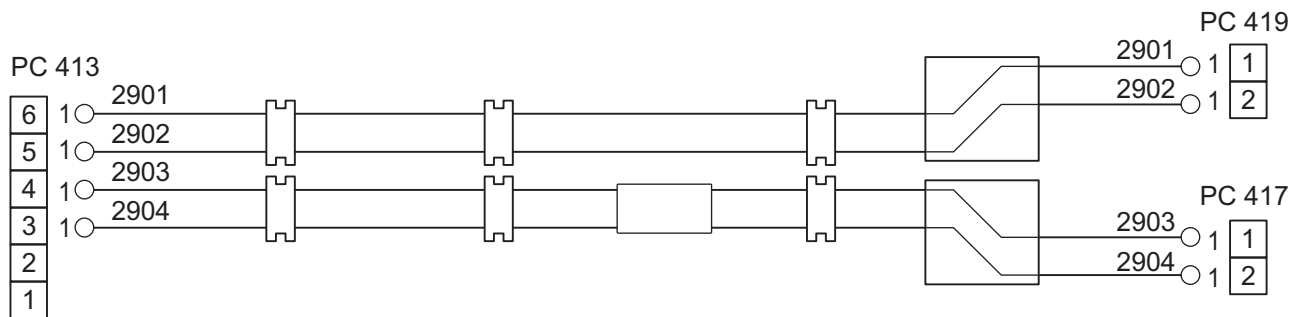
Item No.	Order Number
2	116858
3	803452-005



SCHEMATIC DIAGRAMS

WE S / WS S up to serial no. 5A132186

Horn Harness



811931_2E_1

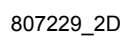
Connector housing

Housing	Order Number
PC413	803450-021
PC419	803450-023
PC417	803450-023

Contact pins

Item No.	Order Number
2	803450-022
3	803450-024

Main Harness, Auxiliary Hydraulics



WE/WS 2300

SCHEMATIC DIAGRAMS

WE S / WS S up to serial no. 5A132186



For tables for Fig. 807229_2D (see page 241)

Connector housing

Housing	Order Number
PC201	803452-002
PC205	803452-001
JC404	803450-002
PC405	803450-008

Contact pins

Item No.	Order Number
1	803450-010
2	116858
3	803452-005
4	062007-021
6	803448-003
7	062007-050
8	062007-063
1	803450-010

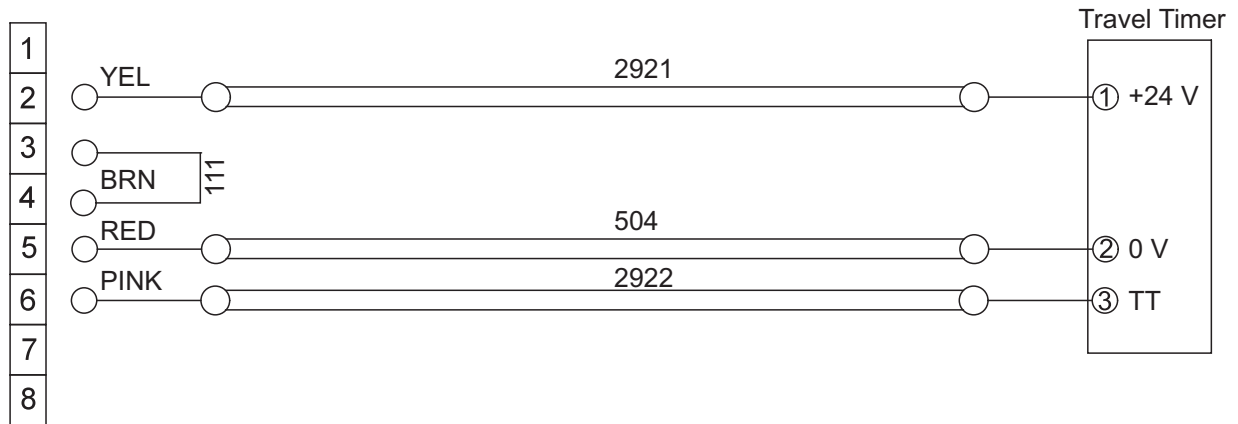


SCHEMATIC DIAGRAMS

WE S / WS S up to serial no. 5A132186

Hourmeter Harness

PC405



803545_2C

Connector housing

Housing	Order Number
PC405	803450-004

Contact pins

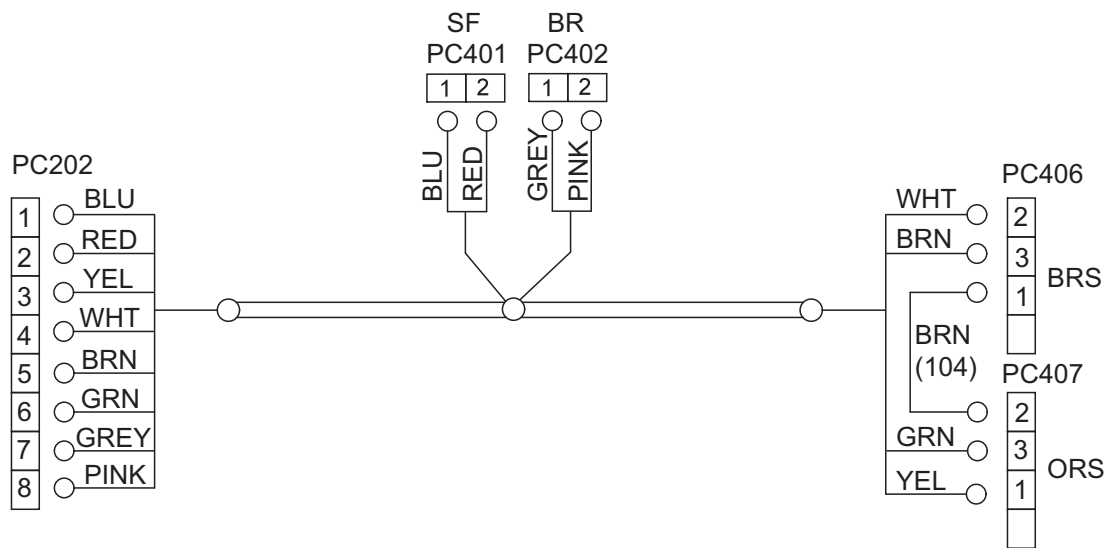
Item No.	Order Number
---	062007-043

SCHEMATIC DIAGRAMS

WE S / WS S up to serial no. 5A132186



Harness, Brake



803460_2F

Connector housing

Housing	Order Number
PC202	803452-001
PC406 PC407	803450-002
PC401	803450-005 803450-001
PC402	803450-001 803450-005

Contact pins

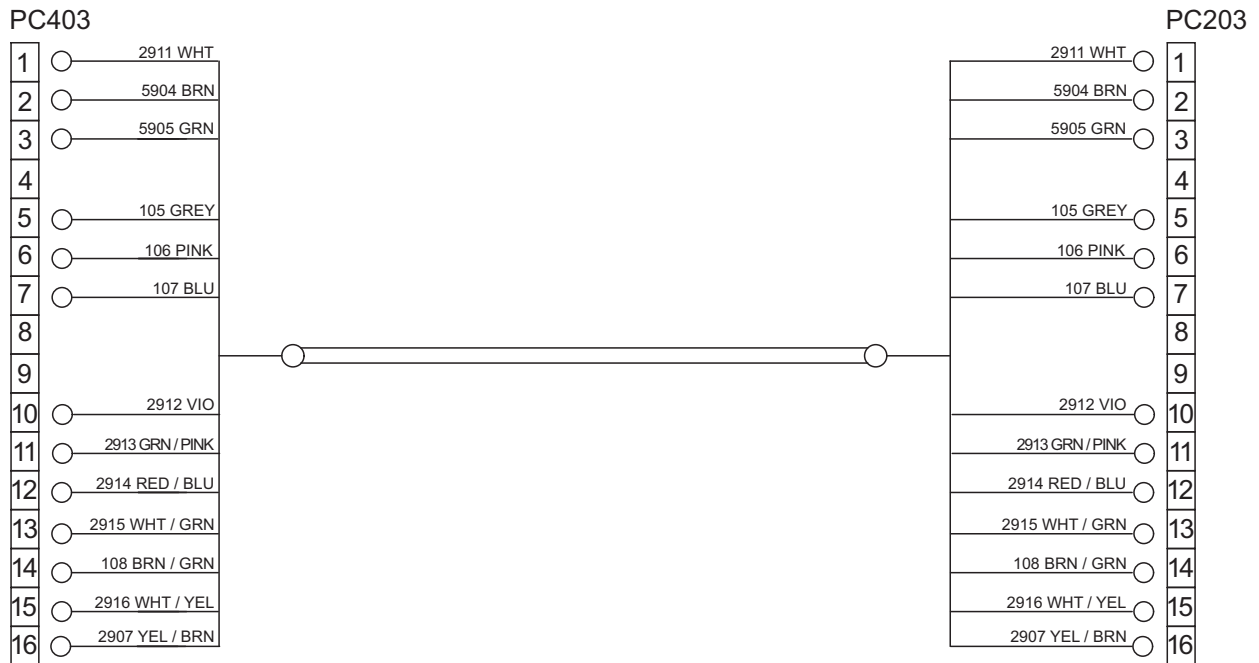
Item No.	Order Number
1	803450-010
2	803452-006
3	803452-005
4	116858



SCHEMATIC DIAGRAMS

WE S / WS S up to serial no. 5A132186

Harness, Control Module



803462_2D

Connector housing

Housing	Order Number
PC203	803452-002
PC403	116851

Contact pins

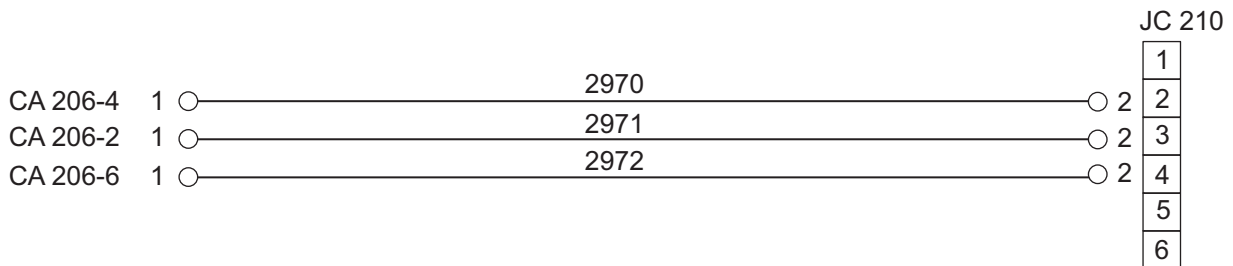
Item No.	Order Number
1	116858
2	803452-005

SCHEMATIC DIAGRAMS

WE S / WS S up to serial no. 5A132186



Proportional Hydraulics Connector Lead, Standard



813472_2A

Connector housing

Housing	Order Number
LC210	803450-003

Contact pins

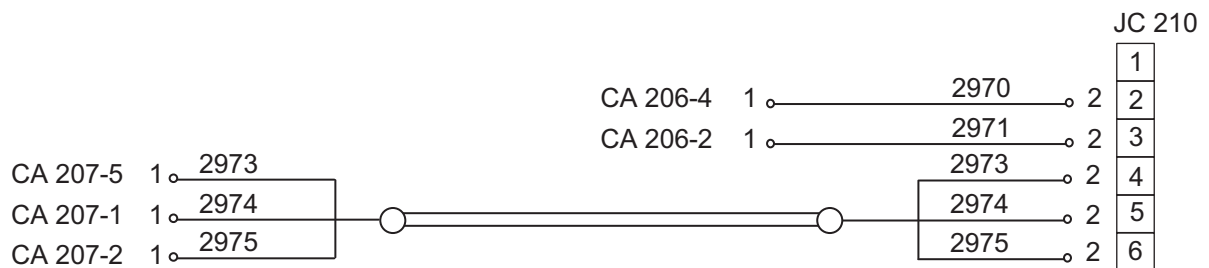
Item No.	Order Number
1	803452-005
2	803450-010



SCHEMATIC DIAGRAMS

WE S / WS S up to serial no. 5A132186

Proportional Hydraulics Connector Lead, Standard, Auxiliary Hydraulics



813473_2A

Connector housing

Housing	Order Number
JC210	803450-003

Contact pins

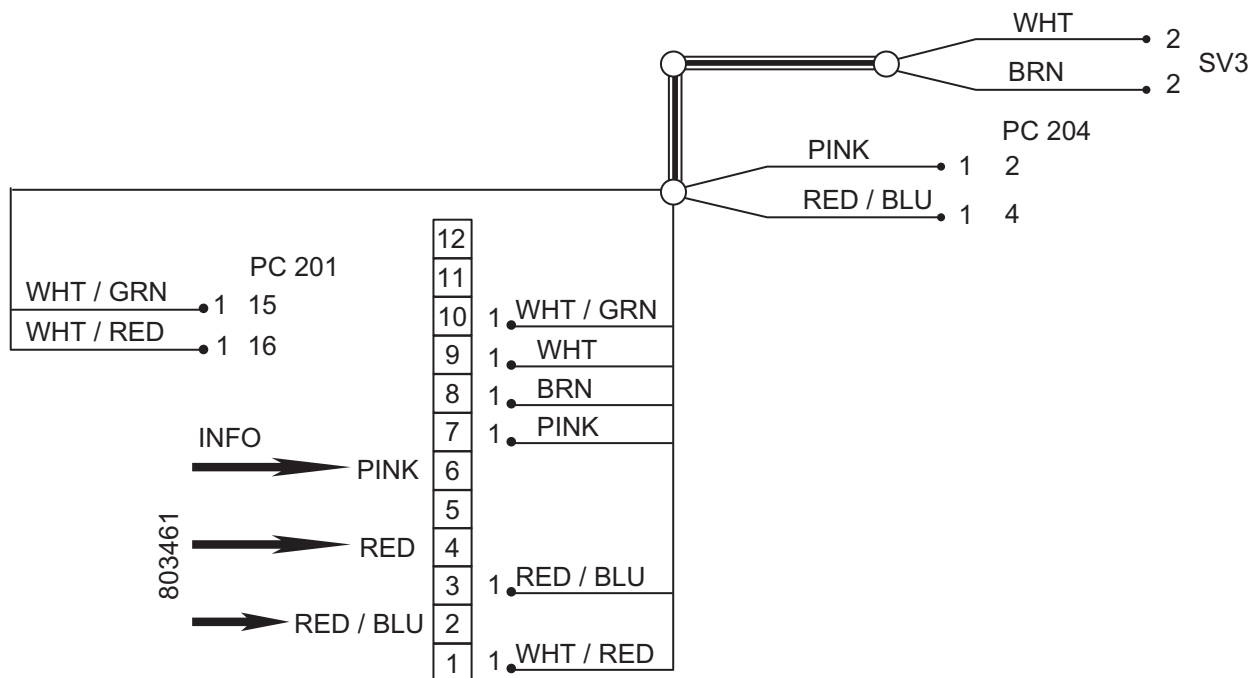
Item No.	Order Number
1	803452-005
2	803450-010

SCHEMATIC DIAGRAMS

WE S / WS S up to serial no. 5A132186



Harness, Proportional Valve



804368_2B

Connector housing

Housing	Order Number
PC206	803452-007

Contact pins

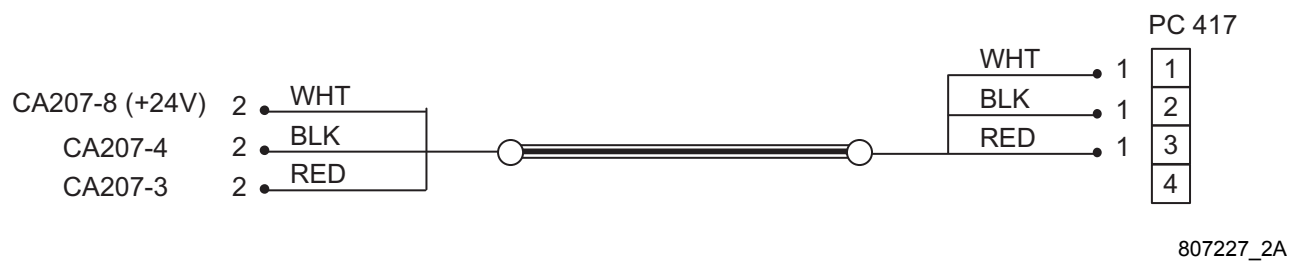
Item No.	Order Number
1	803452-005
2	062007-021



SCHEMATIC DIAGRAMS

WE S / WS S up to serial no. 5A132186

Harness, Auxiliary Hydraulics



Connector housing

Housing	Order Number
PC417	803450-006

Contact pins

Item No.	Order Number
1	116858
2	803452-006

SCHEMATIC DIAGRAMS

WE S / WS S up to serial no. 5A132186



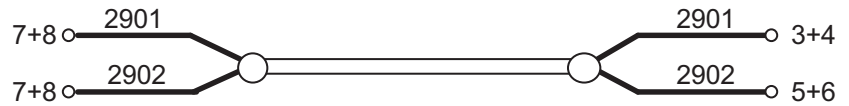
Harness, On-board charger

810528-001

Ground Lead



810528-002



810528_XB

Contact pins

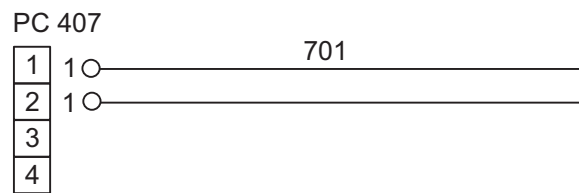
Item No.	Order Number
1	062007-044
2	062007-003
3	062007-021
4	803488-003
5	803448-004
6	803448-005
7	062007-043
8	803452-005
9	062007-051



SCHEMATIC DIAGRAMS

WE S / WS S up to serial no. 5A132186

ORS Jumper



808133_2A

Contact pins

Item No.	Order Number
1	116858
PC407	803450-006

SCHEMATIC DIAGRAMS

WE S / WS S up to serial no. 5A132186



Harness 1, Platform



Connector housing

Housing	Order Number
JC420	803450-015
PC421	803450-002
PC422	803450-002
PC423	803450-002

Contact pins

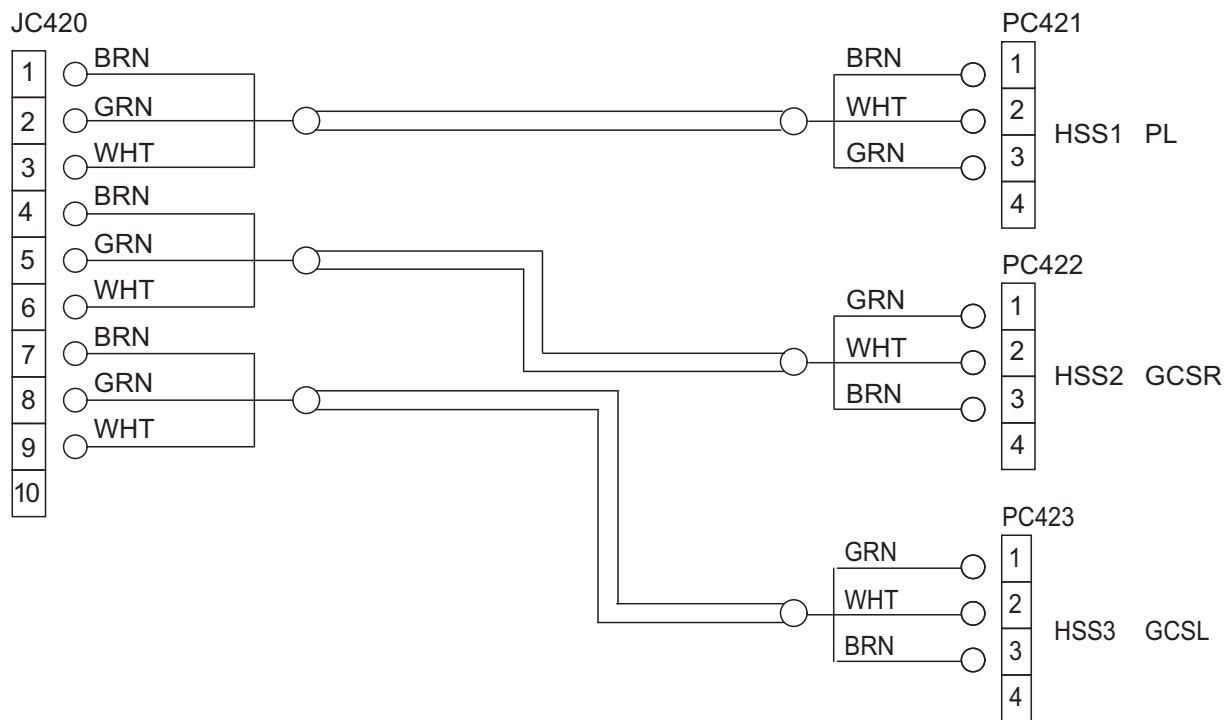
Item No.	Order Number
1	803450-010
2	116858



SCHEMATIC DIAGRAMS

WE S / WS S up to serial no. 5A132186

Harness 2, Platform



806781_2B

Connector housing

Housing	Order Number
JC420	803450-015
PC421	803450-002
PC422	803450-002
PC423	803450-002

Contact pins

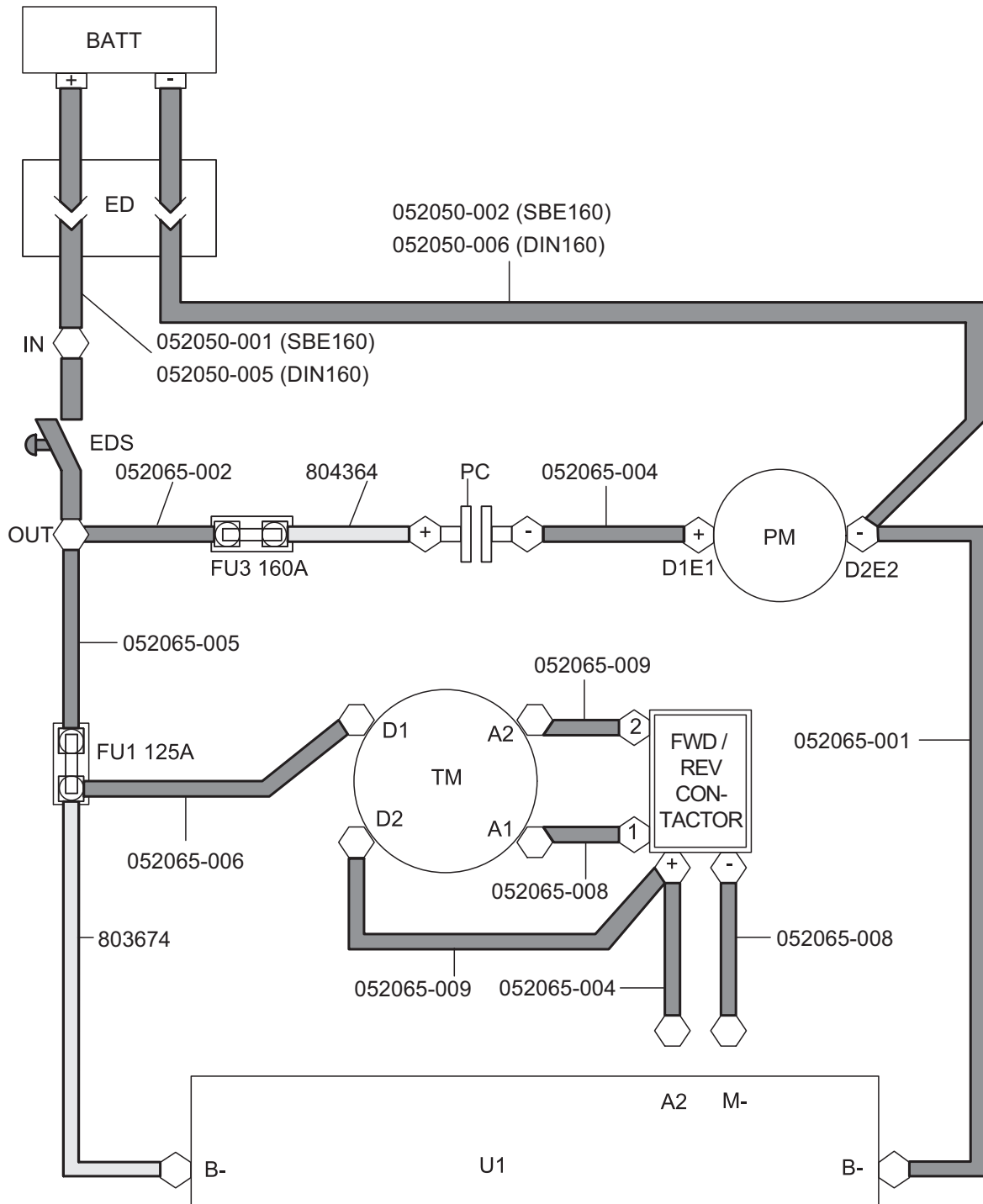
Item No.	Order Number
1	803450-010
2	116858

SCHEMATIC DIAGRAMS

WE S / WS S up to serial no. 5A132186



Power Cables



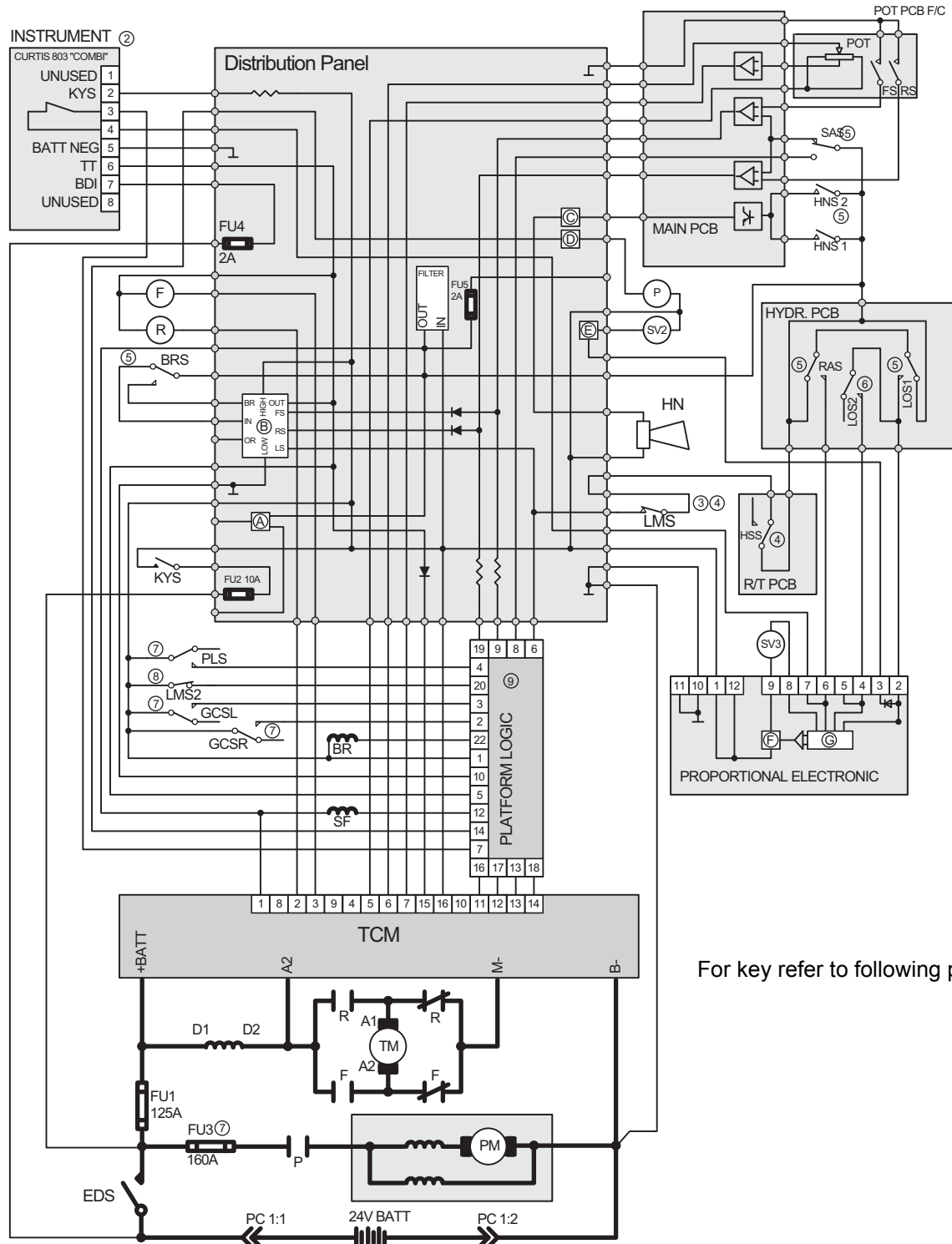
803466



SCHEMATIC DIAGRAMS

WE / WS from serial no. 5A132188 to serial no. 5A134880

Schematic Diagram, Standard



For key refer to following page

816157_2C_1

SCHEMATIC DIAGRAMS

WE / WS from serial no. 5A132188 to serial no. 5A134880



Key to Fig. 816157_2C_1 (see page 293)

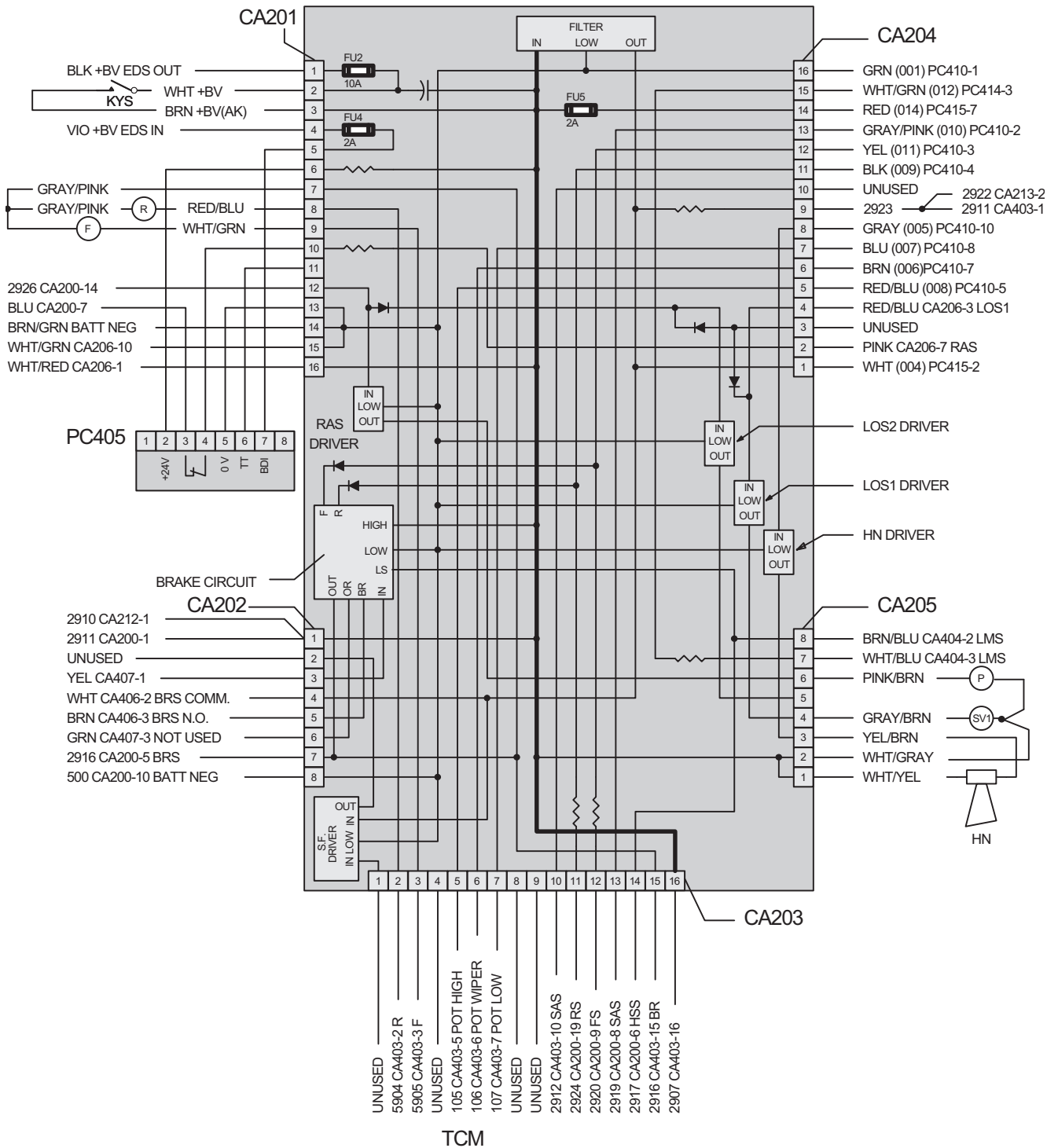
- | | | | |
|---|--|---|--|
| 1 | This is an overview drawing | 2 | Curtis 803, Unigage |
| 3 | Forks higher than 250 - 2300 mm: LMS open | 4 | Reduced speed: HSS and / or LMS open |
| 5 | Active: RAS, BRS, ORS, SAS, HNS, LOS1 are closed | 6 | For North American truck only: FU3 = 125 A |
| 7 | Walkie Mode: GCSL & GCSR & PLS open OR PLS closed & GCSL & GCSR open | 8 | LMS2 < 1700 mm closed |
| 9 | Platform Logic | | |



SCHEMATIC DIAGRAMS

WE / WS from serial no. 5A132188 to serial no. 5A134880

Distribution Panel, Standard



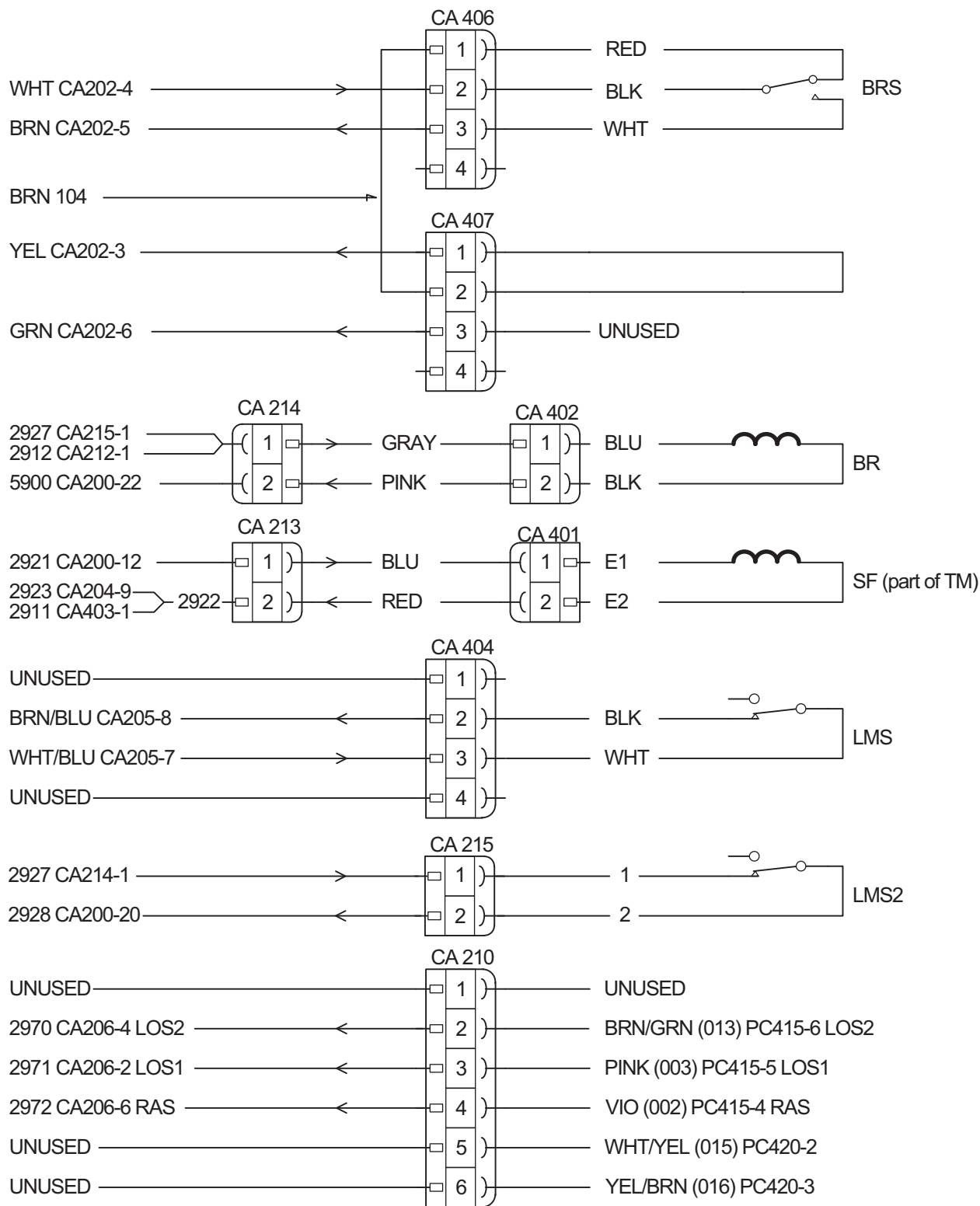
816157_2C_2



SCHEMATIC DIAGRAMS

WE / WS from serial no. 5A132188 to serial no. 5A134880

Brake Circuit, Standard



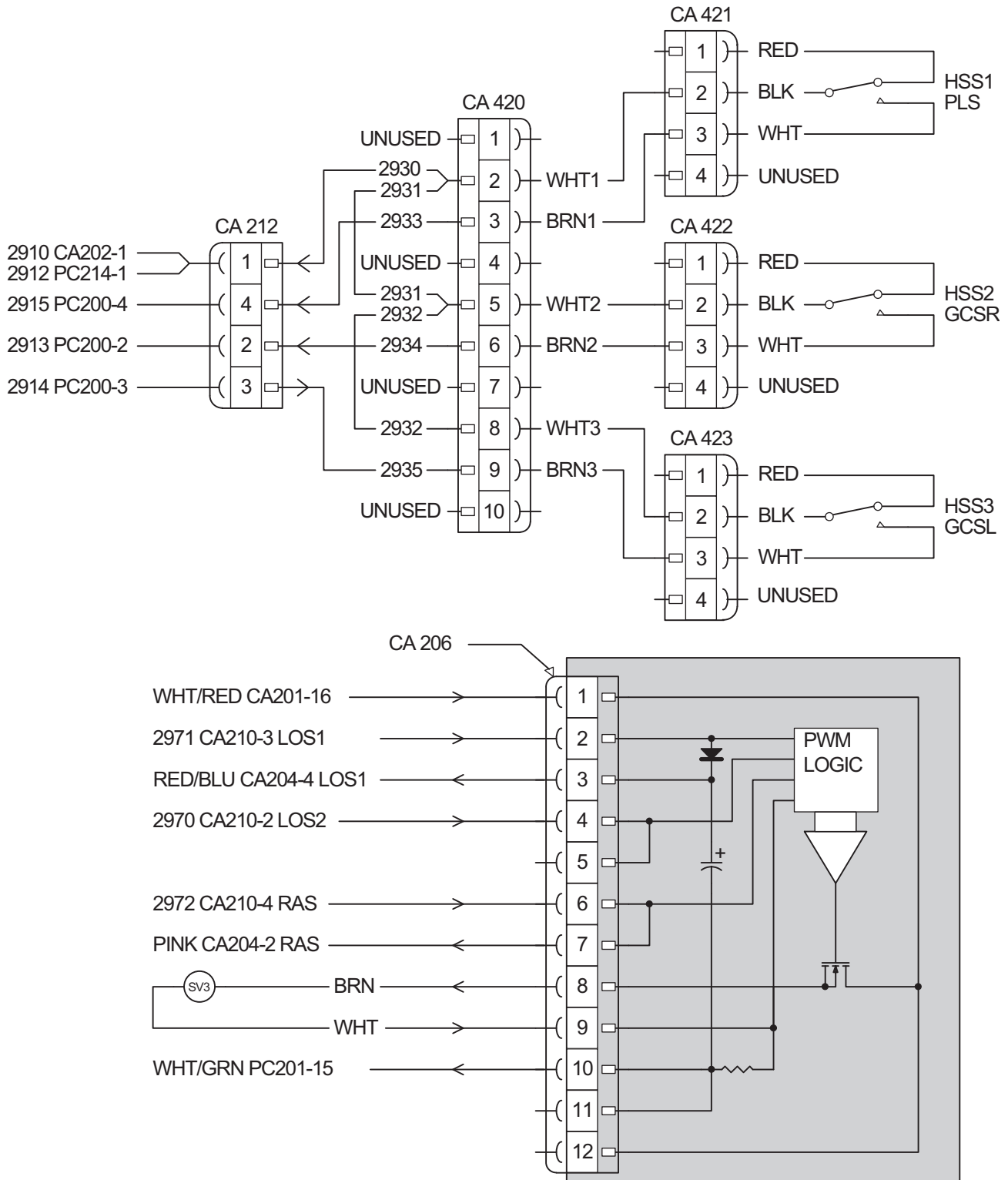
816157_2C_4

SCHEMATIC DIAGRAMS

WE / WS from serial no. 5A132188 to serial no. 5A134880



Walkie / Rider, Standard



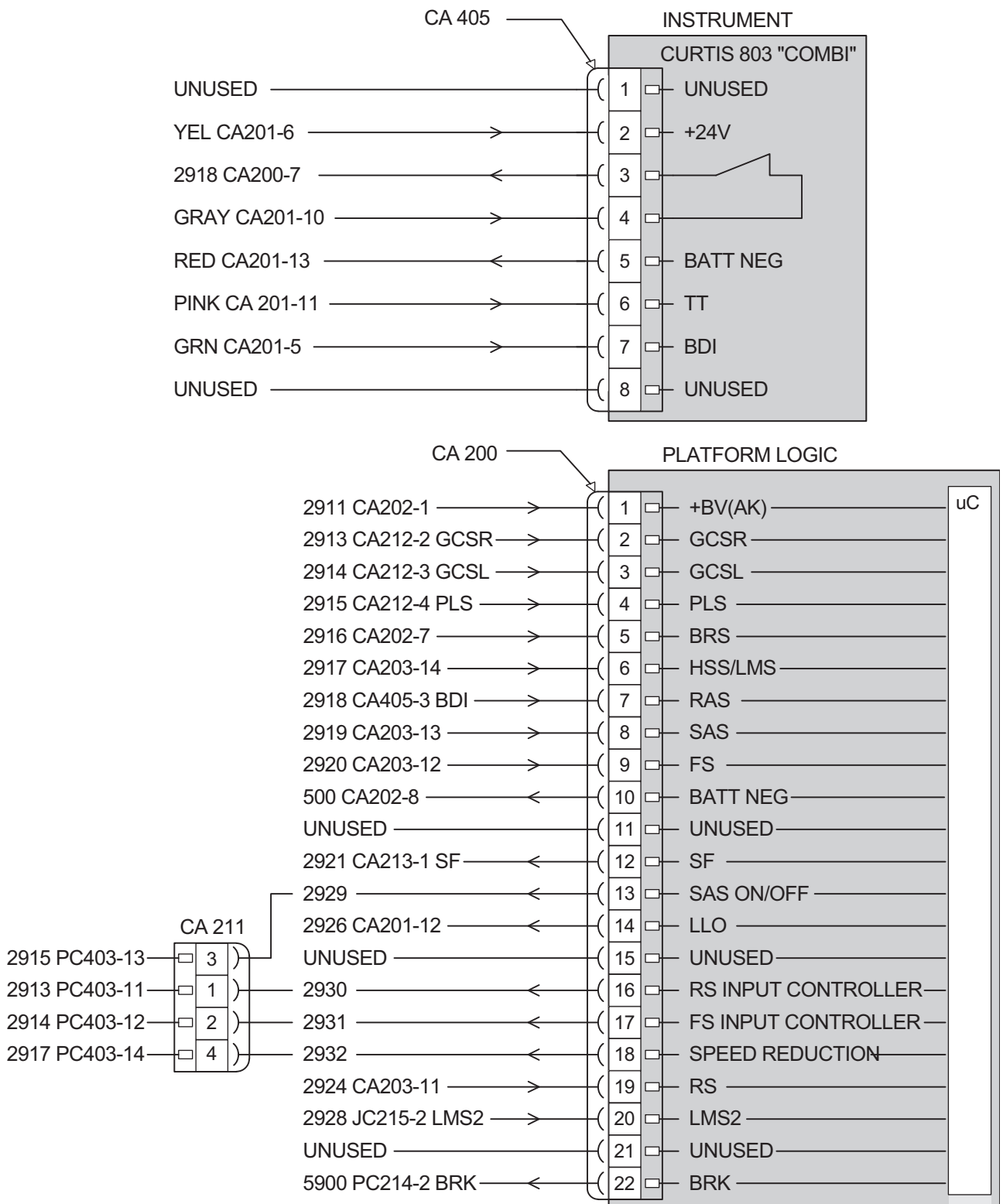
816157_2C_5



SCHEMATIC DIAGRAMS

WE / WS from serial no. 5A132188 to serial no. 5A134880

Instrument & Platform Logic, Standard



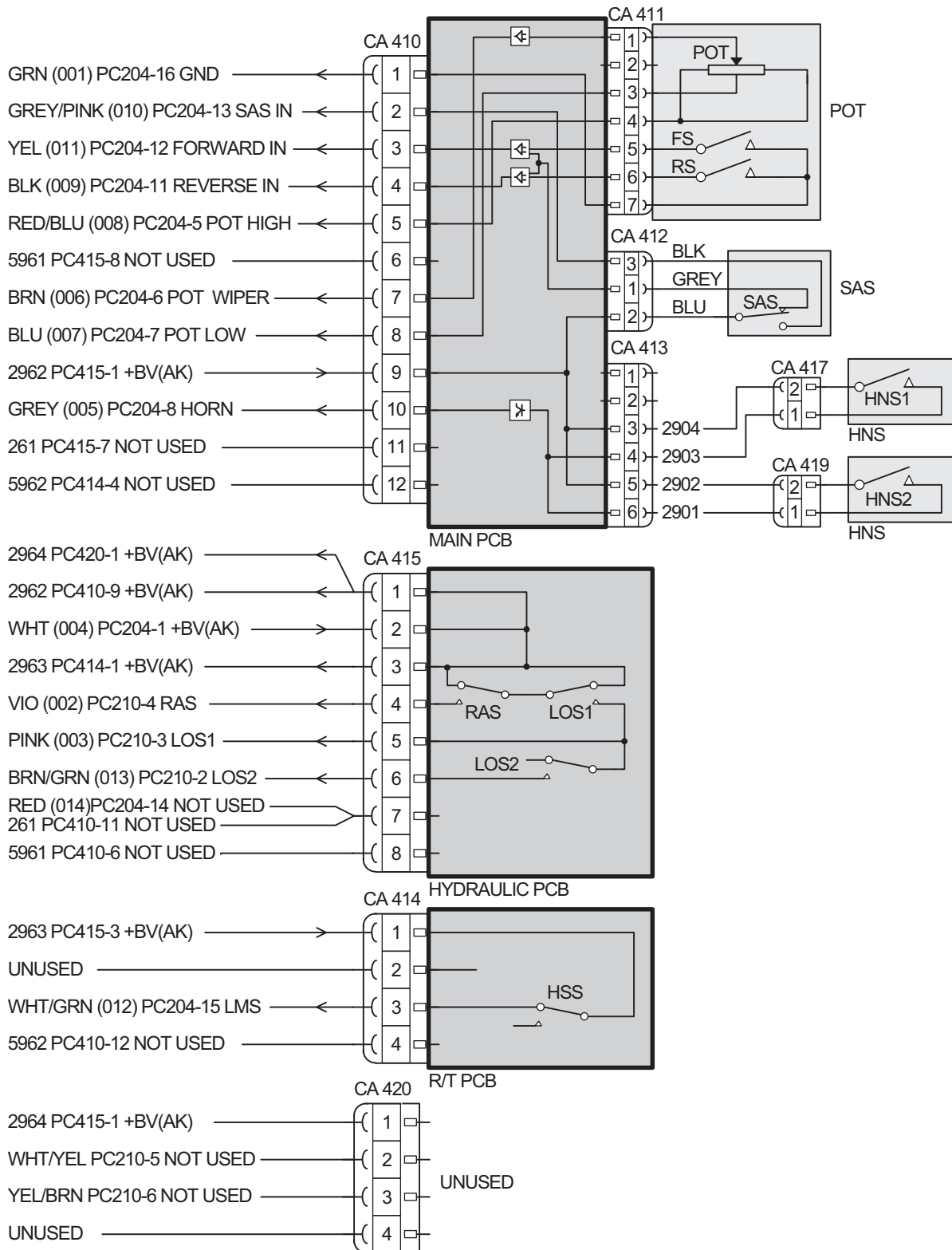
816157_2C_6

SCHEMATIC DIAGRAMS

WE / WS from serial no. 5A132188 to serial no. 5A134880



Control Handle Circuit, Standard



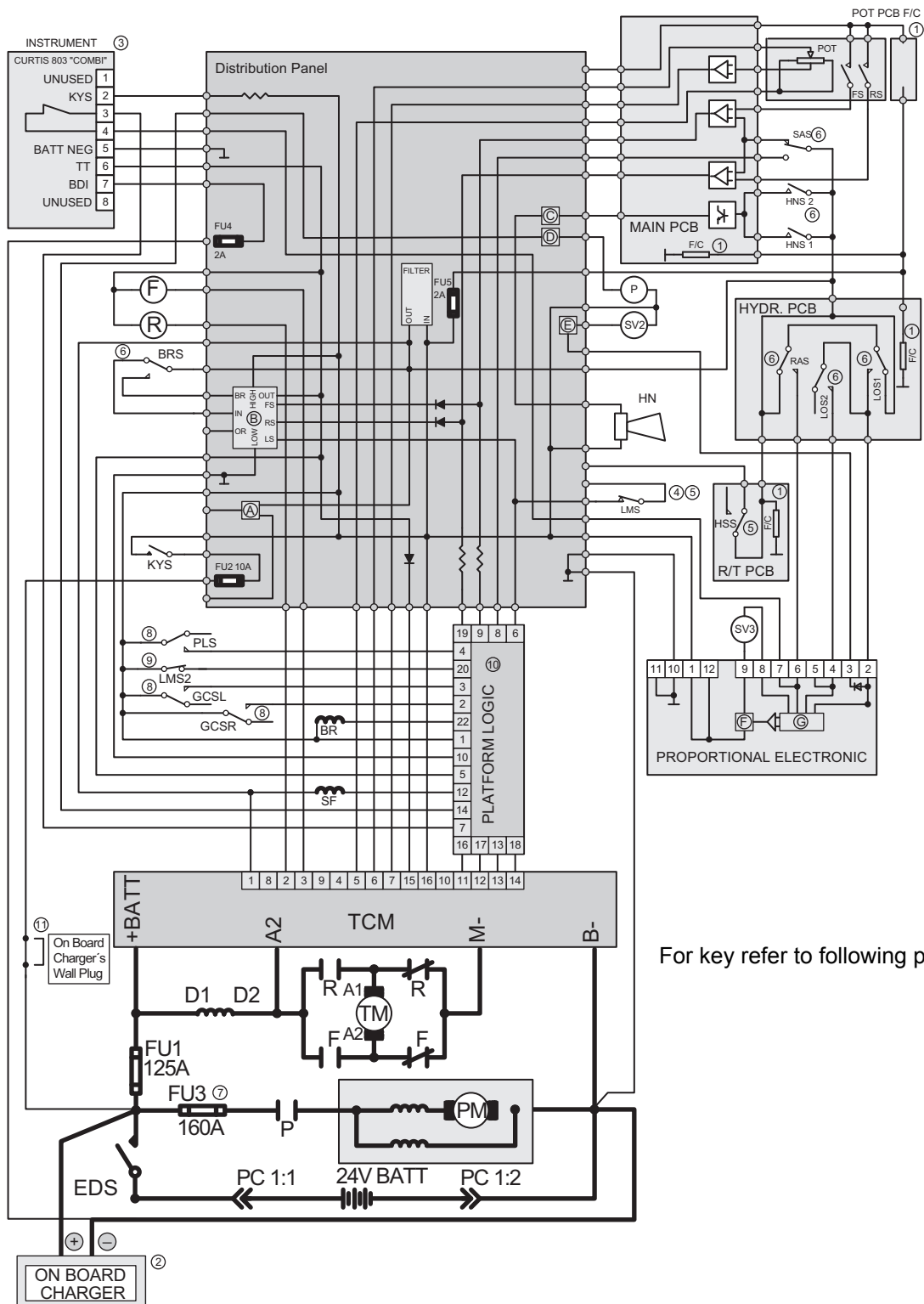
816157_2C_7



SCHEMATIC DIAGRAMS

WE / WS from serial no. 5A132188 to serial no. 5A134880

Schematic Diagram, Standard



For key refer to following page

816158_2C_1

SCHEMATIC DIAGRAMS

WE / WS from serial no. 5A132188 to serial no. 5A134880



Key to Fig. 816158_2C_1 (see page 301)

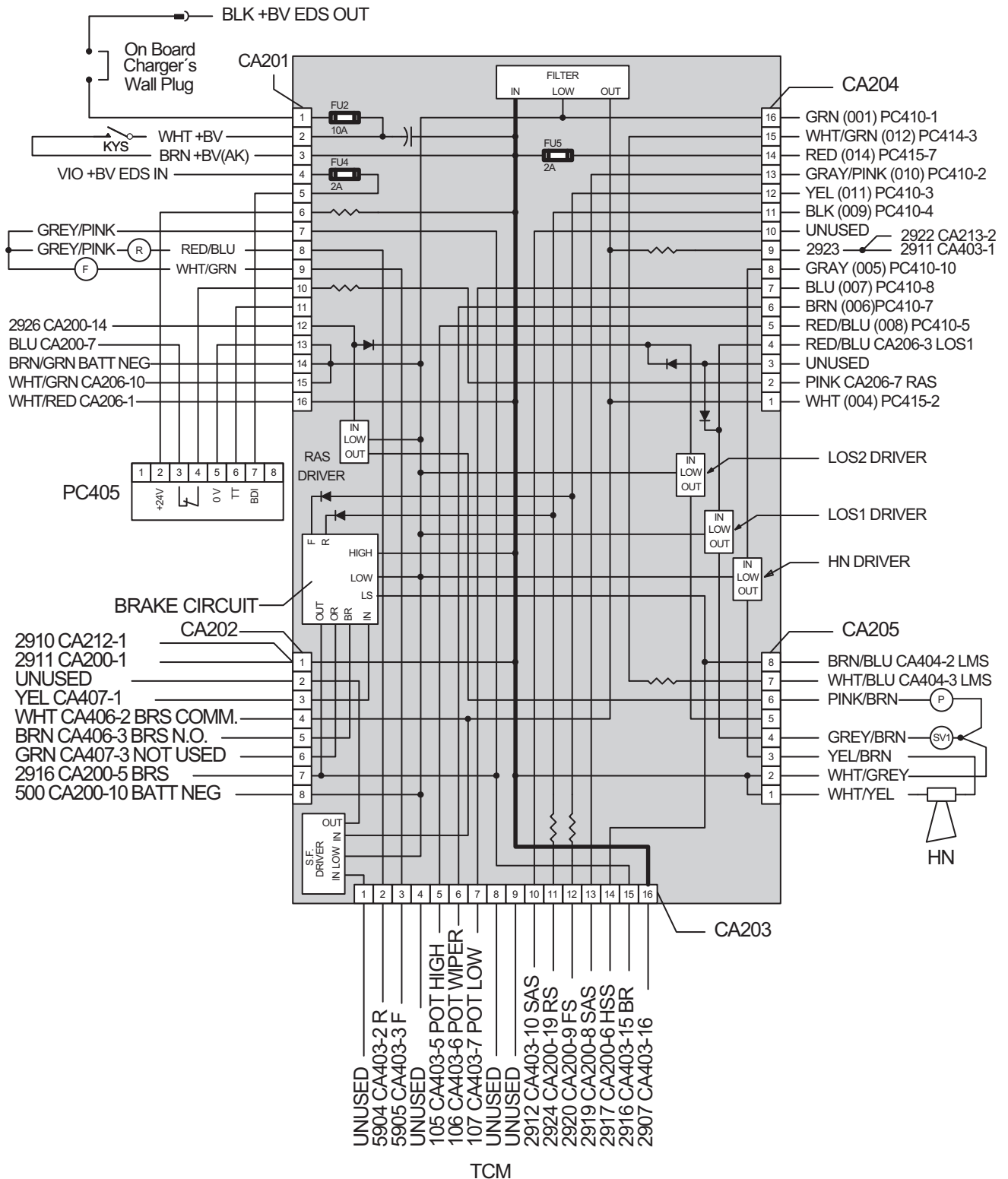
- | | | | |
|----|---|----|--|
| 1 | F / C package active below 5°C | 2 | On board charger connection |
| 3 | Curtis 803, Unigage | 4 | Forks higher than 250 - 2300 mm: LMS open |
| 5 | Reduced speed: HSS and / or LMS open | 6 | Active: RAS, BRS, ORS, SAS, HNS, LOS are closed |
| 7 | For North American truck only: FU3 = 125 A | 8 | Walkie Mode: GCSL & GCSR & PLS open OR PLS closed & GCSL & GCSR open |
| 9 | LMS2 < 1700 mm closed | 10 | Platform Logic |
| 11 | For plug holder & LED connections, see 805835 | | |



SCHEMATIC DIAGRAMS

WE / WS from serial no. 5A132188 to serial no. 5A134880

Distribution Panel, Option



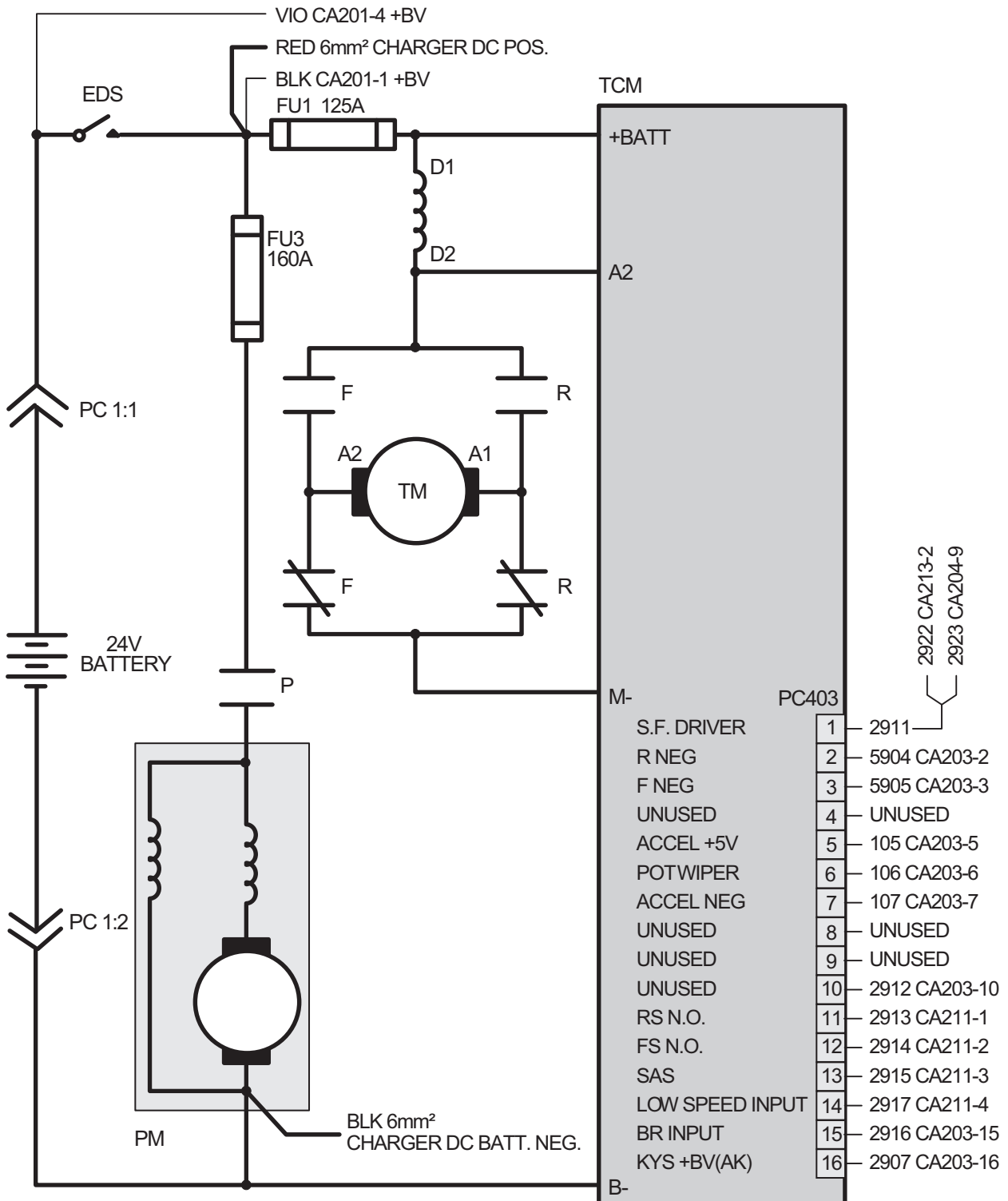
816158_2C_2

SCHEMATIC DIAGRAMS

WE / WS from serial no. 5A132188 to serial no. 5A134880



Traction Controller, Option



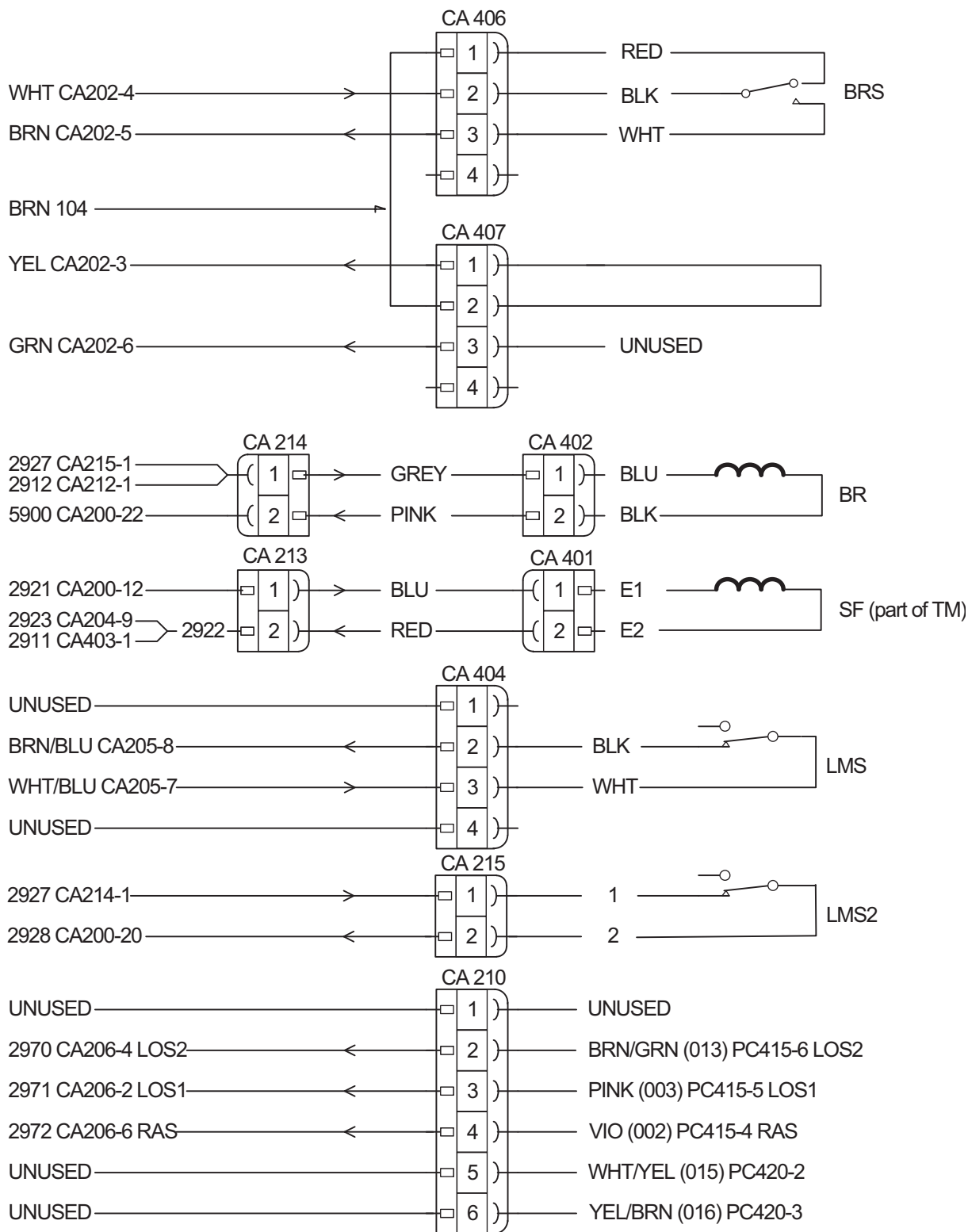
816158_2C_3



SCHEMATIC DIAGRAMS

WE / WS from serial no. 5A132188 to serial no. 5A134880

Brake Circuit, Option



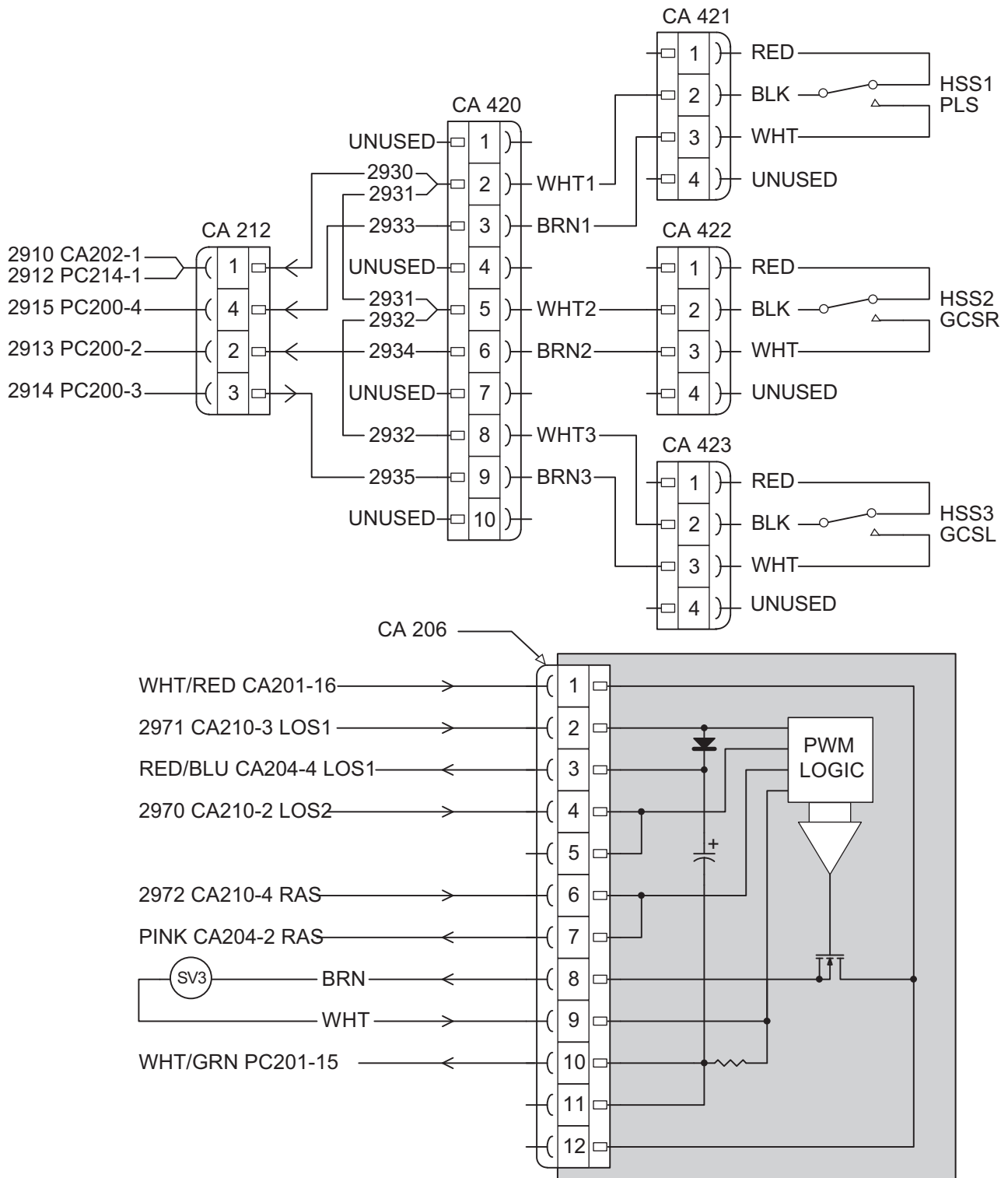
816158_2C_4

SCHEMATIC DIAGRAMS

WE / WS from serial no. 5A132188 to serial no. 5A134880



Walkie / Rider Circuit, Option



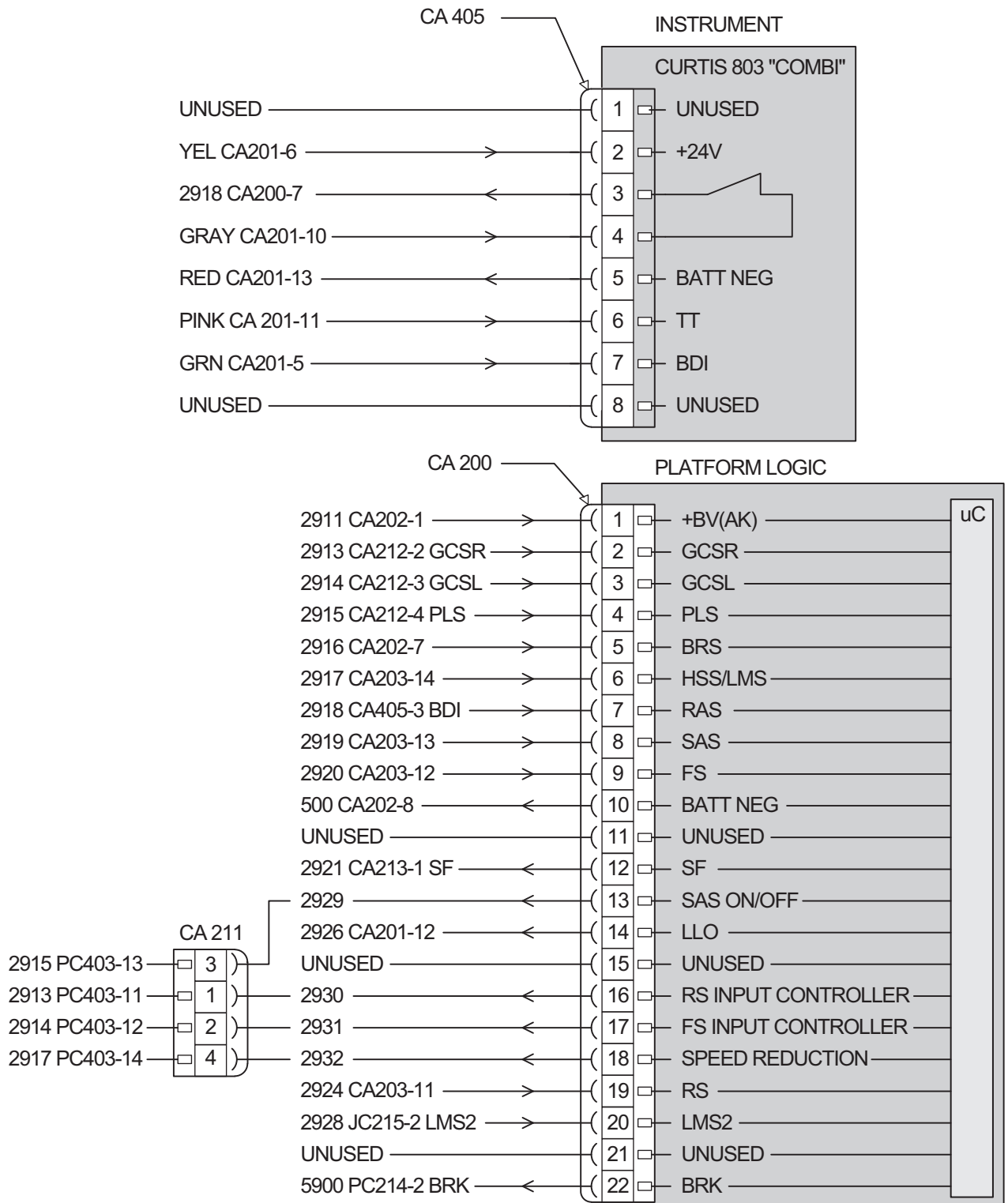
816158_2C_5



SCHEMATIC DIAGRAMS

WE / WS from serial no. 5A132188 to serial no. 5A134880

Instrument & Platform Logic, Option



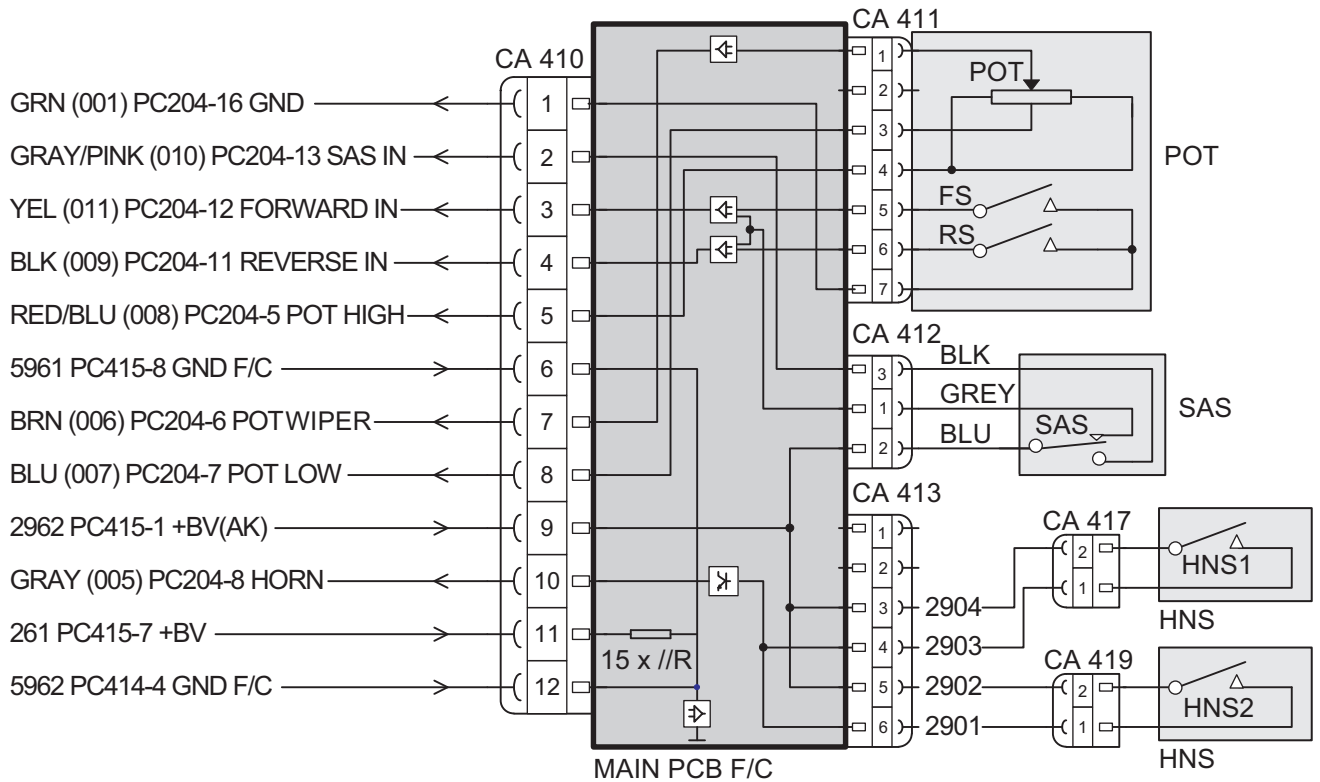
816158_2C_6

SCHEMATIC DIAGRAMS

WE / WS from serial no. 5A132188 to serial no. 5A134880



Control Handle Circuit, Option

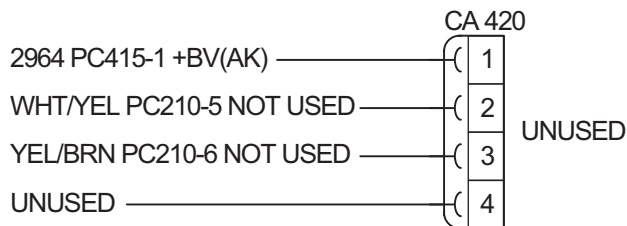
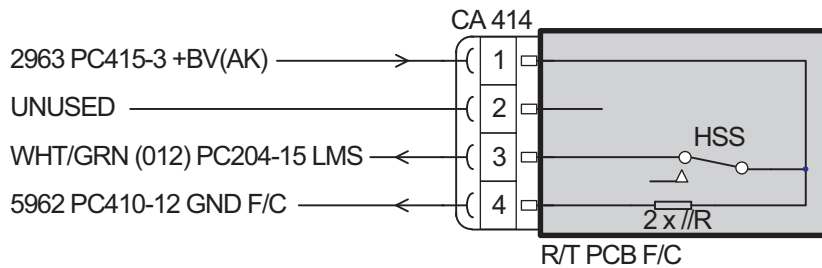
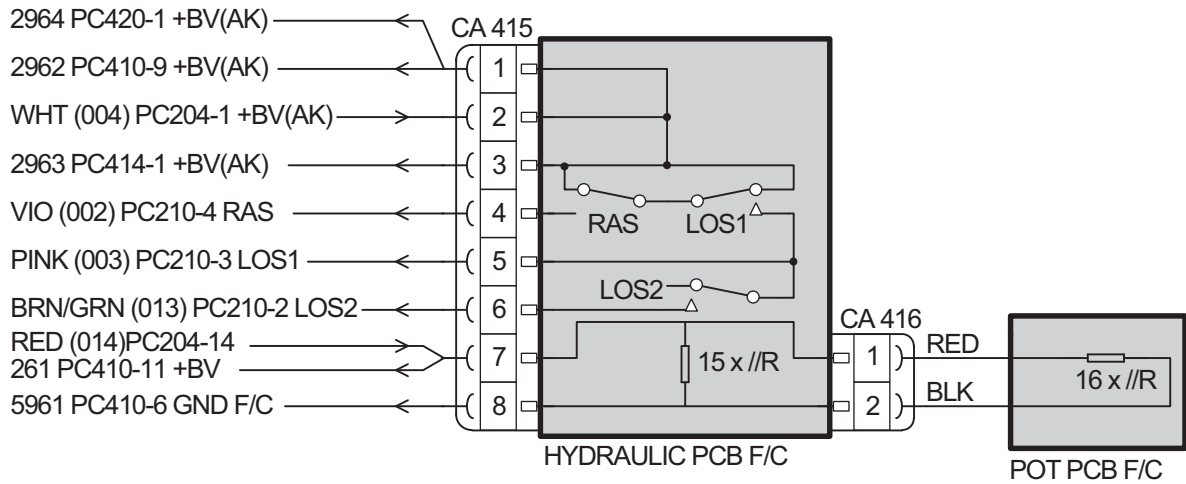


816158_2C_7-1



SCHEMATIC DIAGRAMS

WE / WS from serial no. 5A132188 to serial no. 5A134880



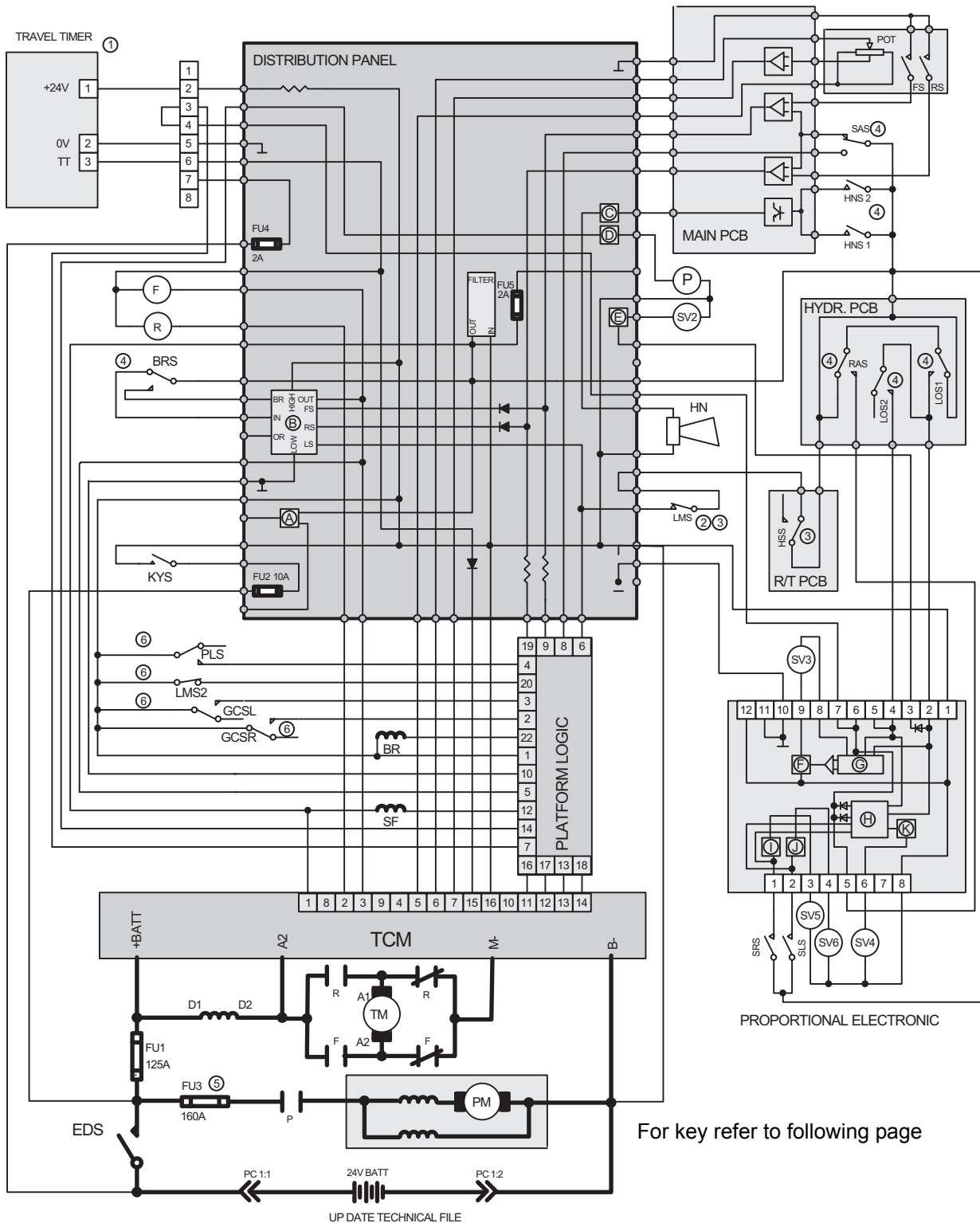
816158_2C_7-2

SCHEMATIC DIAGRAMS

WE / WS from serial no. 5A132188 to serial no. 5A134880



Schematic Diagram, Auxiliary Hydraulics



816550_2B_1

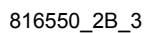


SCHEMATIC DIAGRAMS

WE / WS from serial no. 5A132188 to serial no. 5A134880

Key to Fig. 816550_2B_1 (see page 310)

- | | | | |
|---|--|---|---|
| 1 | Travel Timer | 2 | Forks higher than 250 - 2300 mm (depends on mast type):
LMS open |
| 3 | Reduced speed: HSS and / or LMS open | 4 | Active: RAS, BRS, SAS, HNS, LOS1 & LOS2 are closed |
| 5 | For North American truck only: FU3 = 125 A | 6 | Walkie Mode: HSS3 &/or HSS2 &/or HSS1 open |
| 7 | Platform Logic | | |

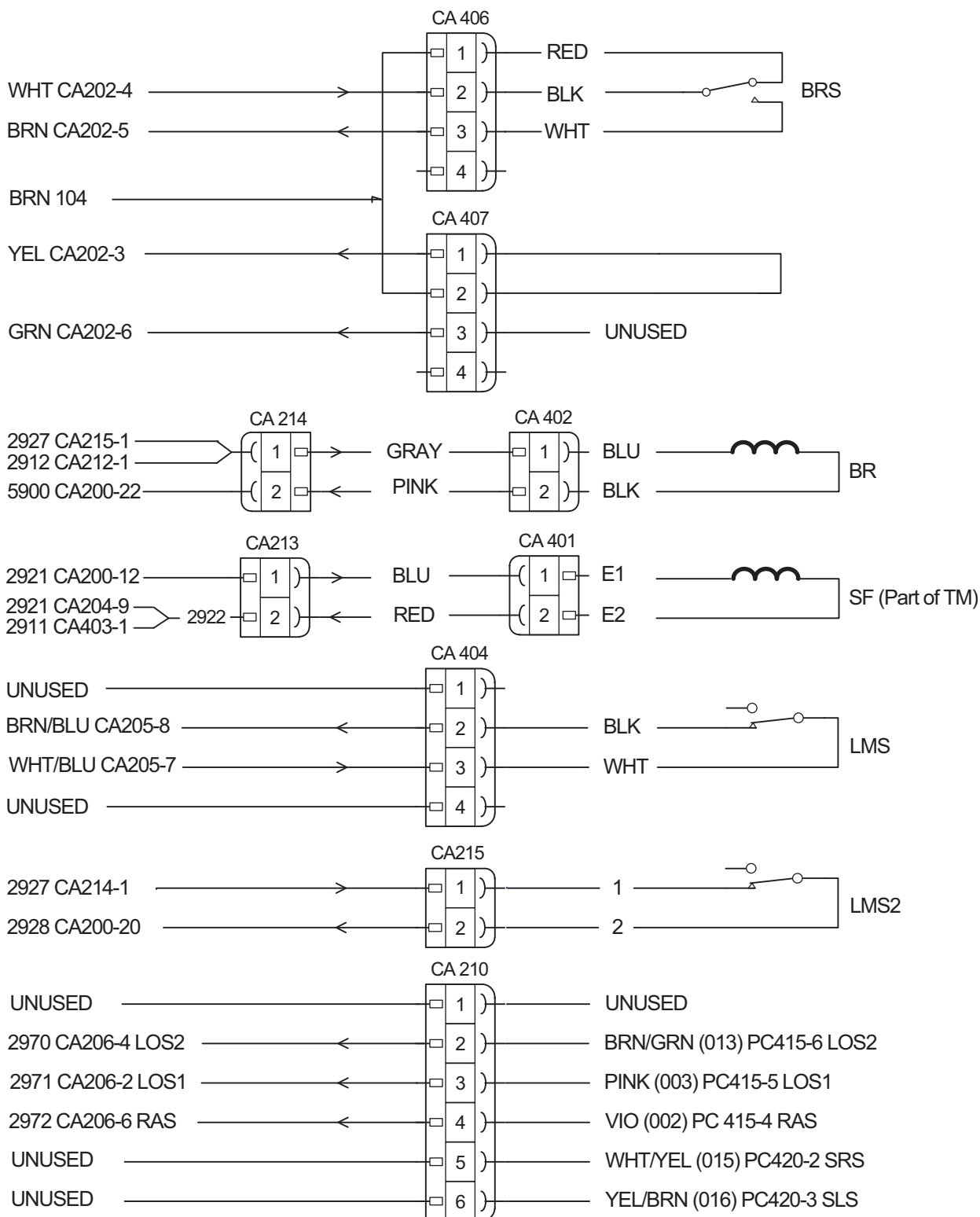


SCHEMATIC DIAGRAMS

WE / WS from serial no. 5A132188 to serial no. 5A134880



Brake Circuit, Auxiliary Hydraulics



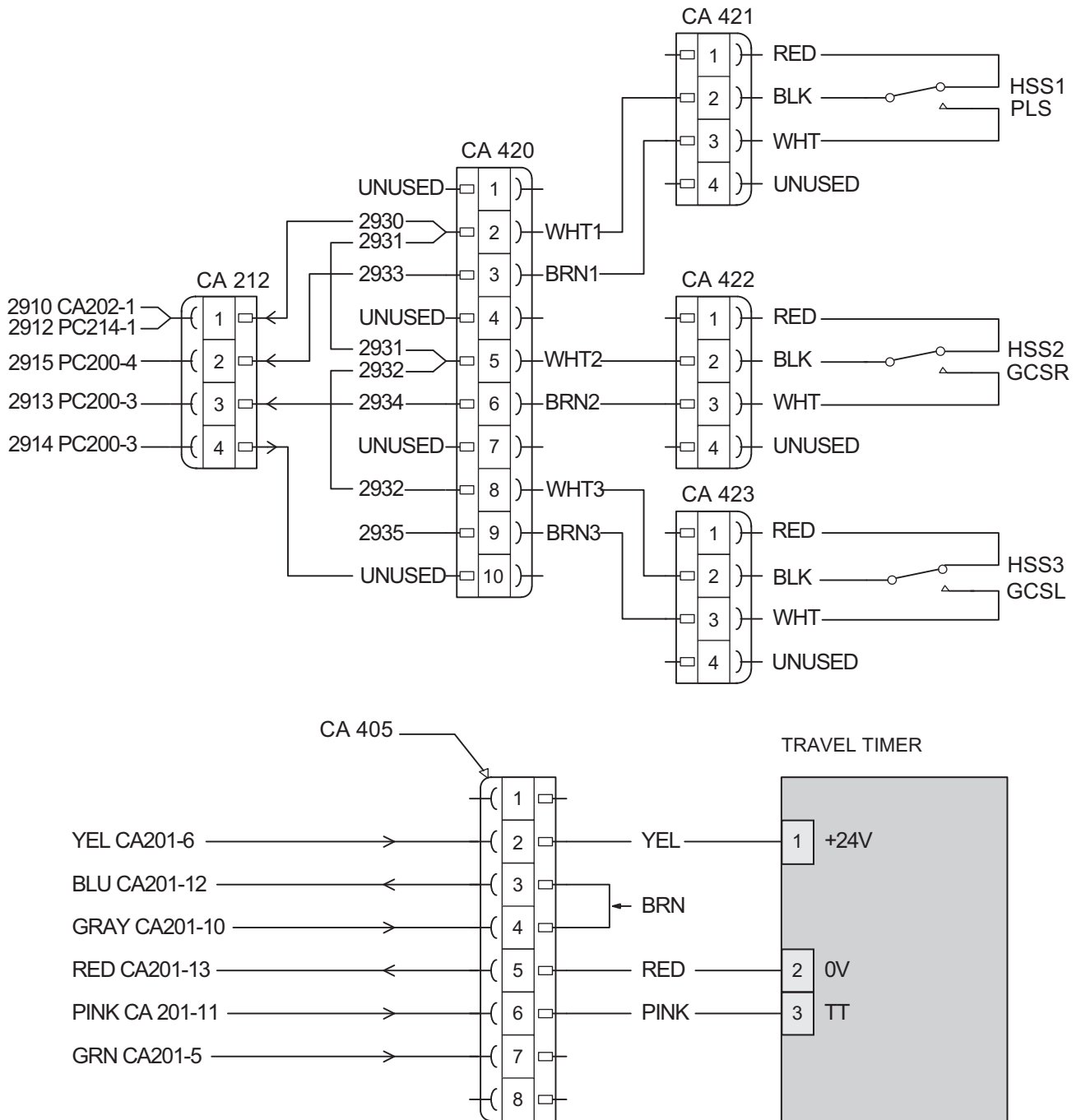
816550_2B_4



SCHEMATIC DIAGRAMS

WE / WS from serial no. 5A132188 to serial no. 5A134880

Walkie / Rider Circuit & Instrument, Auxiliary Hydraulics



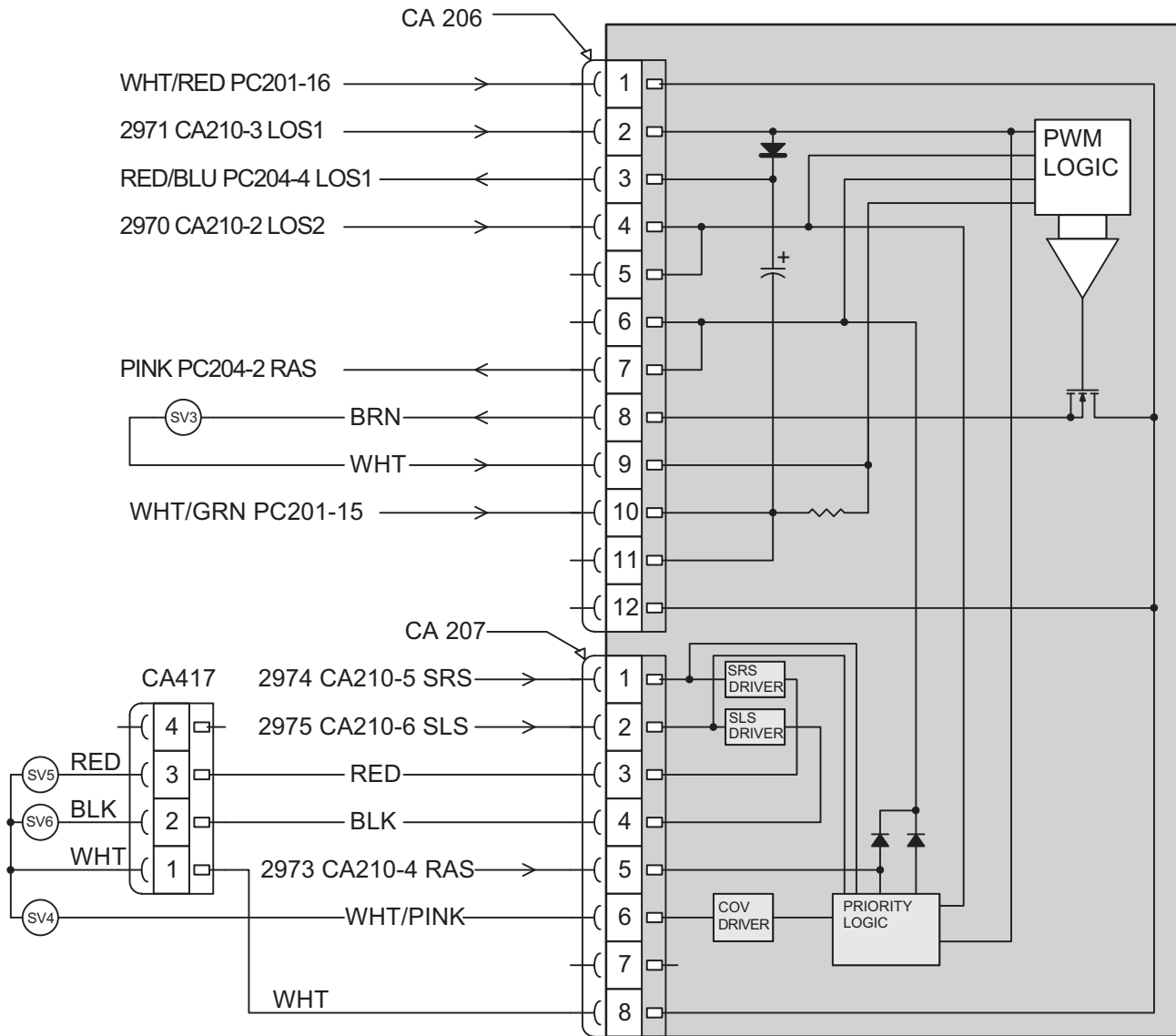
816550_2B_5

SCHEMATIC DIAGRAMS

WE / WS from serial no. 5A132188 to serial no. 5A134880



Instrument & Prop. Electronics & Sideshift Circuit, Auxiliary Hydraulics



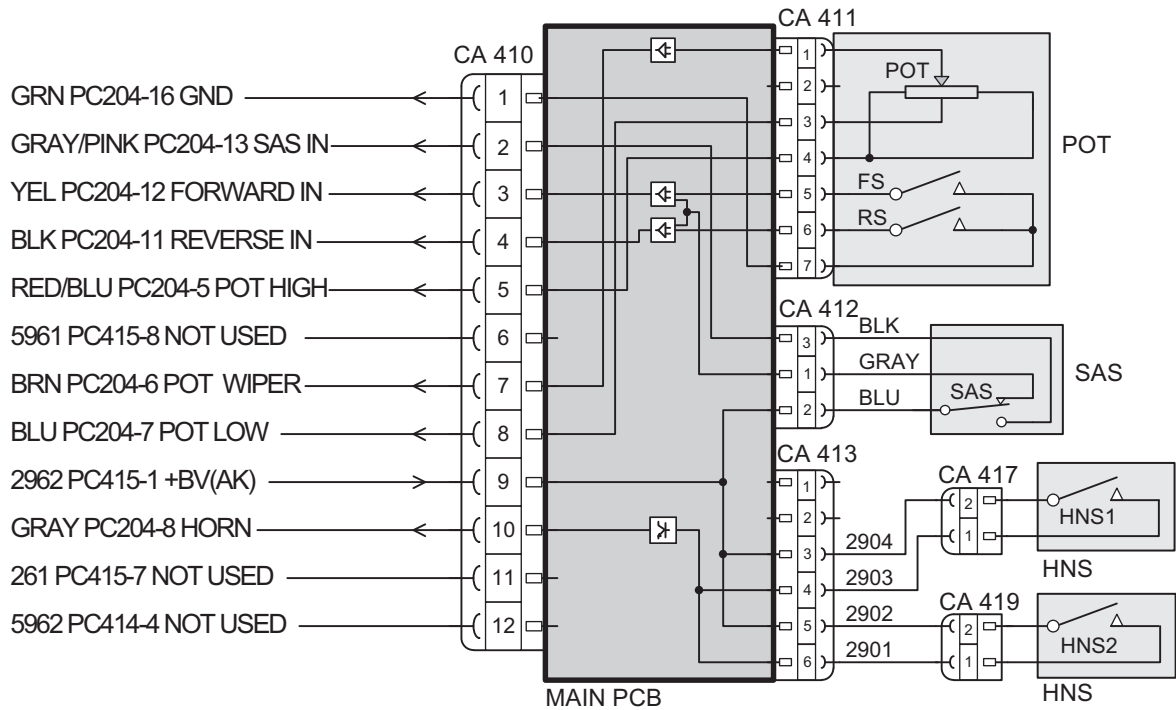
816550_2B_6



SCHEMATIC DIAGRAMS

WE / WS from serial no. 5A132188 to serial no. 5A134880

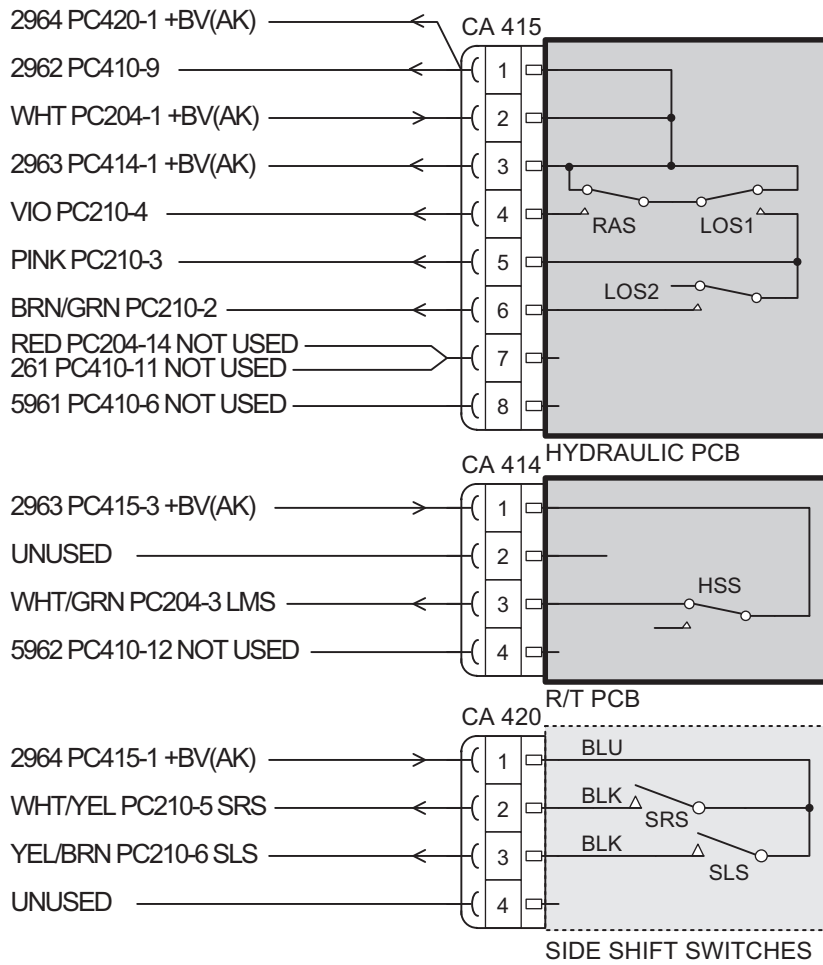
Control Handle Circuit, Auxiliary Hydraulics



816550_2B_7-1

SCHEMATIC DIAGRAMS

WE / WS from serial no. 5A132188 to serial no. 5A134880



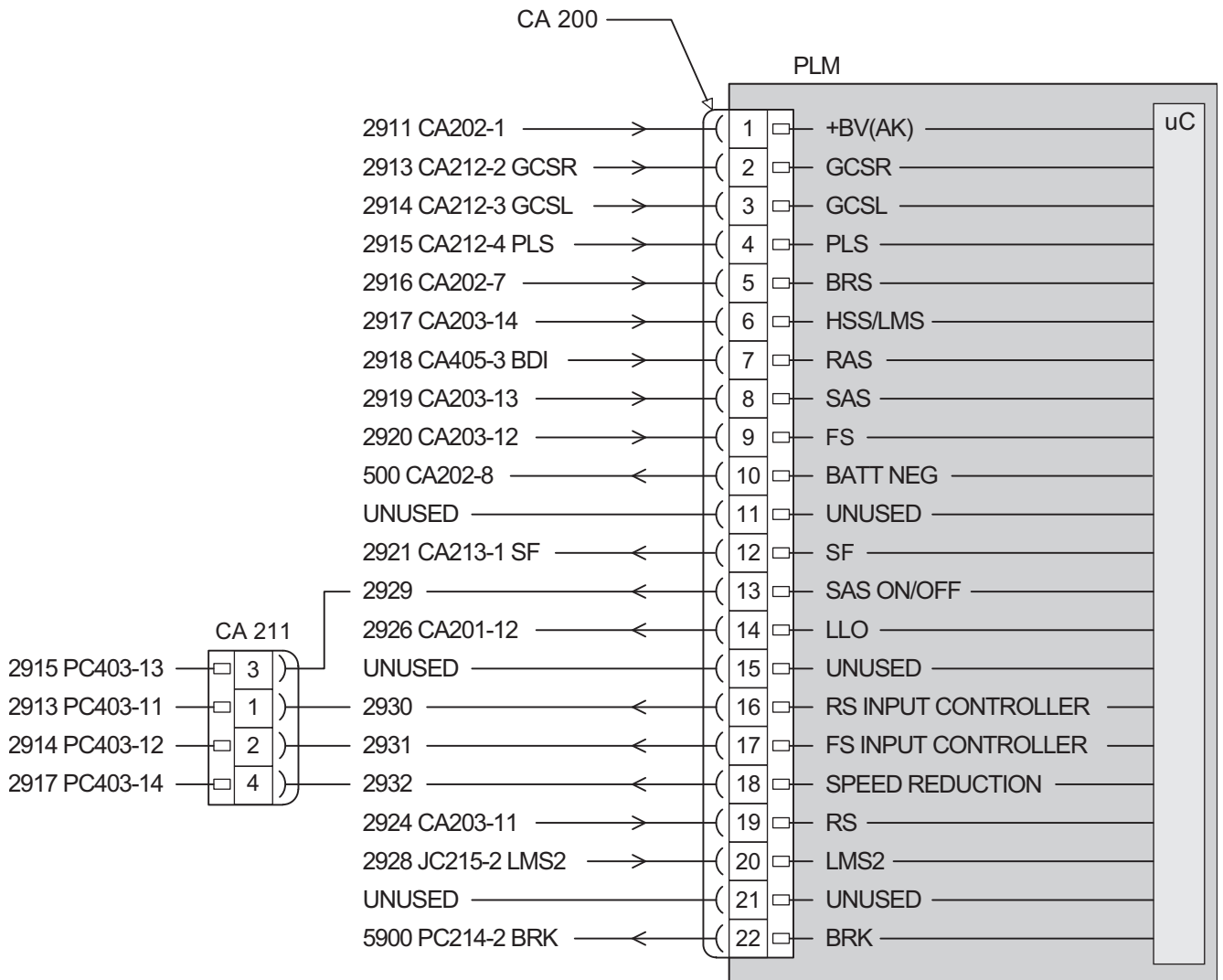
816550_2B_7-2



SCHEMATIC DIAGRAMS

WE / WS from serial no. 5A132188 to serial no. 5A134880

Platform Logic, Auxiliary Hydraulics



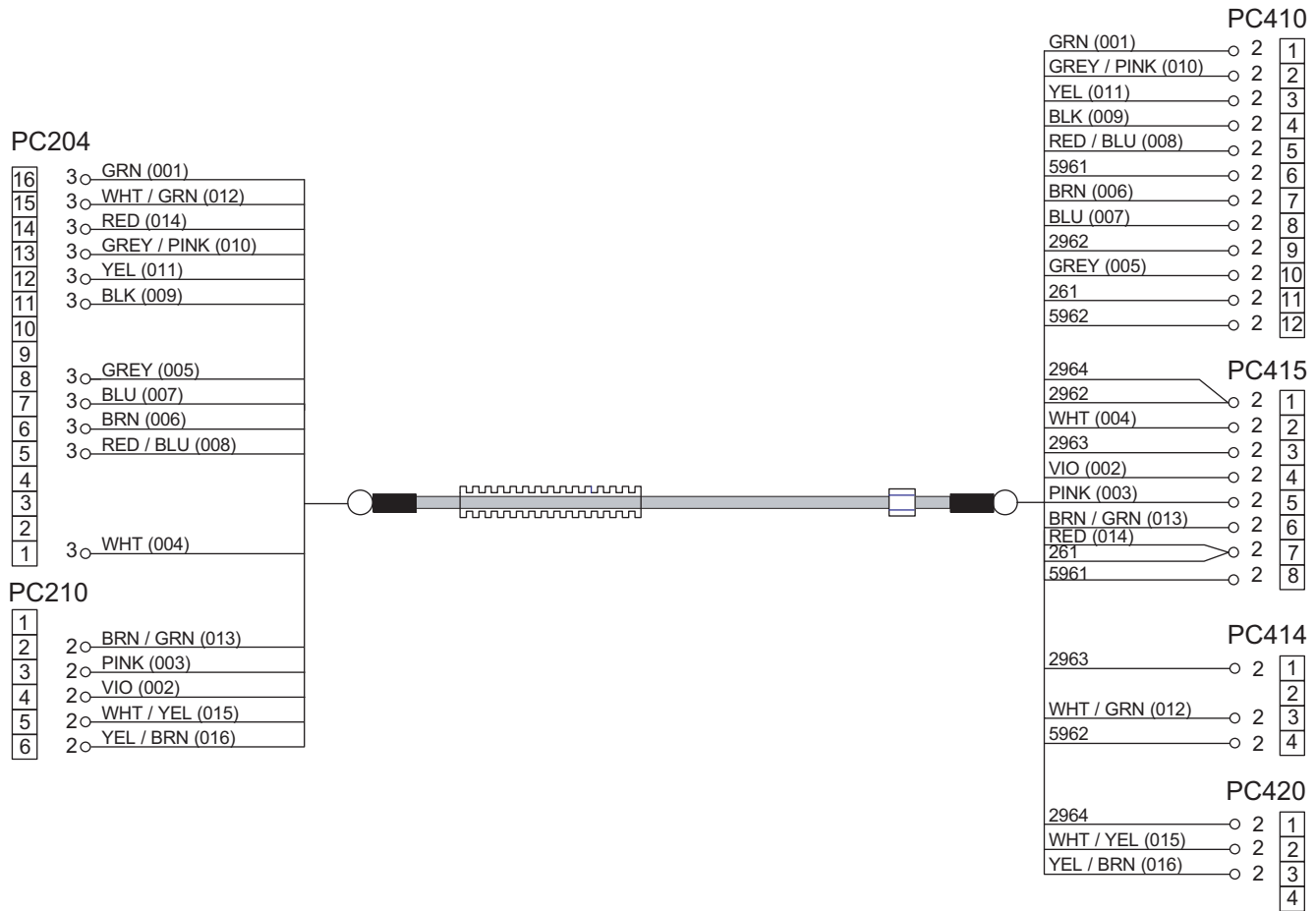
816550_2B_8

SCHEMATIC DIAGRAMS

WE / WS from serial no. 5A132188 to serial no. 5A134880



Control Handle Wire Harness



813426_2C

Connector housing

Housing	Order Number
PC204	803452-002
PC210	803450-007
PC410	803450-009
PC414	803450-020
PC415	803450-008
PC420	803450-006

Contact pins

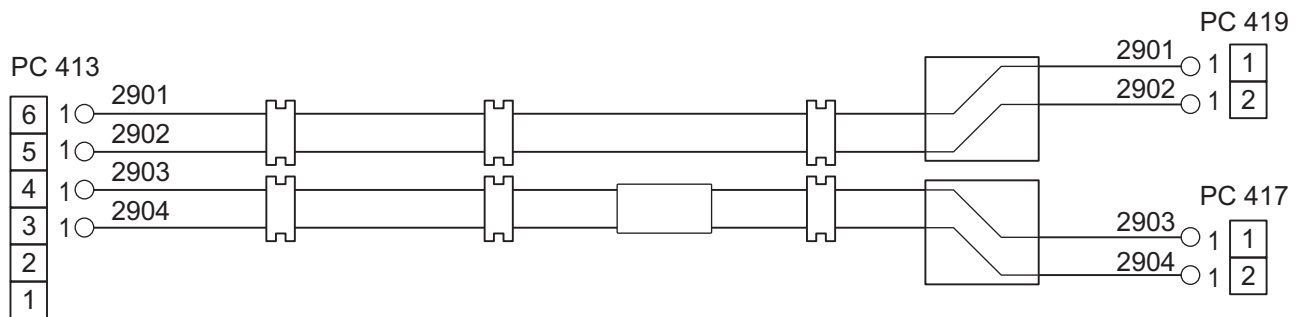
Item No.	Order Number
2	116858
3	803452-005



SCHEMATIC DIAGRAMS

WE / WS from serial no. 5A132188 to serial no. 5A134880

Horn Harness



811931_2E_1

Connector housing

Housing	Order Number
PC413	803450-021
PC419	803450-023
PC417	803450-023

Contact pins

Item No.	Order Number
2	803450-022
3	803450-024



SCHEMATIC DIAGRAMS

WE / WS from serial no. 5A132188 to serial no. 5A134880

For tables for Fig. 815408_2E (see page 322)

Connector housing

Housing	Order Number
PC201	803452-002
PC205	803452-001
JC404	803450-002
PC405	803450-008

Contact pins

Item No.	Order Number
1	803452-005
2	803450-010
3	116858

Cable lugs and rings

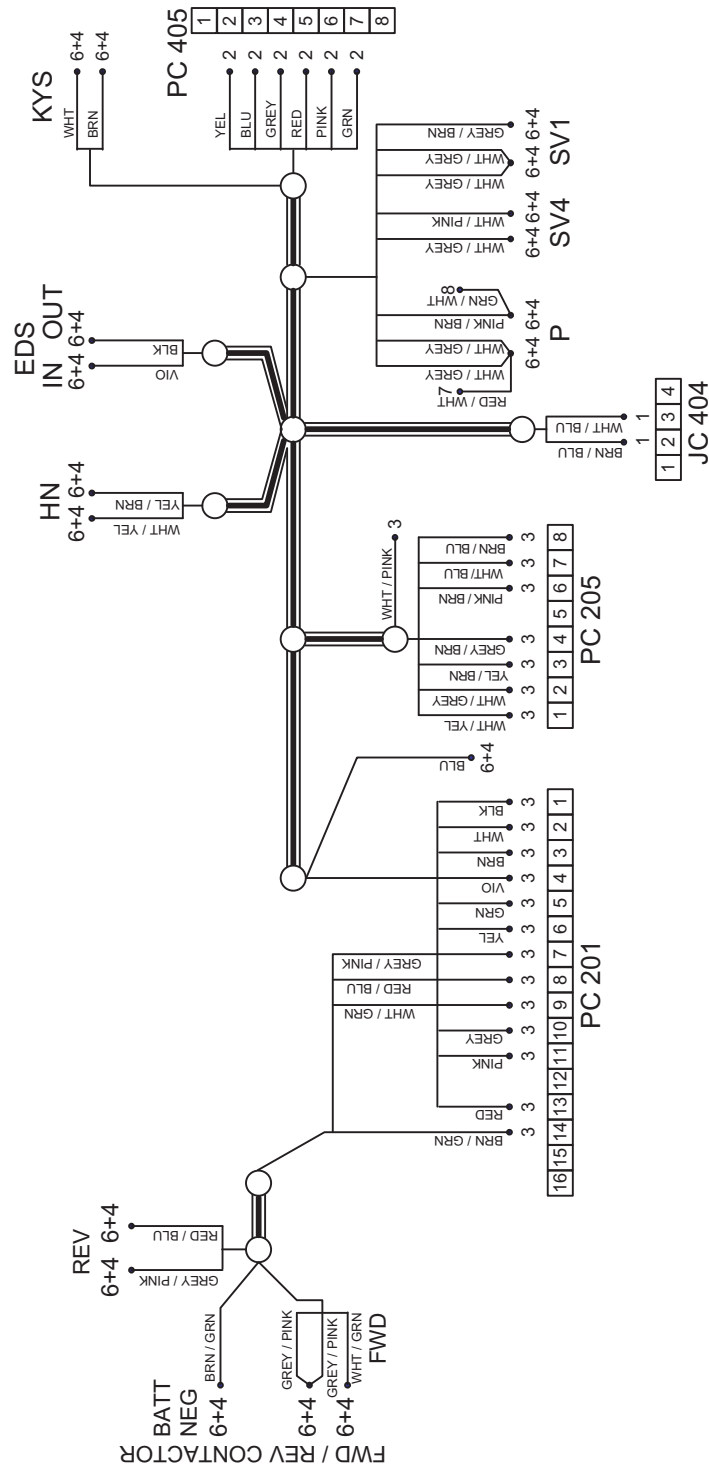
Item No.	Order Number
4	816812-004
5	803448-003
7	062007-050
8	062007-063

SCHEMATIC DIAGRAMS

WE / WS from serial no. 5A132188 to serial no. 5A134880



Main Harness, Auxiliary Hydraulics



816076_2B

See next page for tables



SCHEMATIC DIAGRAMS

WE / WS from serial no. 5A132188 to serial no. 5A134880

For tables for Fig. 816076_2B (see page 324)

Connector housing

Housing	Order Number
PC201	803452-002
PC205	803452-001
JC404	803450-002
PC405	803450-008

Contact pins

Item No.	Order Number
1	803450-010
2	116858
3	803452-005
4	062007-021
6	803448-003
7	062007-050
8	062007-063

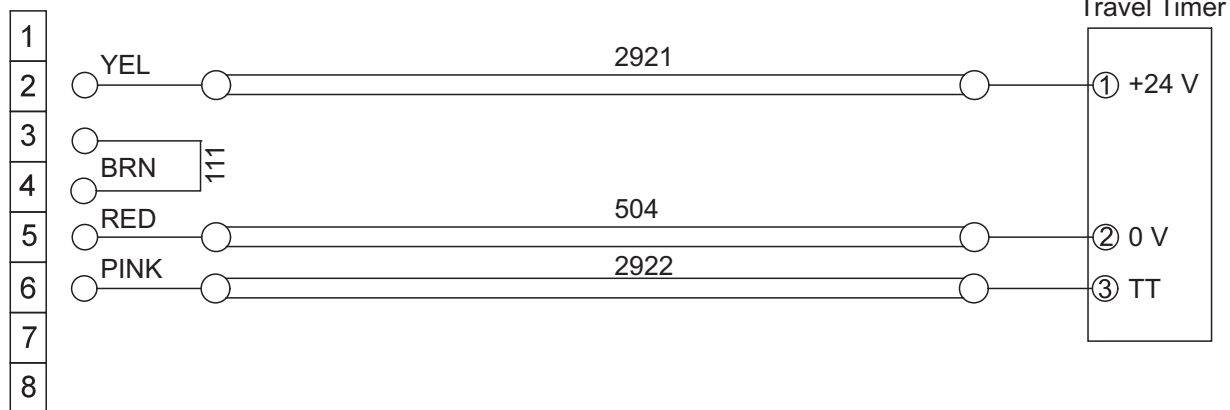
SCHEMATIC DIAGRAMS

WE / WS from serial no. 5A132188 to serial no. 5A134880



Hourmeter Harness

PC405



803545_2C

Connector housing

Housing	Order Number
PC405	803450-004

Contact pins

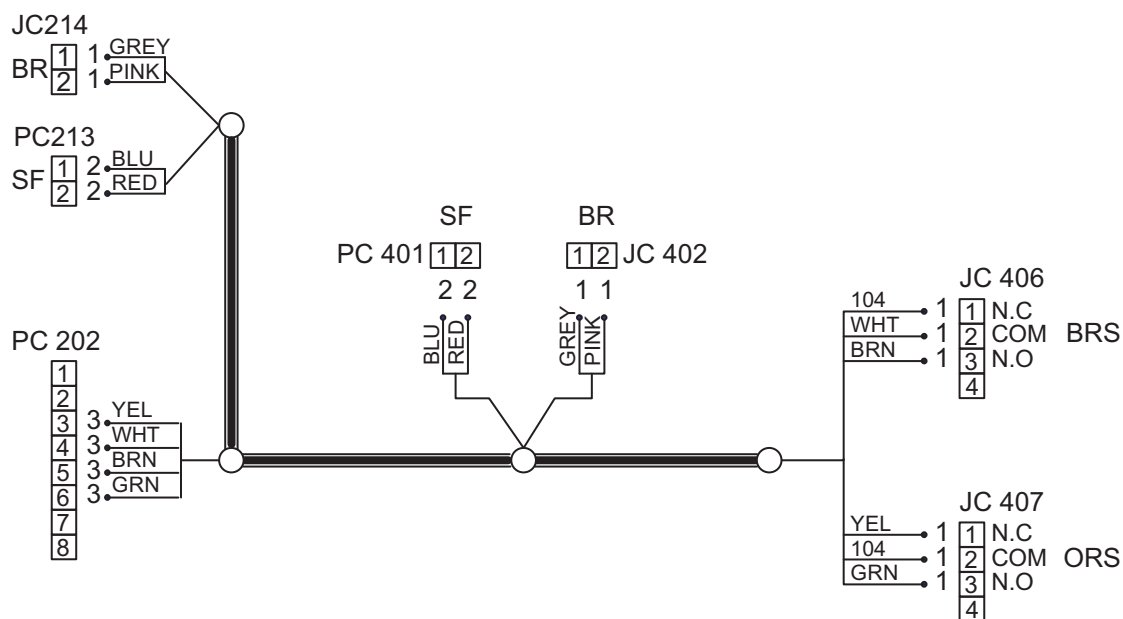
Item No.	Order Number
---	062007-043



SCHEMATIC DIAGRAMS

WE / WS from serial no. 5A132188 to serial no. 5A134880

Harness, ORS - BRS - BRK



815409_2D

Connector housing

Housing	Order Number
PC202	803452-001
PC213	803450-005
JC214	803450-001
JC406	803450-002
JC407	803450-002
PC401	803452-005
JC402	803450-001

Contact pins

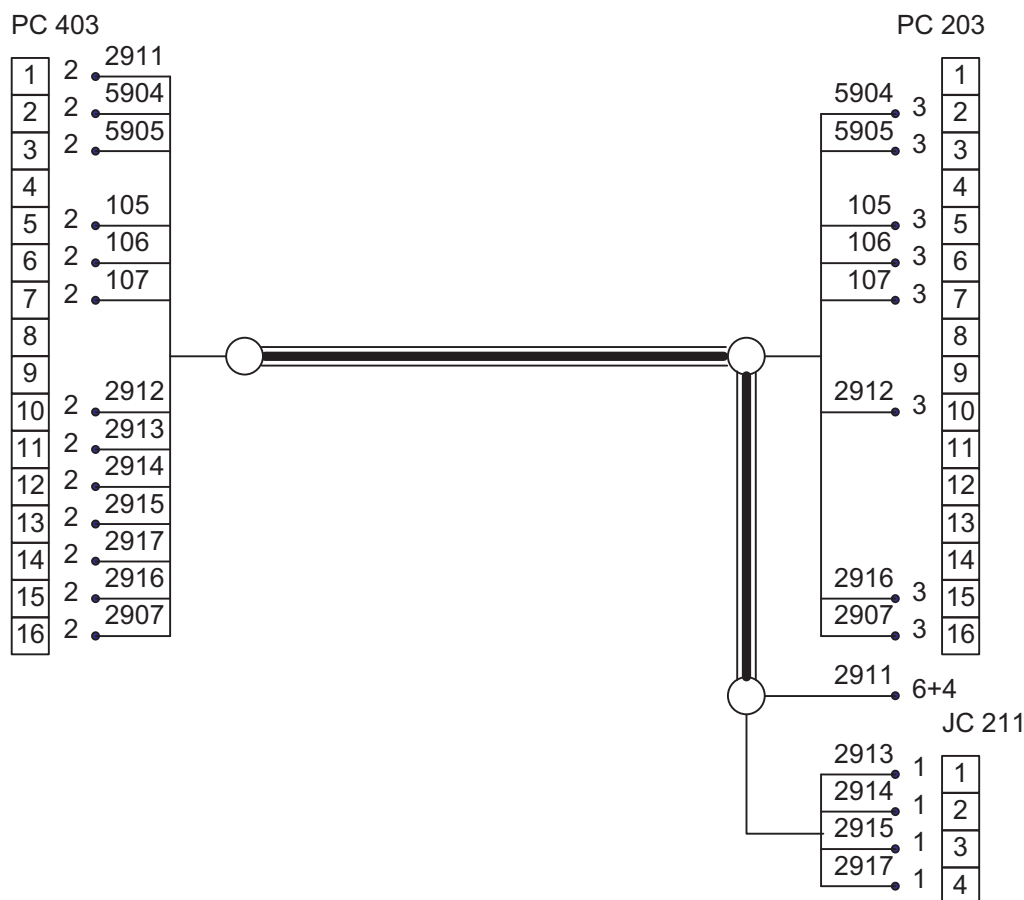
Item No.	Order Number
1	803450-010
2	116858
3	803452-005

SCHEMATIC DIAGRAMS

WE / WS from serial no. 5A132188 to serial no. 5A134880



Harness, TCM



815410_2C

Connector housing

Housing	Order Number
PC203	803452-002
JC211	803450-002
PC403	116851

Contact pins

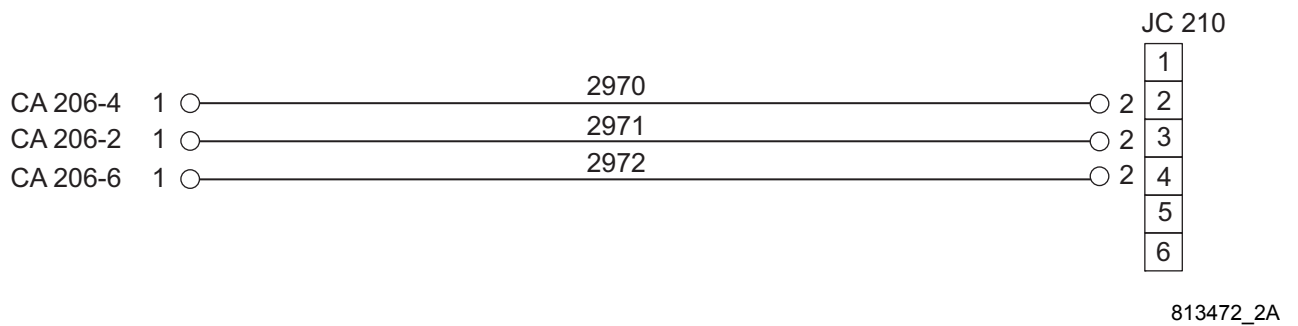
Item No.	Order Number
1	803450-010
2	116858
3	803452-005
4	062007-021
6	803448-003



SCHEMATIC DIAGRAMS

WE / WS from serial no. 5A132188 to serial no. 5A134880

Proportional Hydraulics Connector Lead, Standard



Connector housing

Housing	Order Number
LC210	803450-003

Contact pins

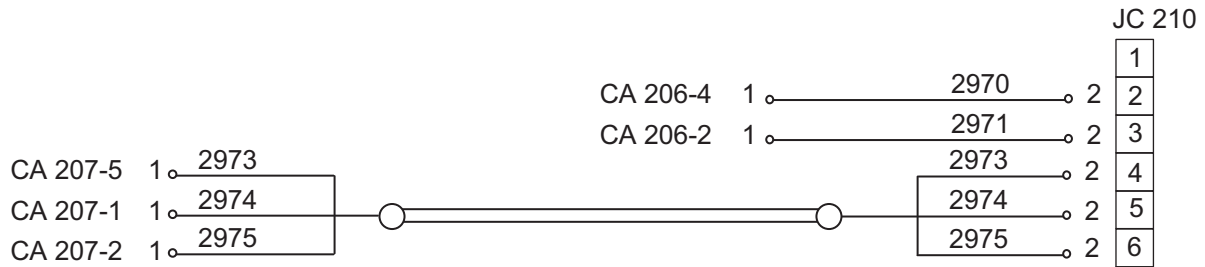
Item No.	Order Number
1	803452-005
2	803450-010

SCHEMATIC DIAGRAMS

WE / WS from serial no. 5A132188 to serial no. 5A134880



Proportional Hydraulics Connector Lead, Standard, Auxiliary Hydraulics



813473_2A

Connector housing

Housing	Order Number
JC210	803450-003

Contact pins

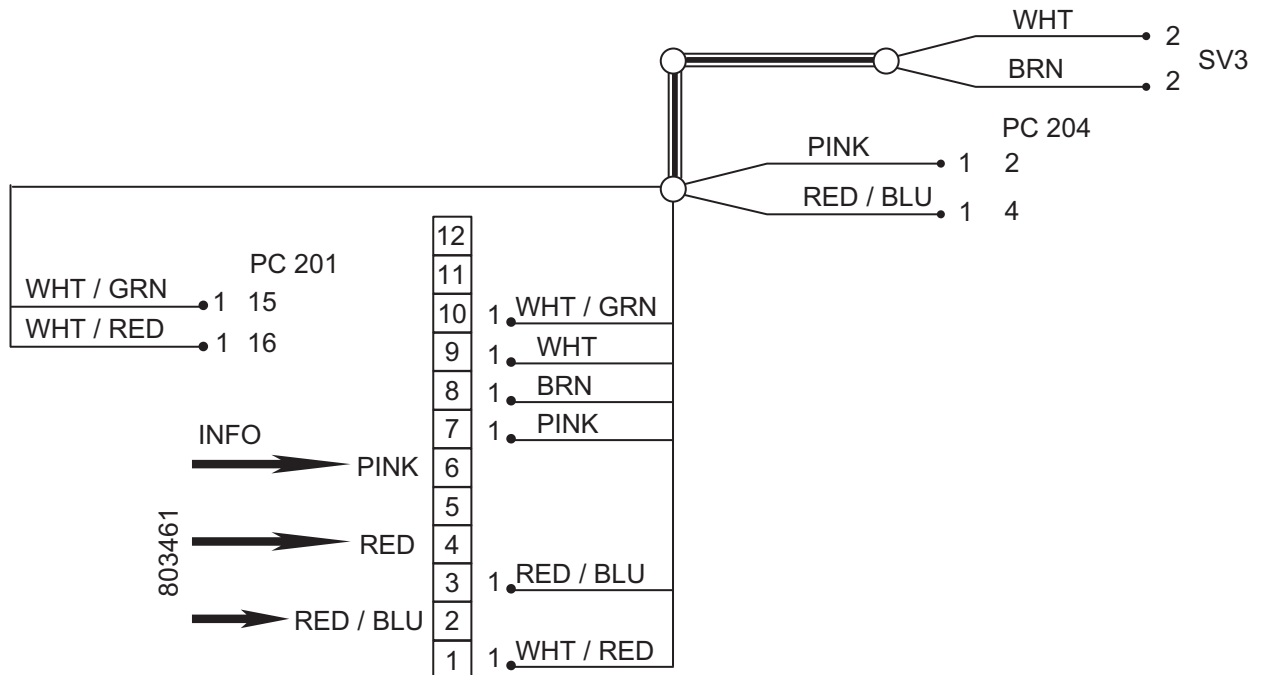
Item No.	Order Number
1	803452-005
2	803450-010



SCHEMATIC DIAGRAMS

WE / WS from serial no. 5A132188 to serial no. 5A134880

Harness, Proportional Valve



804368_2B

Connector housing

Housing	Order Number
PC206	803452-007

Contact pins

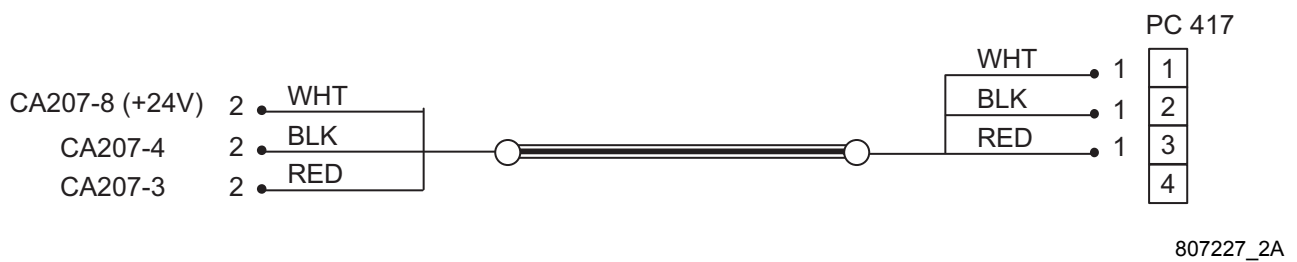
Item No.	Order Number
1	803452-005
2	062007-021

SCHEMATIC DIAGRAMS

WE / WS from serial no. 5A132188 to serial no. 5A134880



Harness, Auxiliary Hydraulics



Connector housing

Housing	Order Number
PC417	803450-006

Contact pins

Item No.	Order Number
1	116858
2	803452-006



SCHEMATIC DIAGRAMS

WE / WS from serial no. 5A132188 to serial no. 5A134880

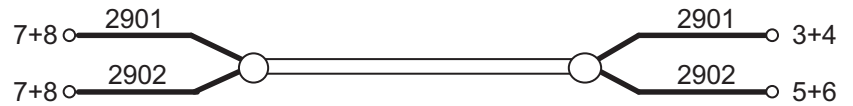
Harness, On-board charger

810528-001

Ground Lead



810528-002



810528_XB

Contact pins

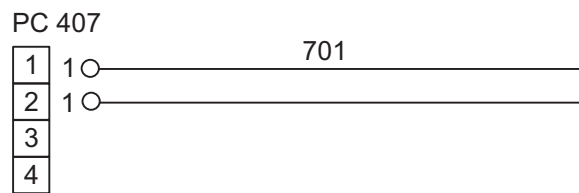
Item No.	Order Number
1	062007-044
2	062007-003
3	062007-021
4	803488-003
5	803448-004
6	803448-005
7	062007-043
8	803452-005
9	062007-051

SCHEMATIC DIAGRAMS

WE / WS from serial no. 5A132188 to serial no. 5A134880



ORS Jumper



808133_2A

Contact pins

Item No.	Order Number
1	116858
PC407	803450-006

WE / WS from serial no. 5A132188 to serial no. 5A134880

SCHEMATIC DIAGRAMS

WE / WS from serial no. 5A132188 to serial no. 5A134880



For tables for Fig. 815374_2H (see page 335)

Connector housing

Housing	Order Number
PC200	803450-047
PC211	803450-006
PC212	803450-006
PC214	803450-005
JC213	803450-001
JC215	803450-001

Contact pins

Item No.	Order Number
1	803450-010
2	116858
3	803452-005
10	803448-004
11	803448-005



SCHEMATIC DIAGRAMS

WE / WS from serial no. 5A132188 to serial no. 5A134880

Platform Cable 1



815406_2B

Connector housing

Housing	Order Number
JC420	803450-025
JC212	803450-002

Contact pins

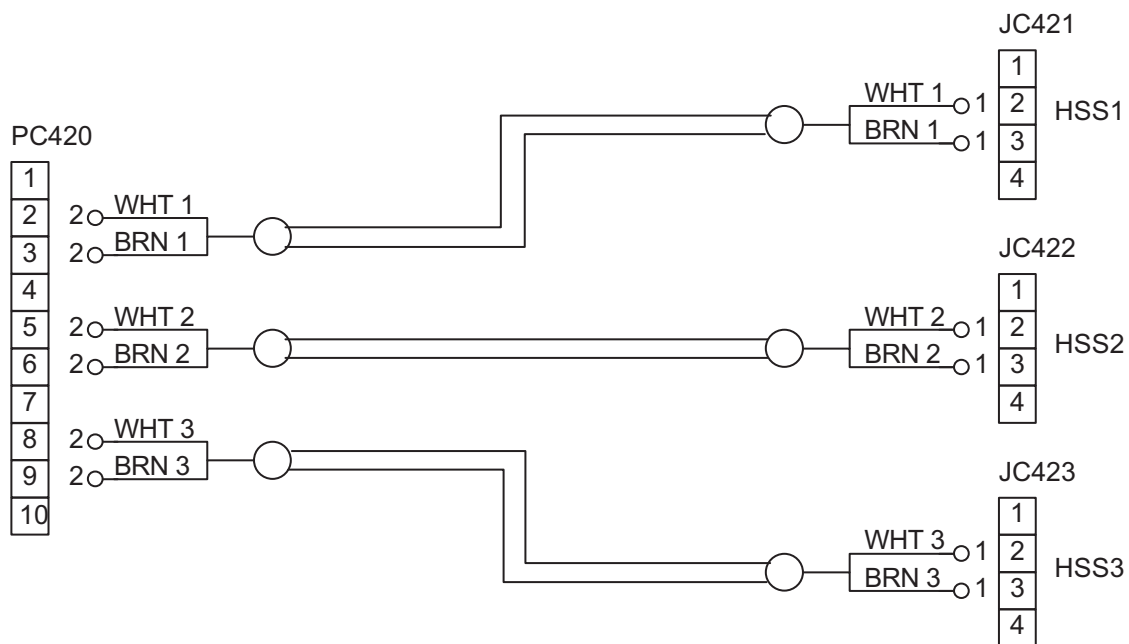
Item No.	Order Number
1	803450-010

SCHEMATIC DIAGRAMS

WE / WS from serial no. 5A132188 to serial no. 5A134880



Platform Cable 2



815407_2B

Connector housing

Housing	Order Number
PC420	803450-015
JC421	803450-002
JC422	803450-002
JC423	803450-002

Contact pins

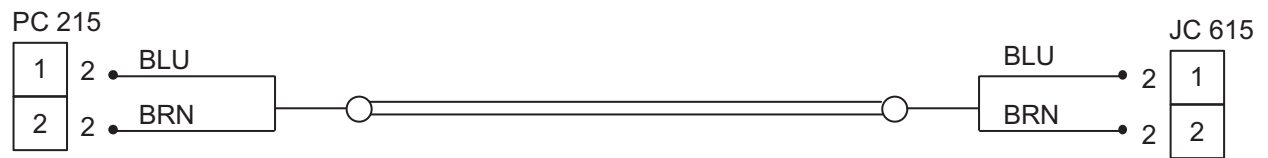
Item No.	Order Number
1	803450-010
2	116858



SCHEMATIC DIAGRAMS

WE / WS from serial no. 5A132188 to serial no. 5A134880

Cable, LMS2



814988_2G

Connector housing

Housing	Order Number
JC615	803450-001
PC215	803450-005

Contact pins

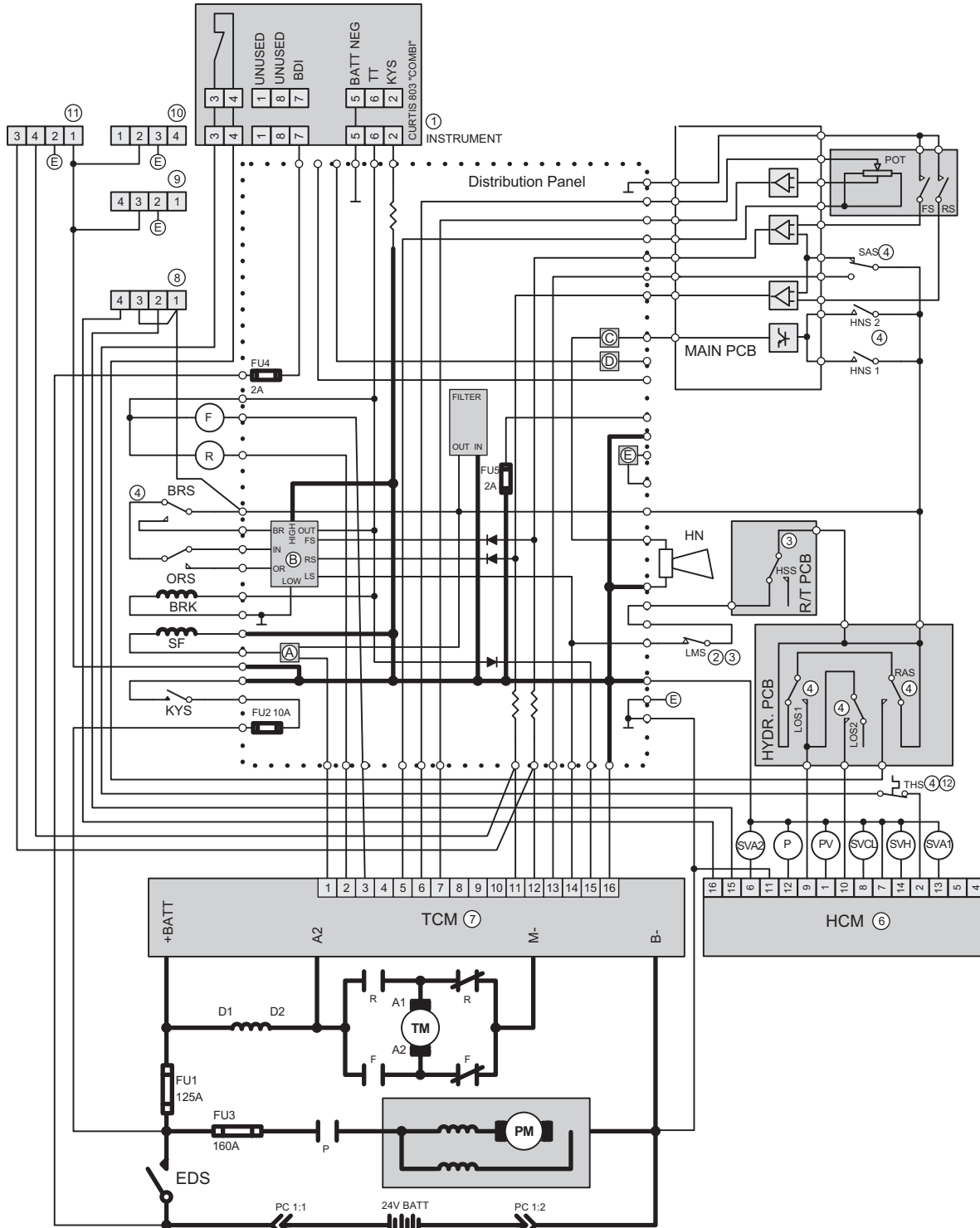
Item No.	Order Number
1	803450-010
2	116858

SCHEMATIC DIAGRAMS

WE / WS from serial no. 5A134882



Schematic Diagram, Standard



816837_2E_1

For key refer to following page



SCHEMATIC DIAGRAMS

WE / WS from serial no. 5A134882

Key to Fig. 816837_2E_1 (see page 340)

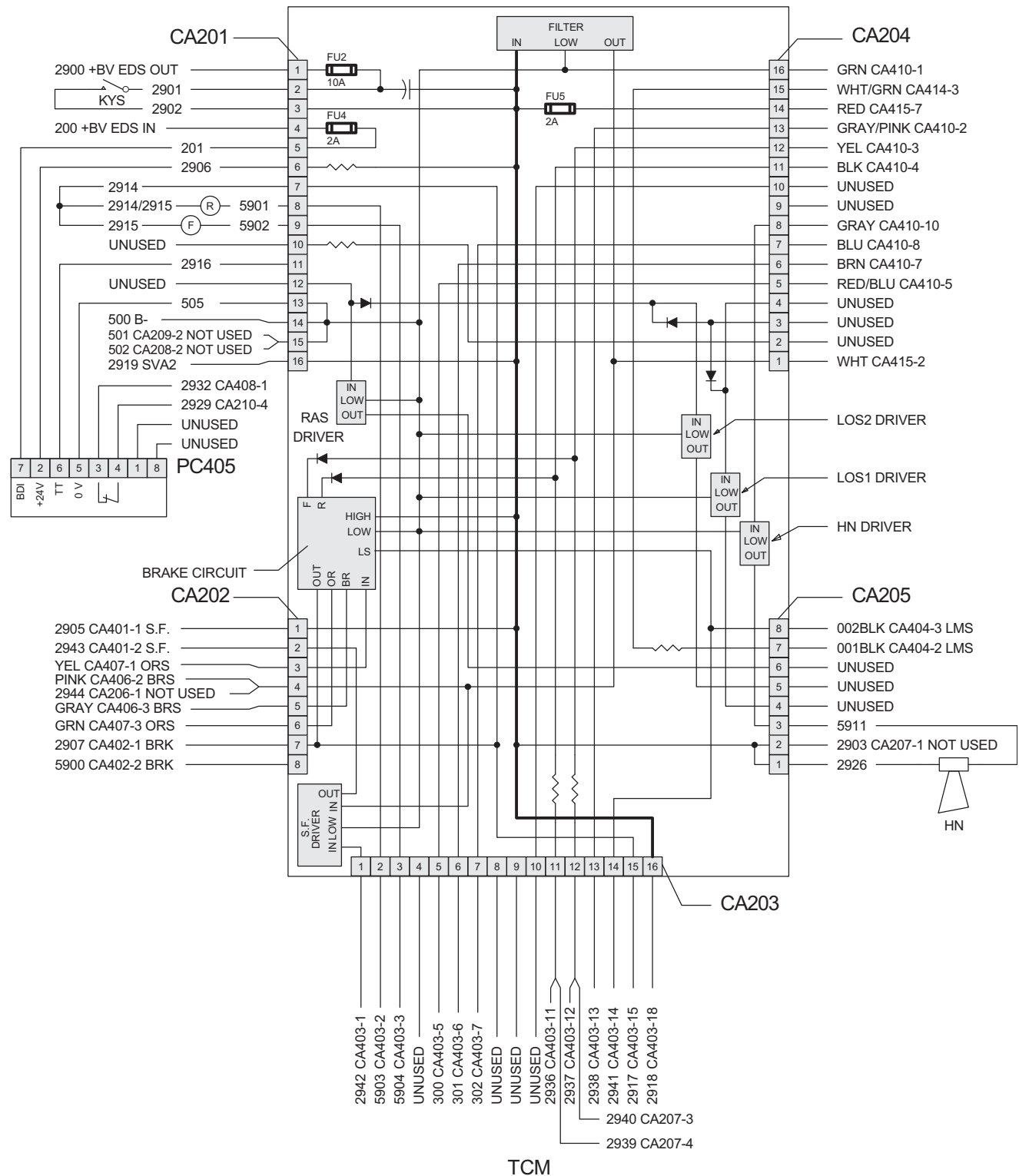
- | | | | |
|----|--------------------------------------|----|---|
| 1 | Curtis Unigage 803 | 2 | Forks higher than 250 - 2300 mm (depends on mast type):
LMS open |
| 3 | Reduced speed: HSS and / or LMS open | 4 | Active: RAS, BRS, SAS, HNS, THS, LOS1 & LOS2 are
closed |
| 6 | Hydraulic Control Module | 7 | Curtis Controller 1207 |
| 8 | Lift Stop / Soft Landing Option | 9 | Power Supply Option |
| 10 | Fan Option | 11 | Travel Alarm / Strobe Light Option |
| 12 | THS: For WE 1.25 t a jumper is used | | |
| A | Shunt Field Driver | B | Brake Circuit |
| C | Horn Driver | D | RAS Driver |
| E | LOS1 Driver | | |

SCHEMATIC DIAGRAMS

WE / WS from serial no. 5A134882



Distribution Panel, Standard



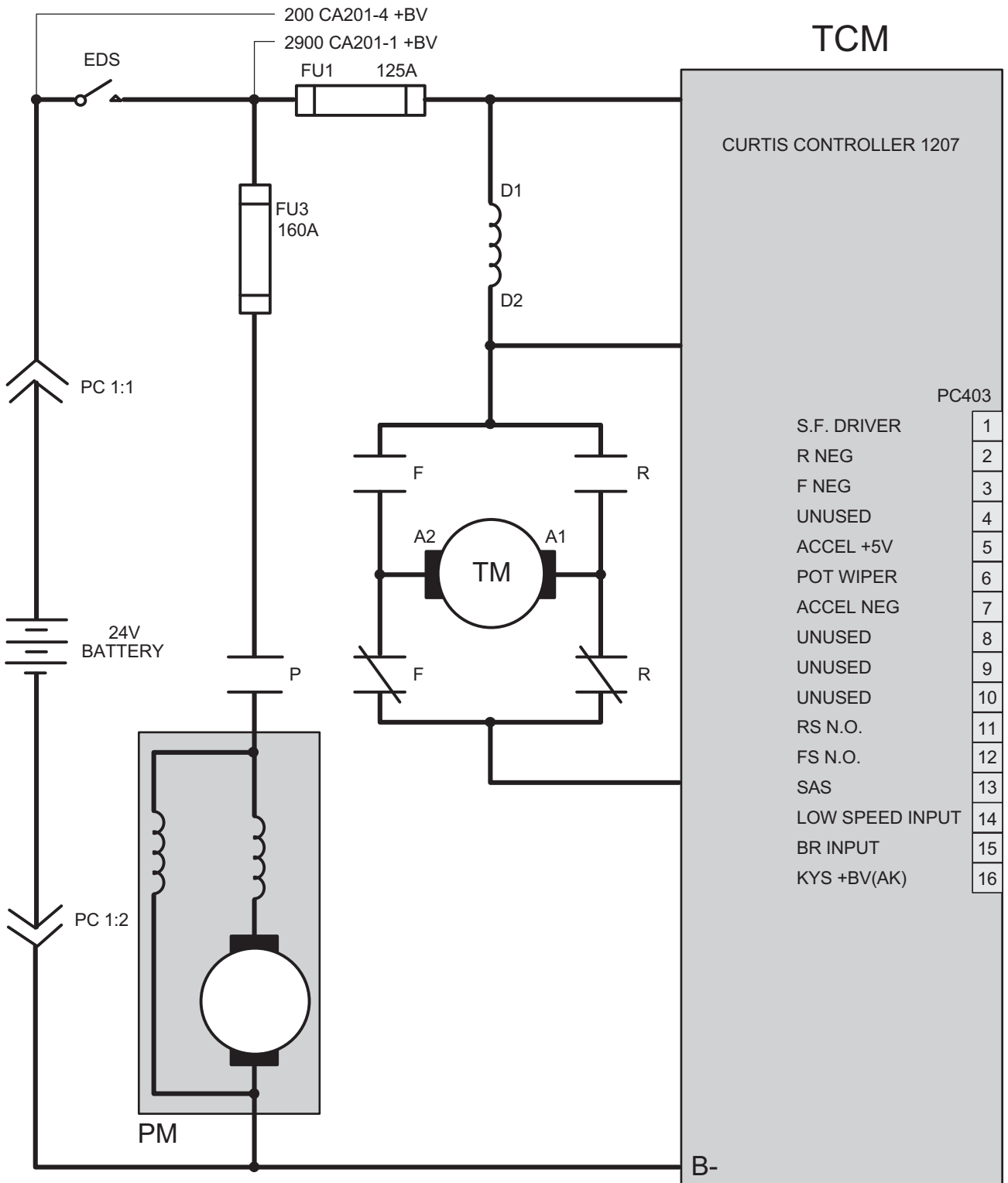
816837_2E_2



SCHEMATIC DIAGRAMS

WE / WS from serial no. 5A134882

Traction Controller - Power Side, Standard



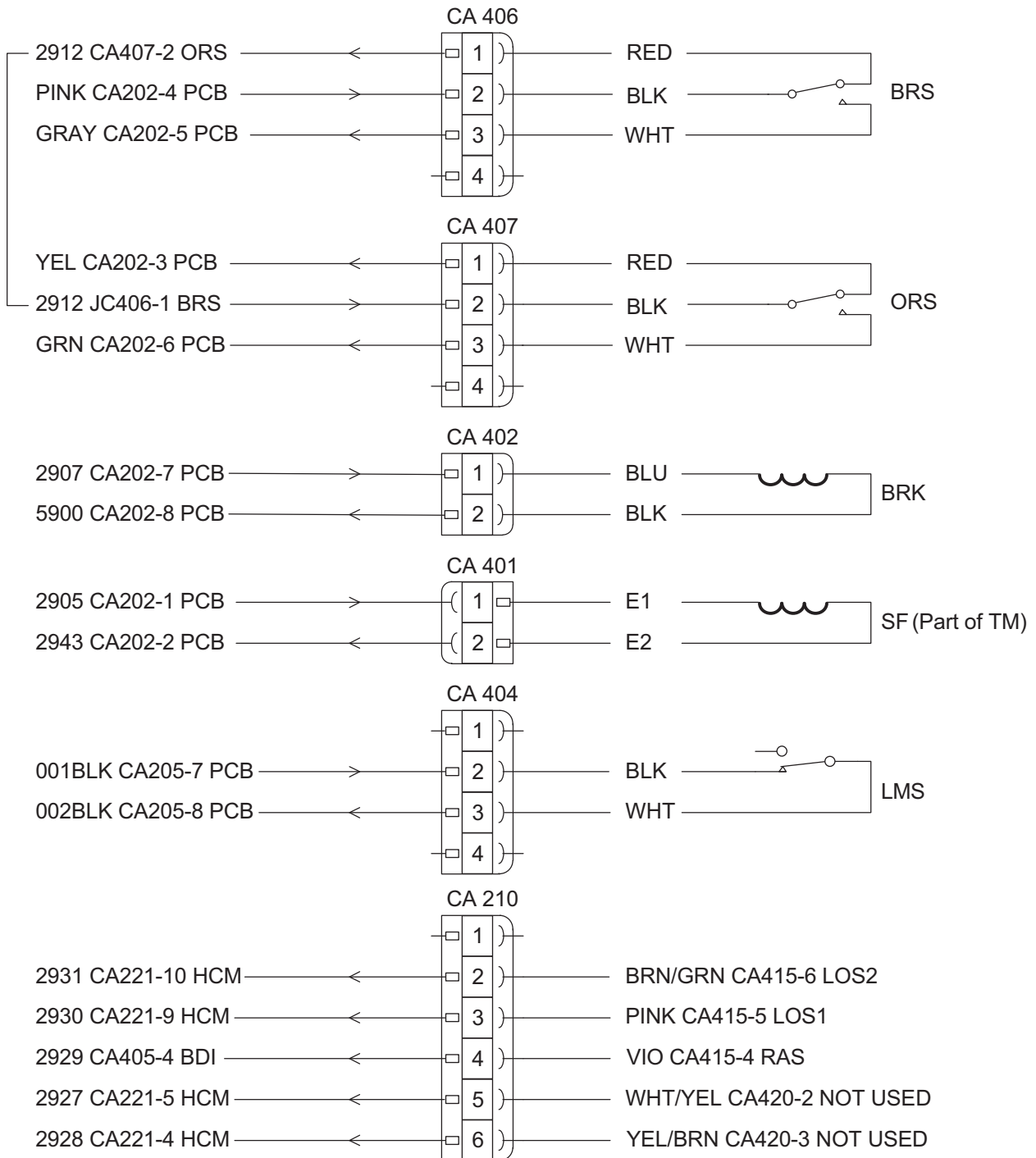
816837_2E_3

SCHEMATIC DIAGRAMS

WE / WS from serial no. 5A134882



Brake Circuit, Standard



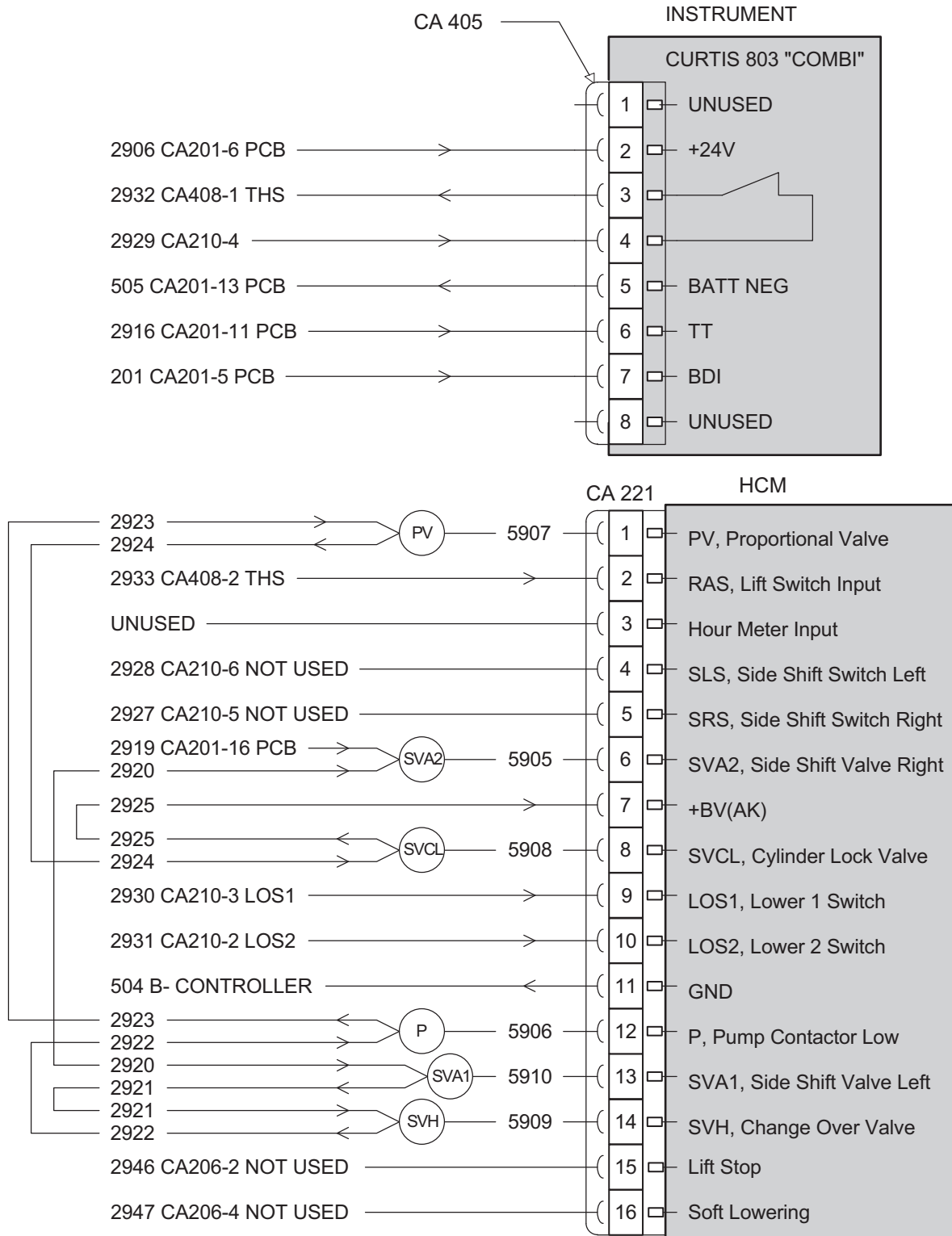
816837_2E_4



SCHEMATIC DIAGRAMS

WE / WS from serial no. 5A134882

Instrument & Proportional Electronic Circuit, Standard



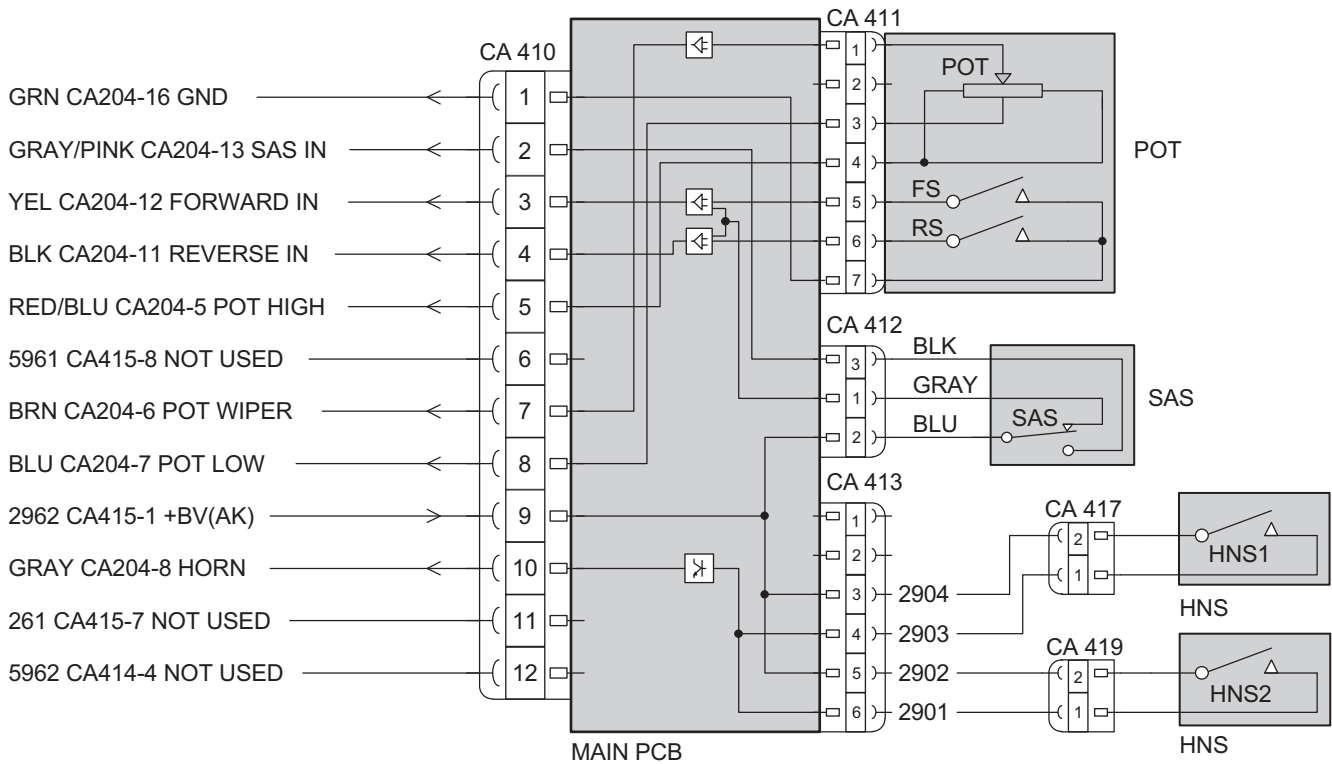
816837_2E_5

SCHEMATIC DIAGRAMS

WE / WS from serial no. 5A134882



Control Handle Circuit, Standard

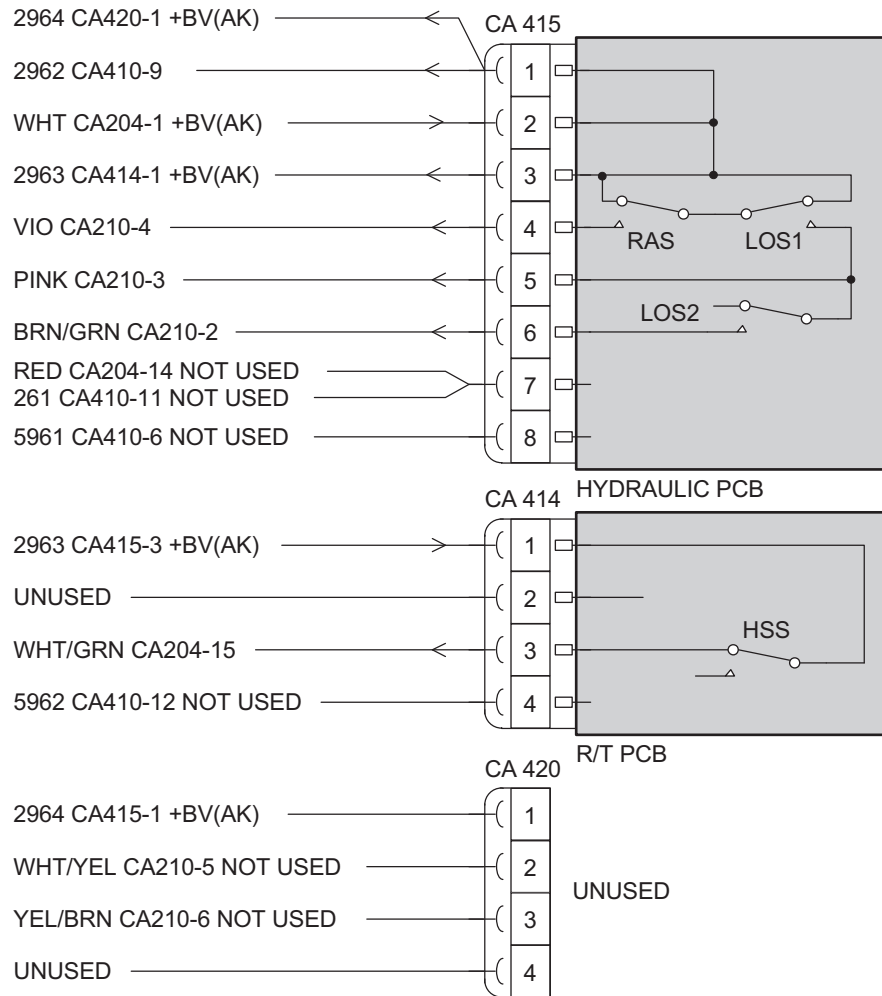


816837_2E_6-1



SCHEMATIC DIAGRAMS

WE / WS from serial no. 5A134882



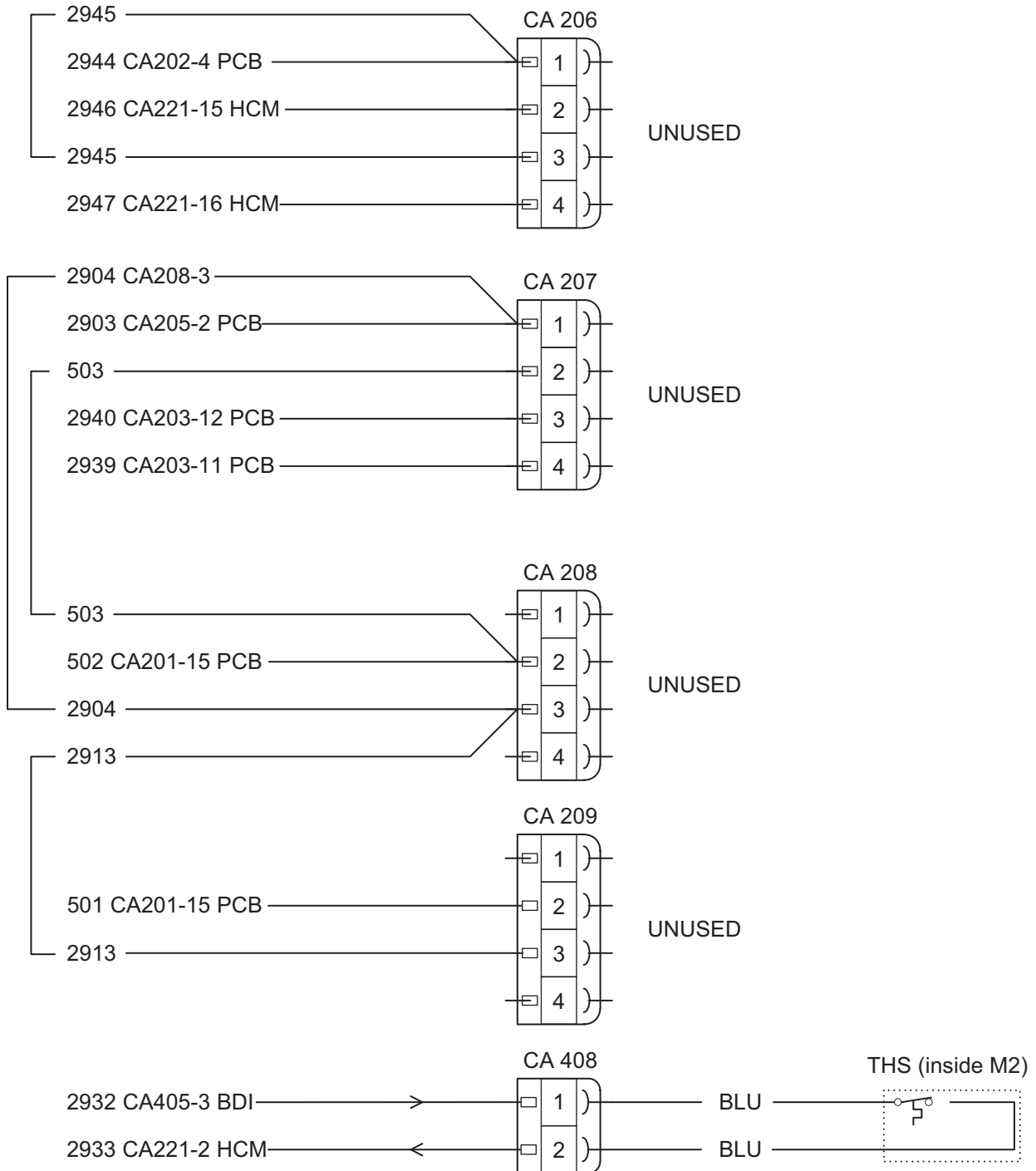
816837_2E_6-2

SCHEMATIC DIAGRAMS

WE / WS from serial no. 5A134882



Option Connection, Thermal Switch, Standard



816837_2E_7

NOTE

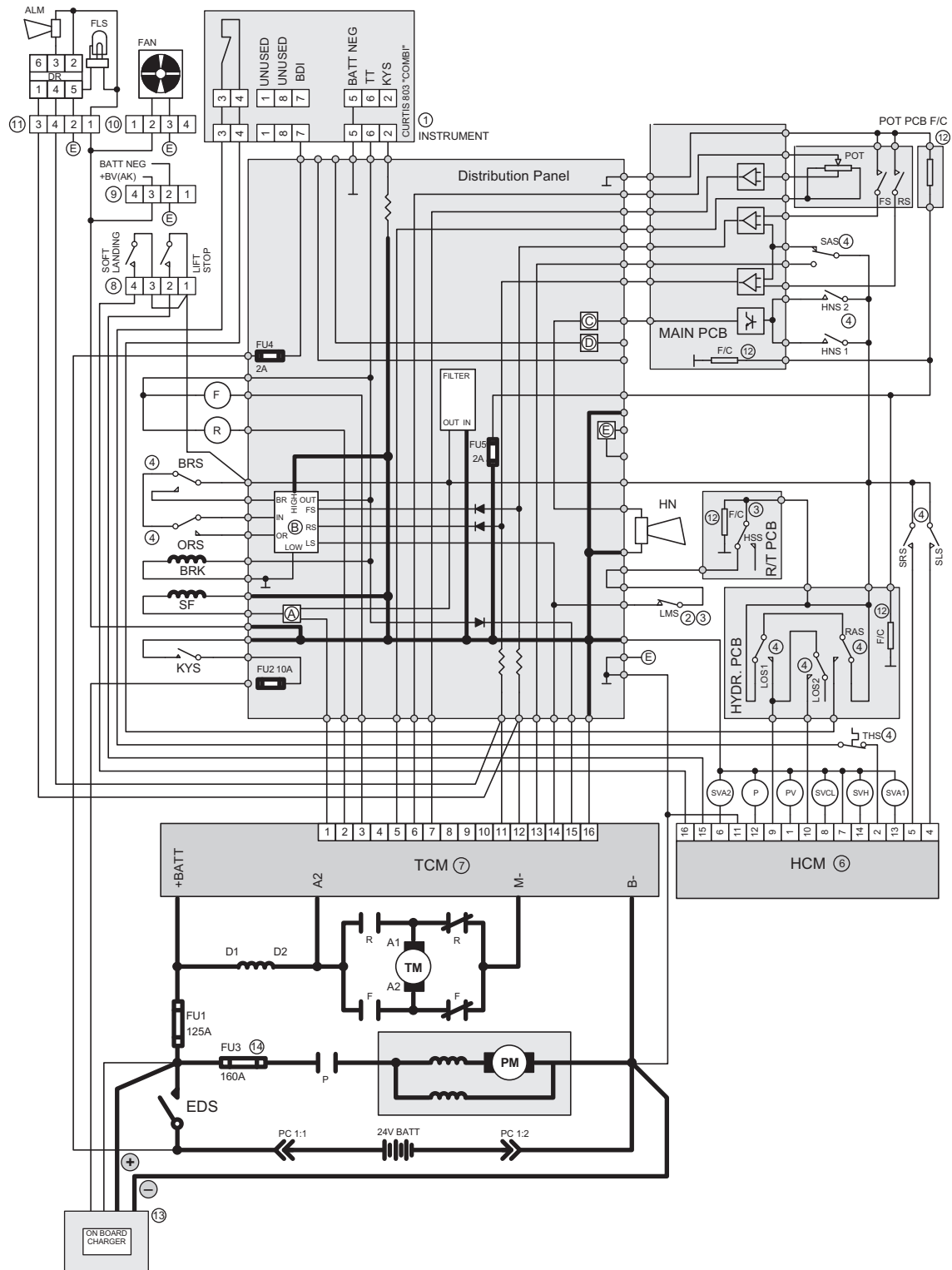
For WE 1.25 t a jumper is used instead of THS



SCHEMATIC DIAGRAMS

WE / WS from serial no. 5A134882

Schematic Diagram, Options



816839_2D_1

For key refer to following page

SCHEMATIC DIAGRAMS

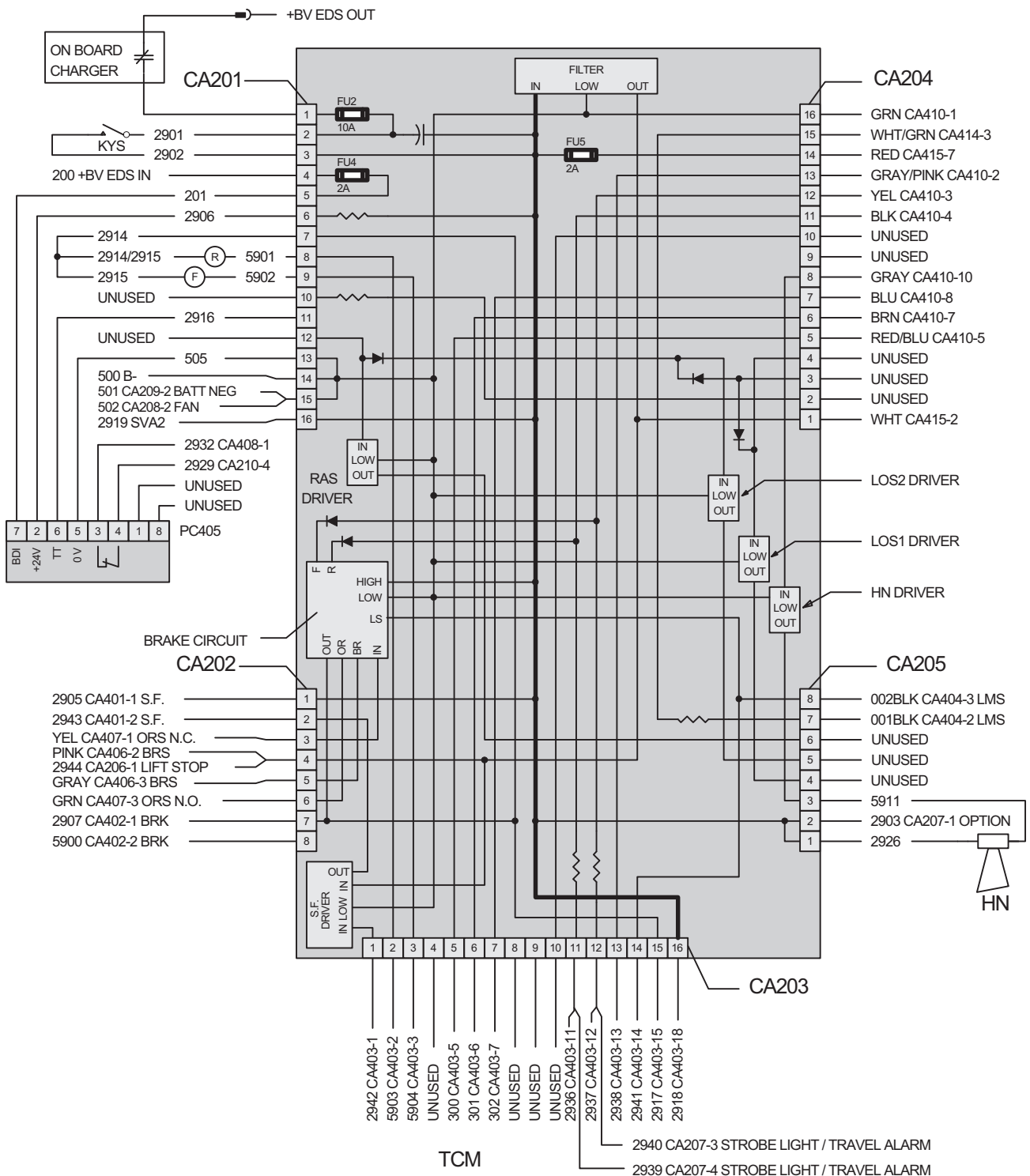
WE / WS from serial no. 5A134882



Key to Fig. 816839_2D_1 (see page 349)

- | | | | |
|----|--|----|---|
| 1 | Curtis Unigage | 2 | Forks higher than 250 - 2300 mm (depends on mast type):
LMS open |
| 3 | Reduced speed: HSS and / or LMS open | 4 | Active: RAS, BRS, ORS, SAS, HNS, THS, LOS1 & LOS2,
SLS, SRS are closed |
| 6 | Hydraulic Control Module | 7 | Curtis Controller 1207 |
| 8 | Lift Stop / Soft Landing Option | 9 | Power Supply Option |
| 10 | Fan Option | 11 | Travel Alarm / Strobe Light Option |
| 12 | F / C package: active below 5 °C | 13 | On board charger connection |
| 14 | For North American truck only: FU3 = 125 A | | |
| A | Shunt Field Driver | B | Brake Circuit |
| C | Horn Driver | D | RAS Driver |
| E | LOS1 Driver | | |

Distribution Panel, Options



816839_2D_2

[illegible]

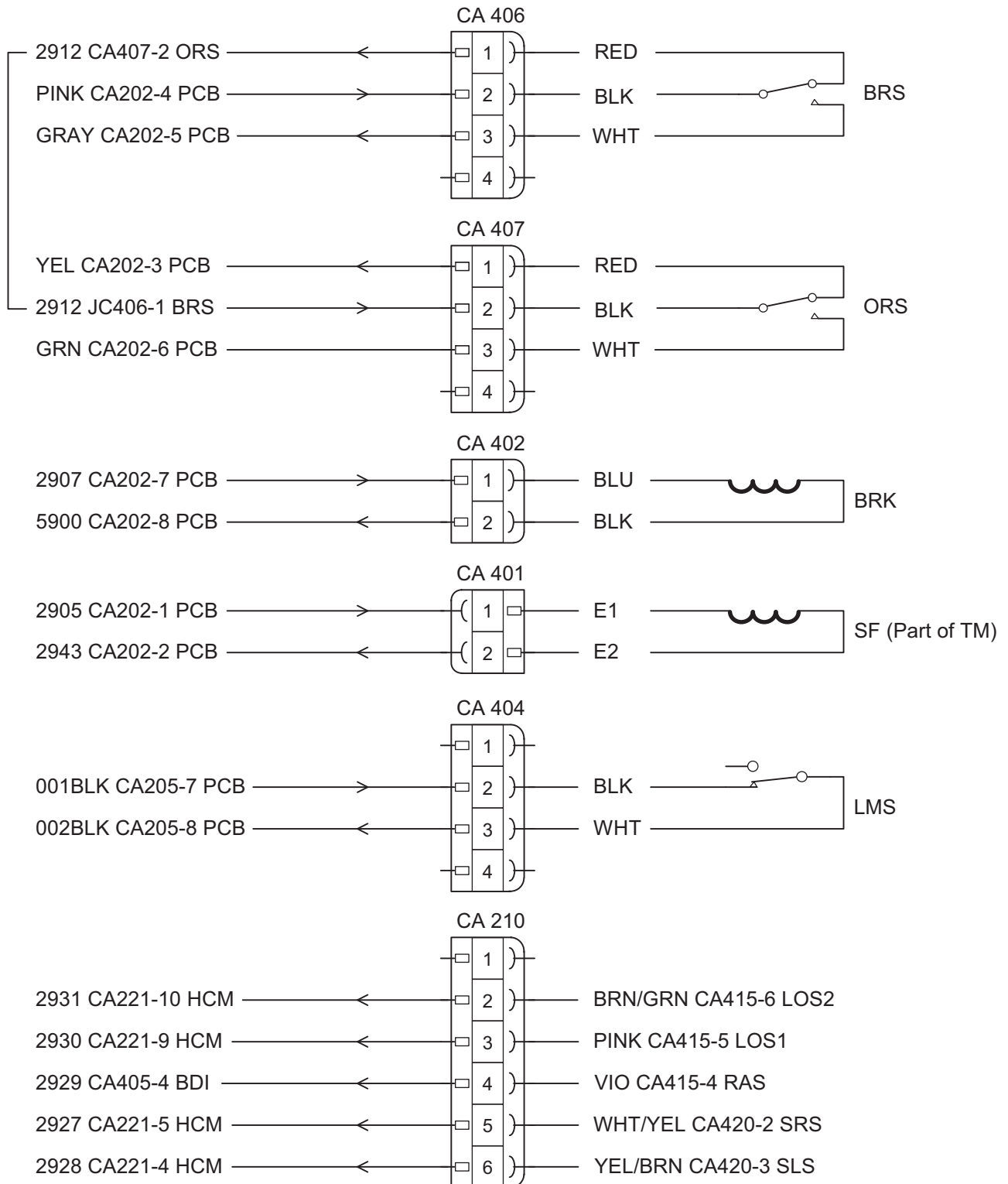
WE/WS 2300



SCHEMATIC DIAGRAMS

WE / WS from serial no. 5A134882

Brake Circuit, Options



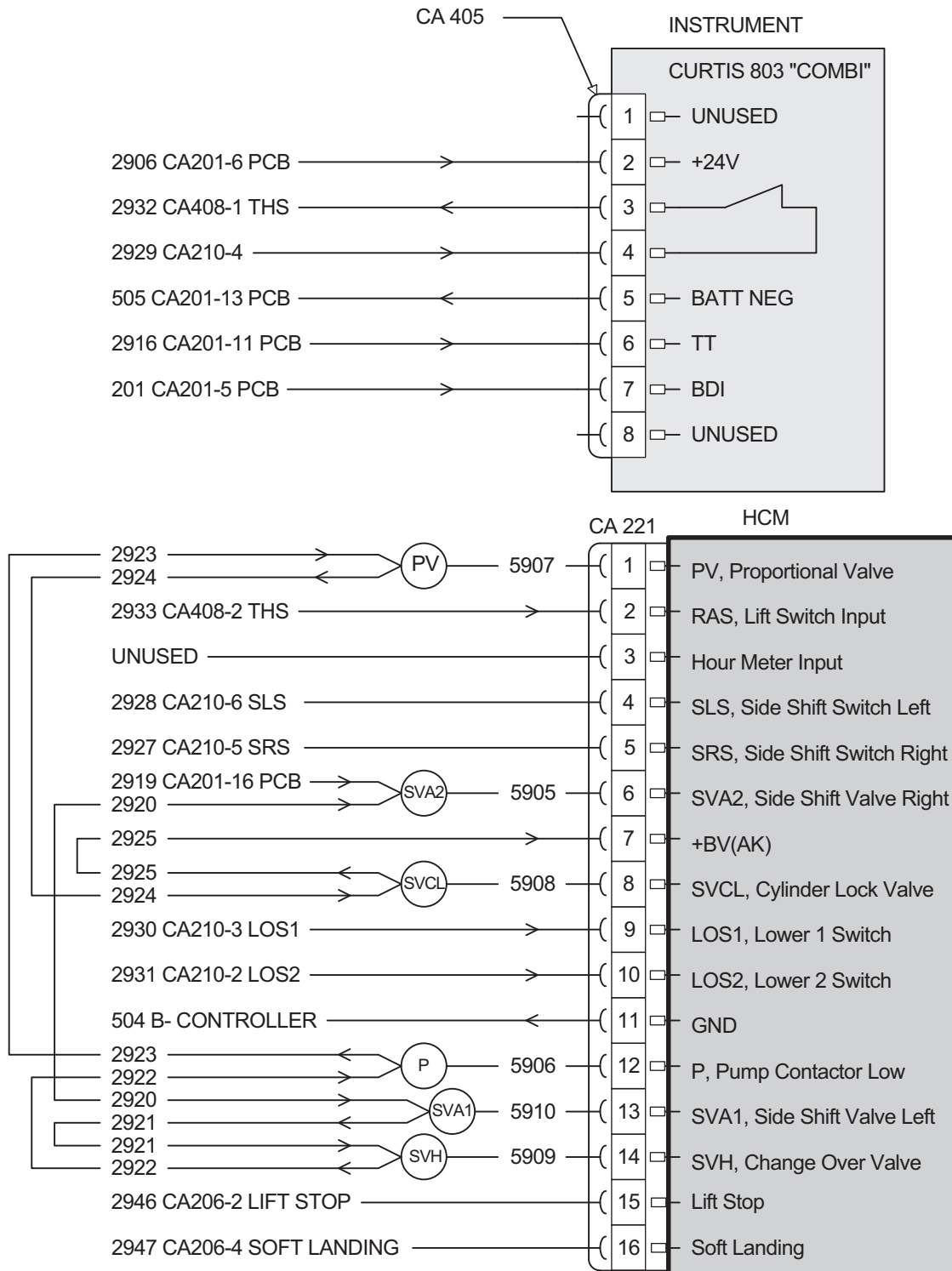
816839_2D_4

SCHEMATIC DIAGRAMS

WE / WS from serial no. 5A134882



Instrument & Proportional Electronic Circuit, Options



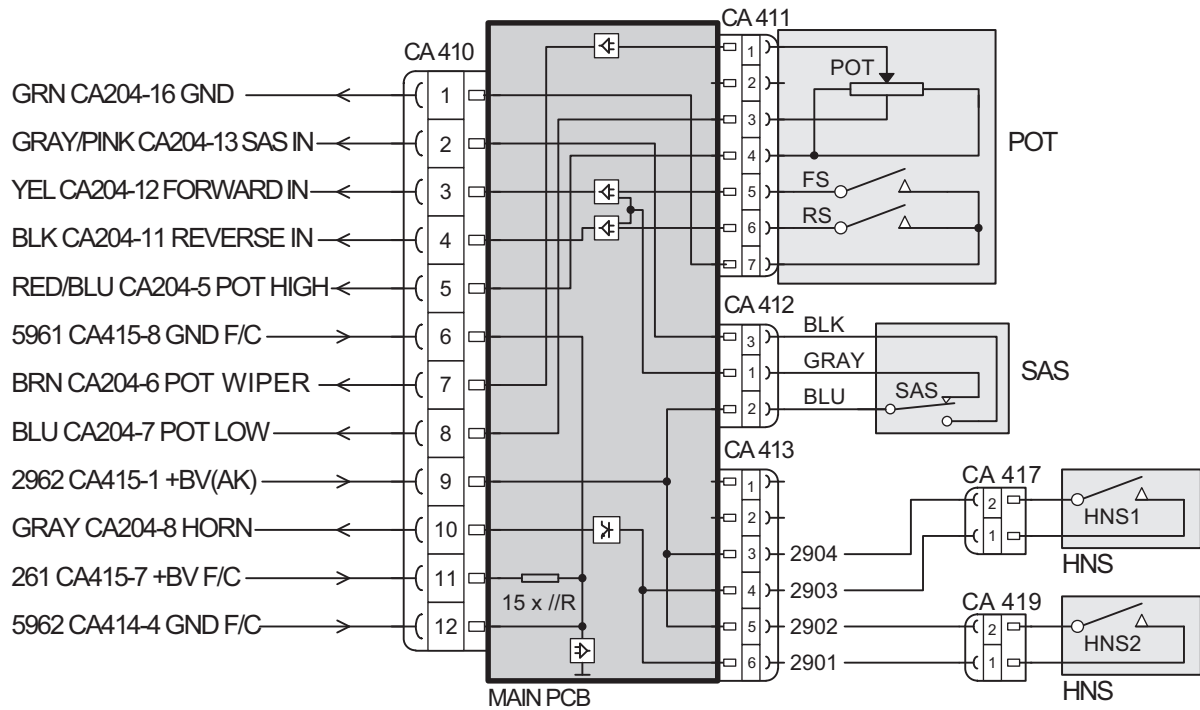
816839_2D_5



SCHEMATIC DIAGRAMS

WE / WS from serial no. 5A134882

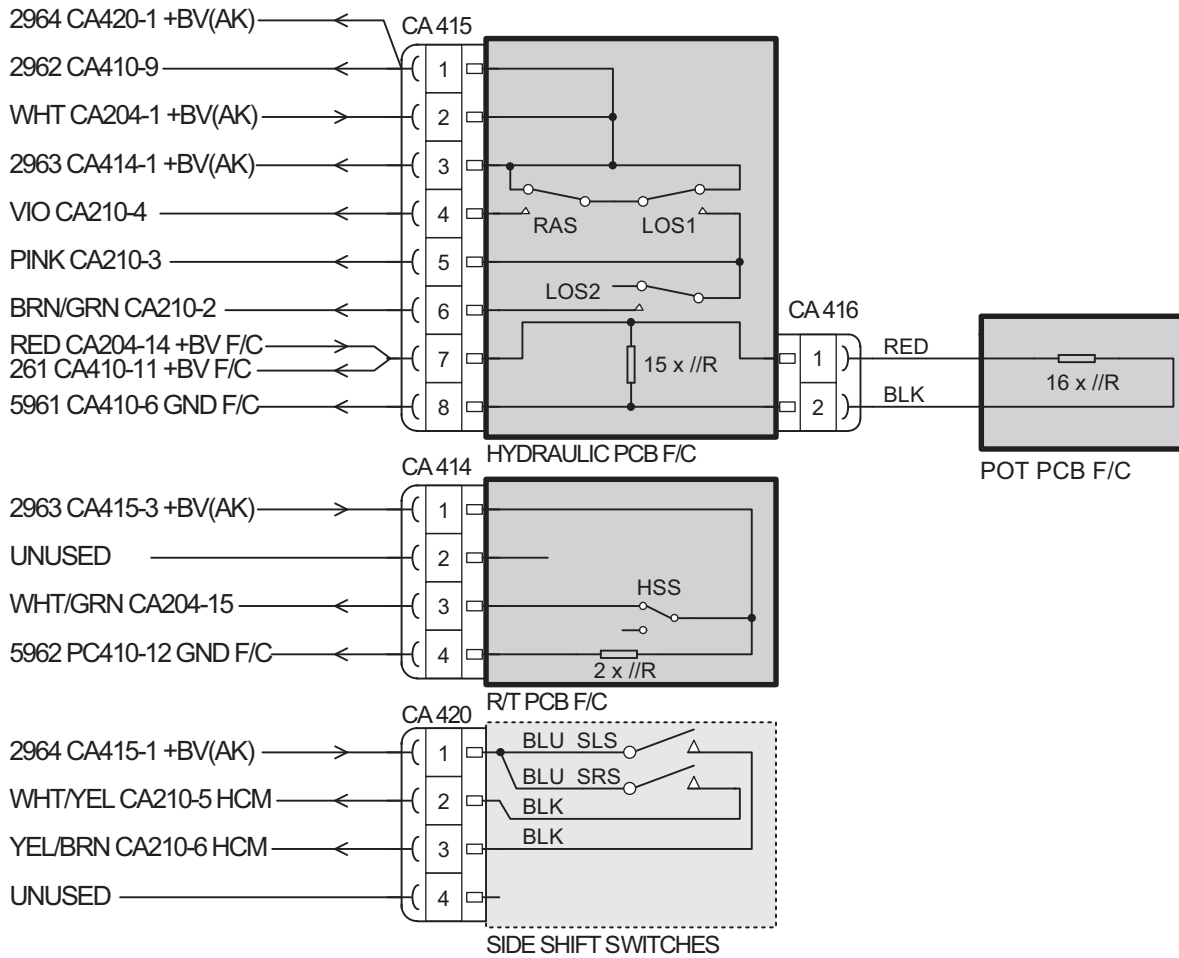
Control Handle Circuit, Options



816839_2D_6-1

SCHEMATIC DIAGRAMS

WE / WS from serial no. 5A134882



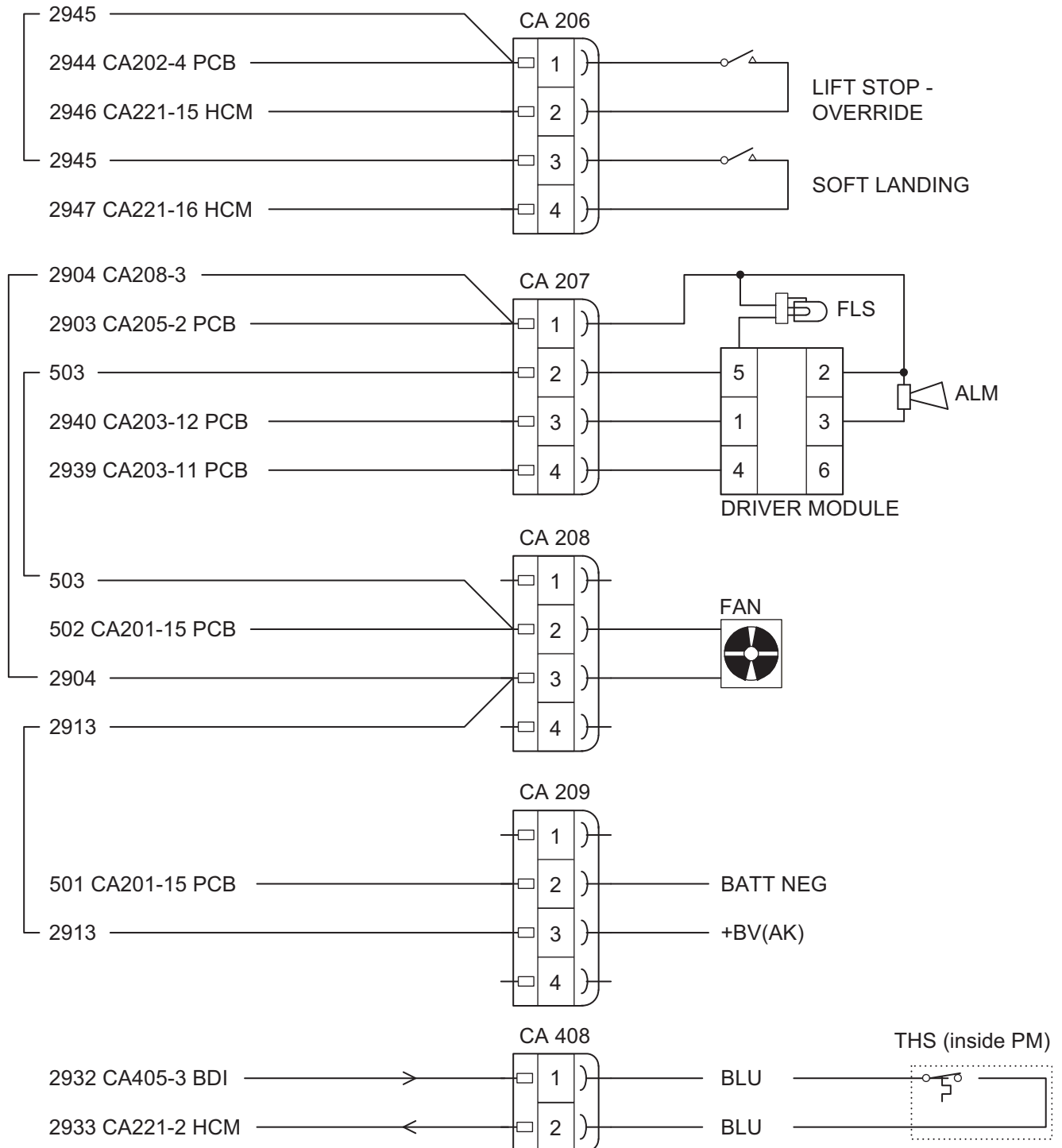
816839_2D_6-2



SCHEMATIC DIAGRAMS

WE / WS from serial no. 5A134882

Option Connection, Thermal Switch, Options



816839_2D_7

NOTE

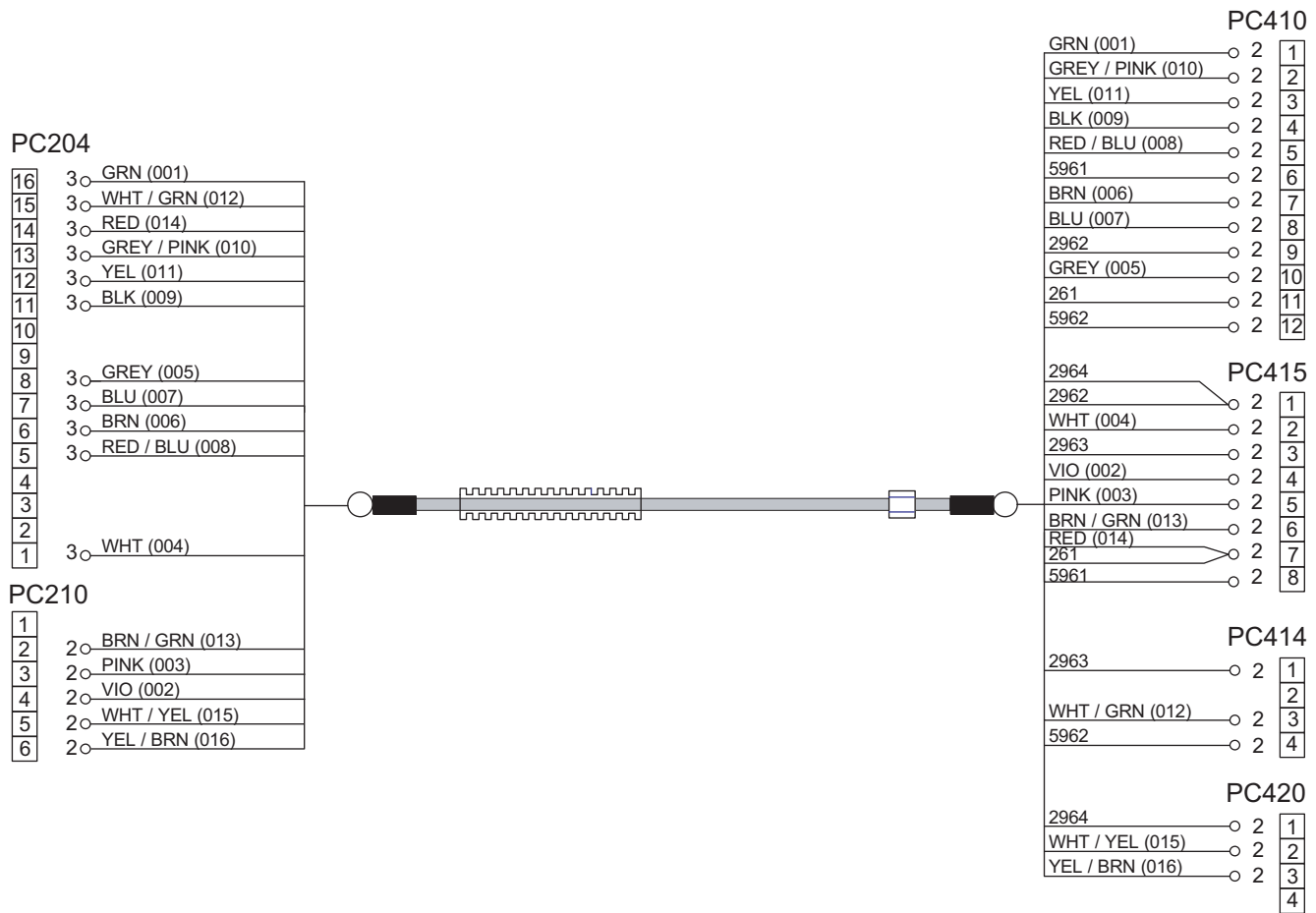
For WE 1.25 t a jumper is used instead of THS

SCHEMATIC DIAGRAMS

WE / WS from serial no. 5A134882



Control Handle Wire Harness



813426_2C

Connector housing

Housing	Order Number
PC204	803452-002
PC210	803450-007
PC410	803450-009
PC414	803450-020
PC415	803450-008
PC420	803450-006

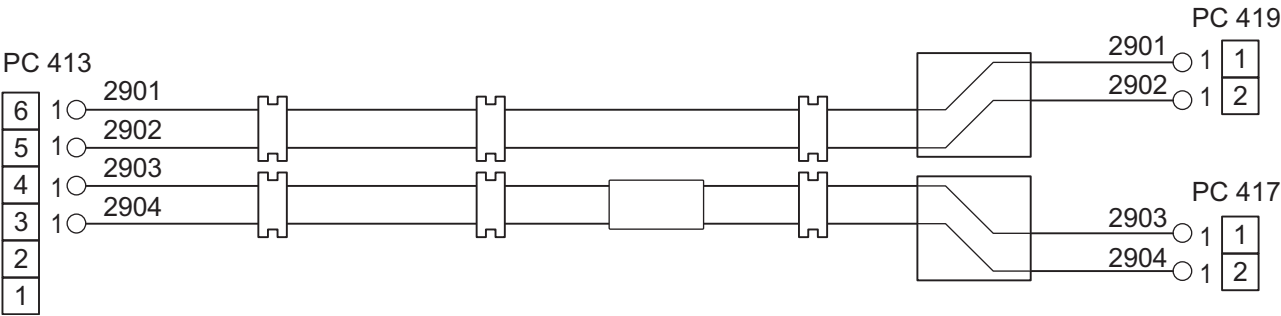
Contact pins

Item No.	Order Number
2	116858
3	803452-005



SCHEMATIC DIAGRAMS
WE / WS from serial no. 5A134882

Horn Harness



811931_2E_1

Connector housing

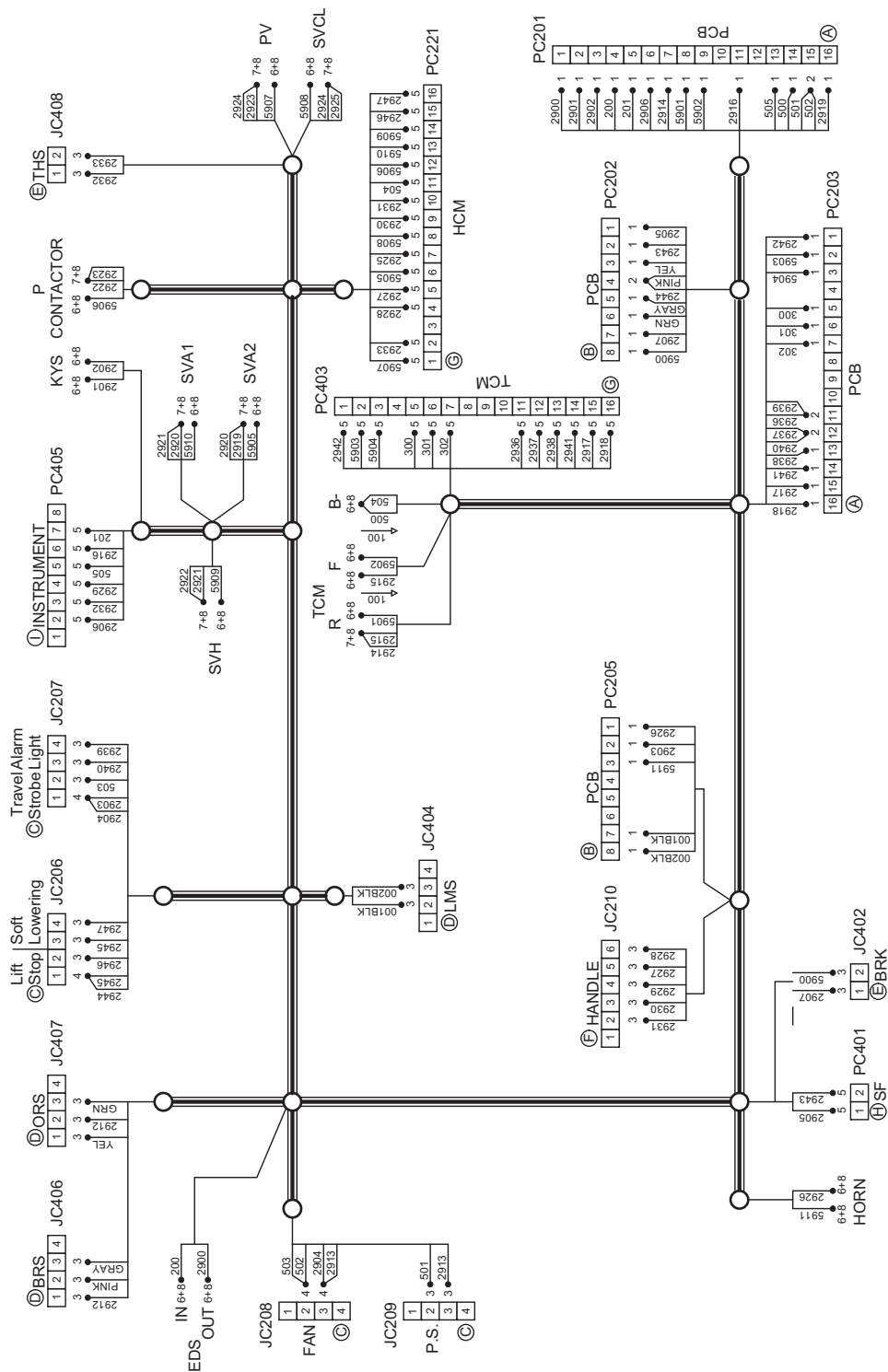
Housing	Order Number
PC413	803450-021
PC419	803450-023
PC417	803450-023

SCHEMATIC DIAGRAMS

WE / WS from serial no. 5A134882



Main Harness



816836_2D_1

For tables refer to following page



SCHEMATIC DIAGRAMS

WE / WS from serial no. 5A134882

For tables for Fig. 816836_2D_1 (see page 360)

Connector housing

Housing	Order Number
PC201, PC203	803452-002
PC202, PC205	803452-001
JC206, JC207, JC208, JC209	803450-034
JC404, JC406, JC407	803450-002
JC402, JC408	803450-001
JC210	803450-003
PC221, PC403	116851
PC401	803450-005
PC405	803450-008

Contact pins

Item No.	Order Number
1	803452-005
2	803452-006
3	803450-010
4	803450-086
5	116858

Cable lugs and rings

Item No.	Order Number
6	816812-004
7	816812-001
8	816812-075

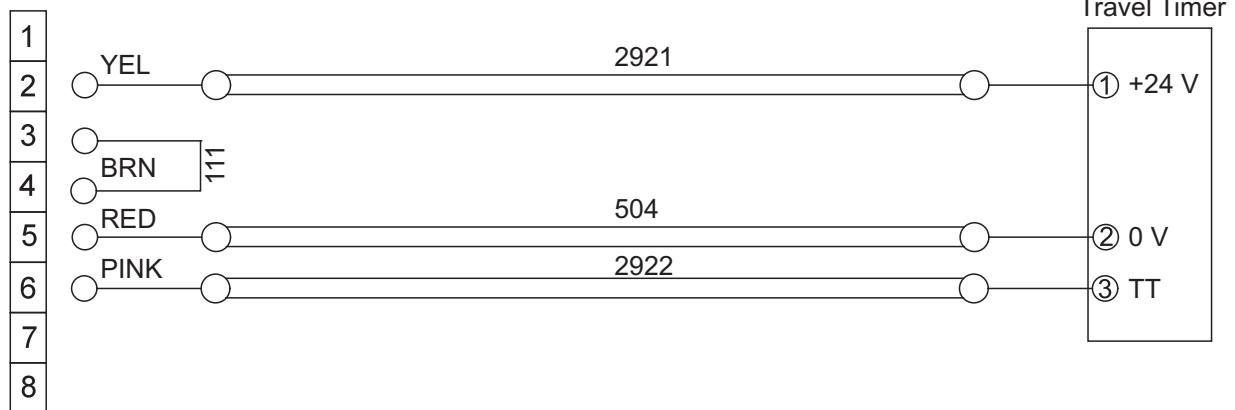
SCHEMATIC DIAGRAMS

WE / WS from serial no. 5A134882



Hourmeter Harness

PC405



803545_2C

Connector housing

Housing	Order Number
PC405	803450-004

Contact pins

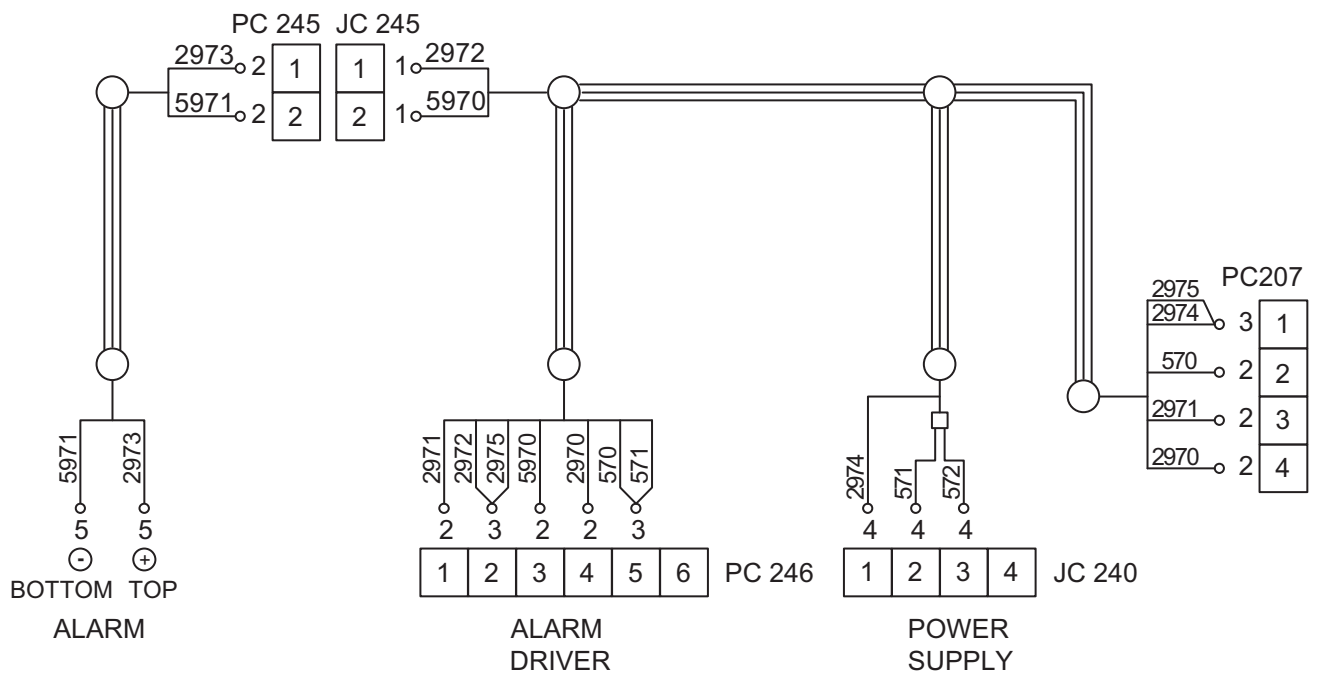
Item No.	Order Number
---	062007-043



SCHEMATIC DIAGRAMS

WE / WS from serial no. 5A134882

Strobe & Alarm Signal Optional Harness



818947_XA

Connector housing

Housing	Order Number
JC245	803450-001
PC207	803450-006
PC245	803450-005
PC246	803450-007
JC240	---

Cable lugs and rings

Item No.	Order Number
5	062007-32
6	---

Contact pins

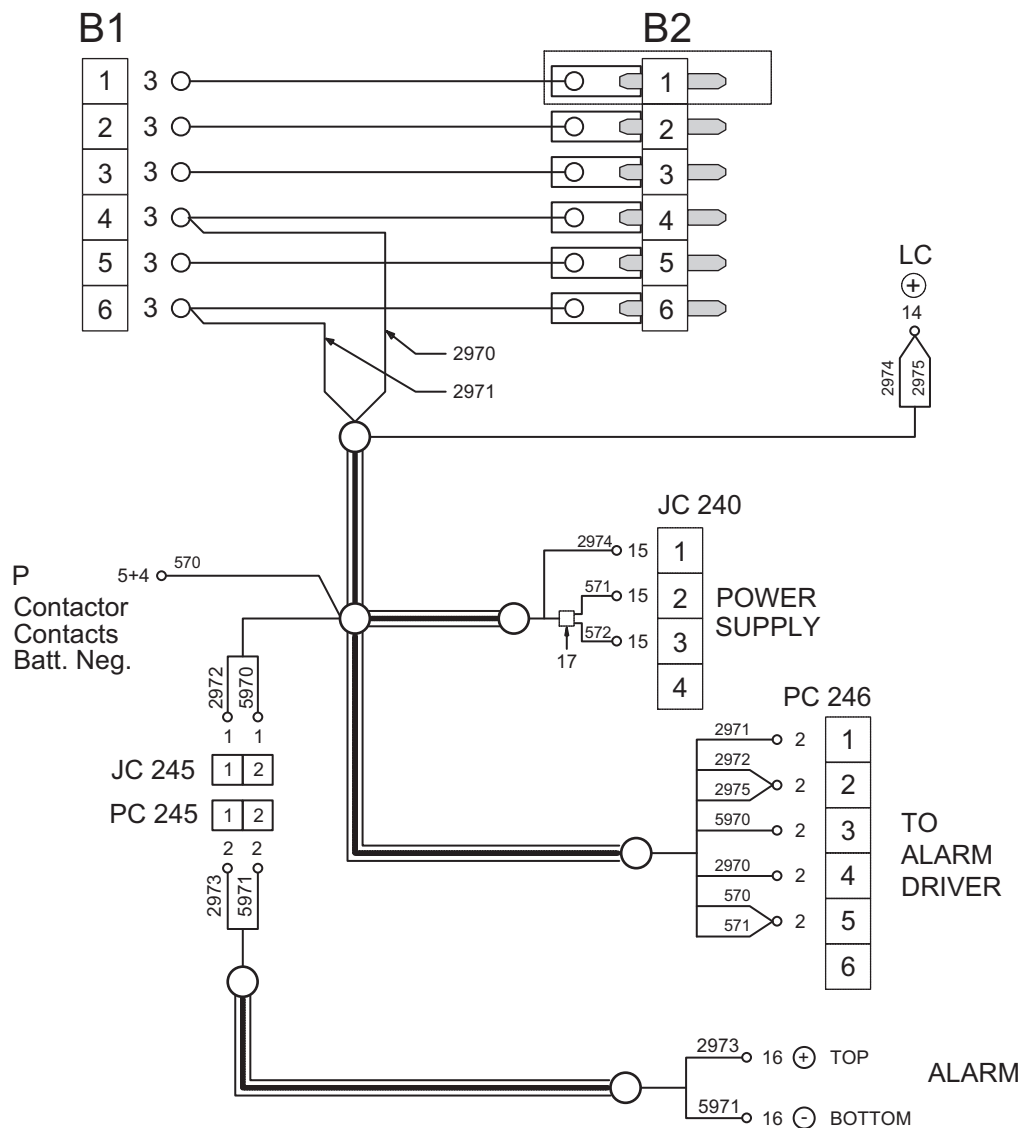
Item No.	Order Number
1	803450-010
2	116858
3	803450-049
4	---

SCHEMATIC DIAGRAMS

WE / WS from serial no. 5A134882



Strobe & Alarm Signal Optional Harness



814992_2B

See next page for tables



SCHEMATIC DIAGRAMS

WE / WS from serial no. 5A134882

Connector housing

Housing	Order Number
JC240	---
JC245	803450-001
PC245	803450-005
PC246	803450-007
B1	803450-017
B2	---

Contact pins

Item No.	Order Number
1	803450-010
2	116858
3	803450-019
4	062007-021
5	803678-006
14	062007-054
15	---
16	062007-032
17	---

SCHEMATIC DIAGRAMS

WE / WS from serial no. 5A134882

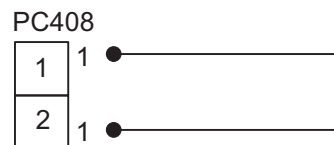


Mast Cable for Strobe Light



813407_2D

Jumper 1.25 t



818919_2B



SCHEMATIC DIAGRAMS

WE / WS from serial no. 5A134882

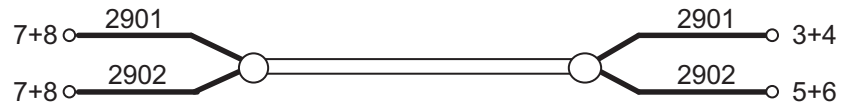
Harness, On-board charger

810528-001

Ground Lead



810528-002



810528_XB

Contact pins

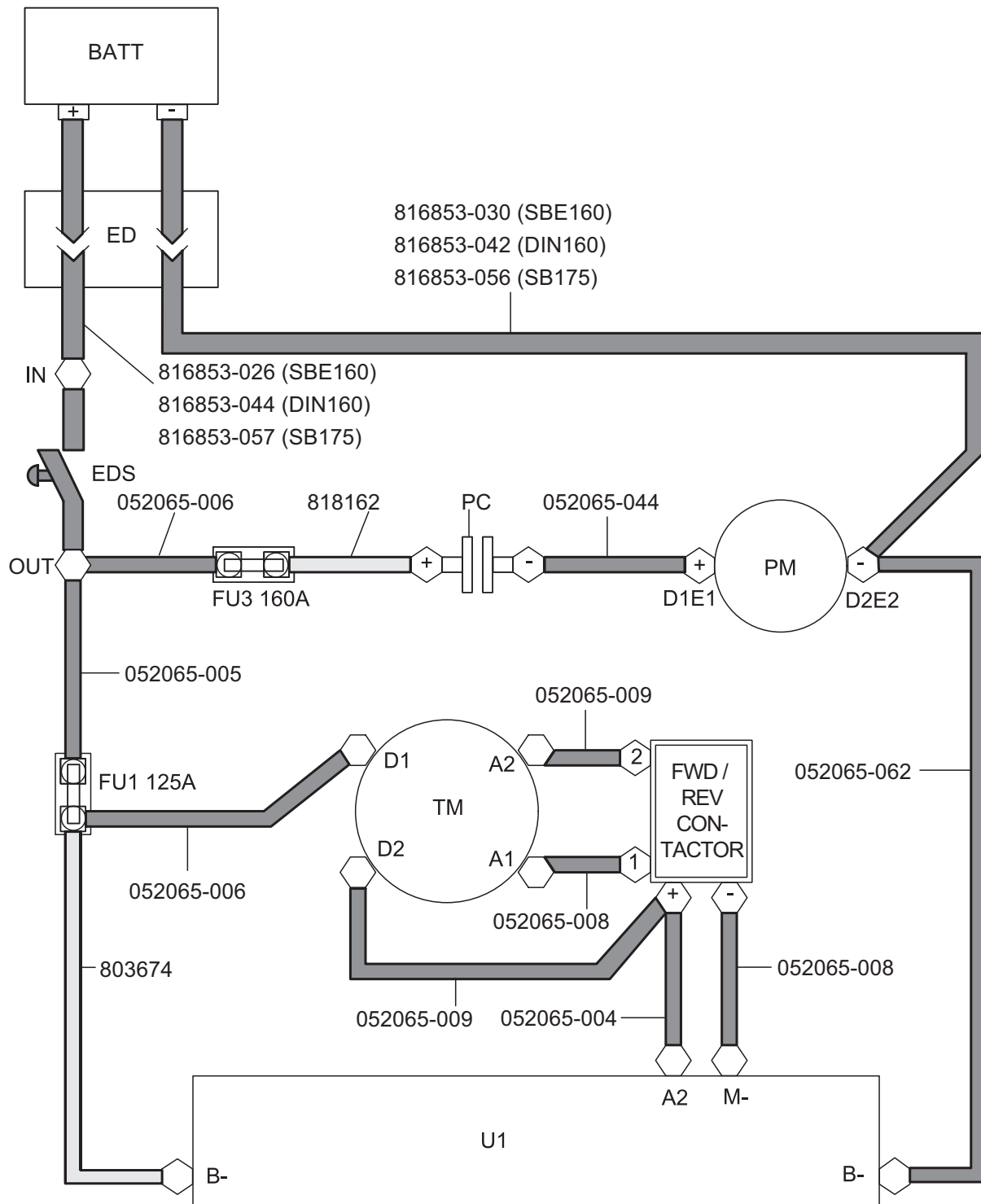
Item No.	Order Number
1	062007-044
2	062007-003
3	062007-021
4	803488-003
5	803448-004
6	803448-005
7	062007-043
8	803452-005
9	062007-051

SCHEMATIC DIAGRAMS

WE / WS from serial no. 5A134882



Power Cables



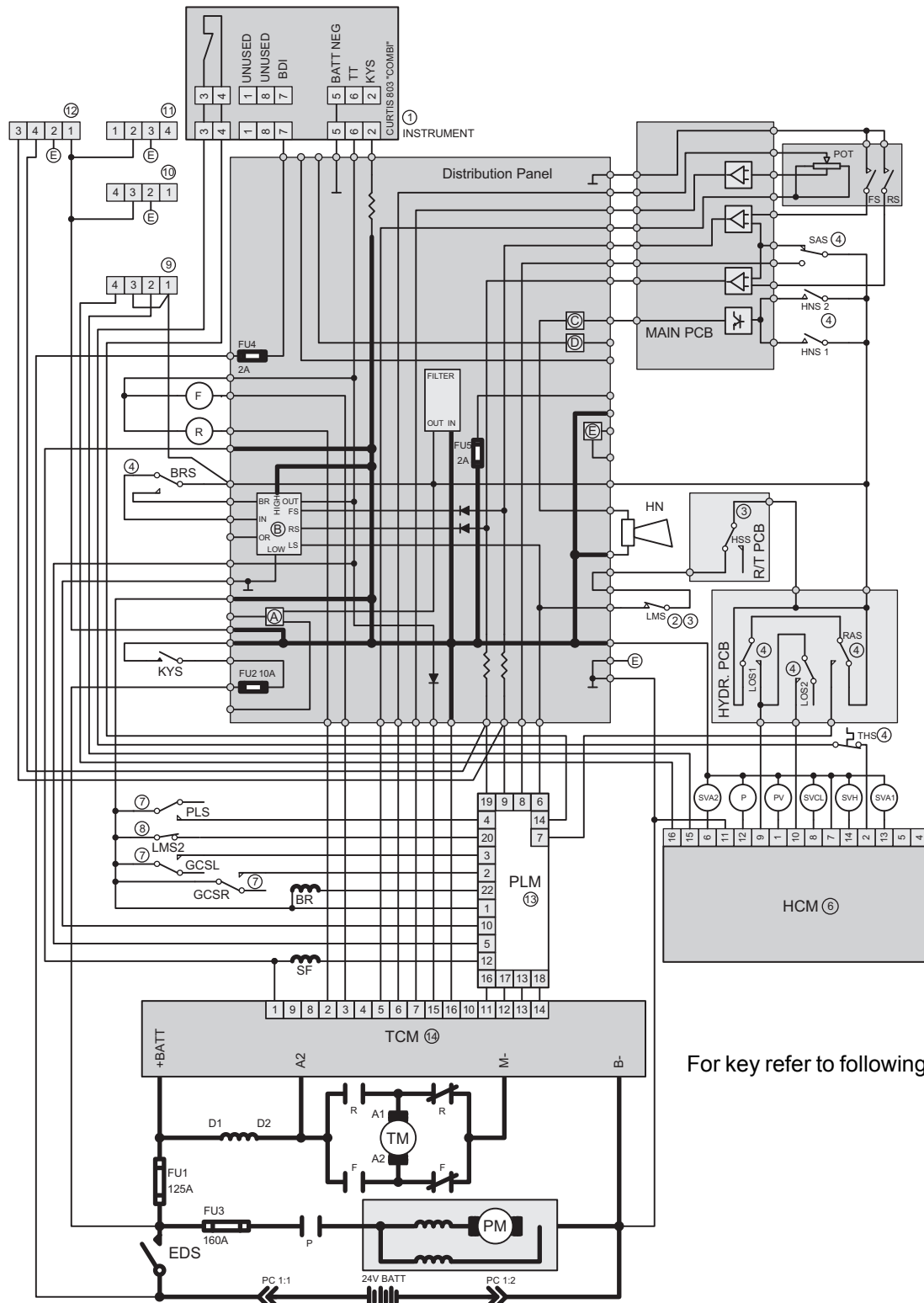
816897_2B



SCHEMATIC DIAGRAMS

WE / WS from serial no. 5A134882

Schematic Diagram, Standard



For key refer to following page

818163_2C_1

SCHEMATIC DIAGRAMS

WE / WS from serial no. 5A134882



Key to Fig. 818163_2C_1 (see page 369)

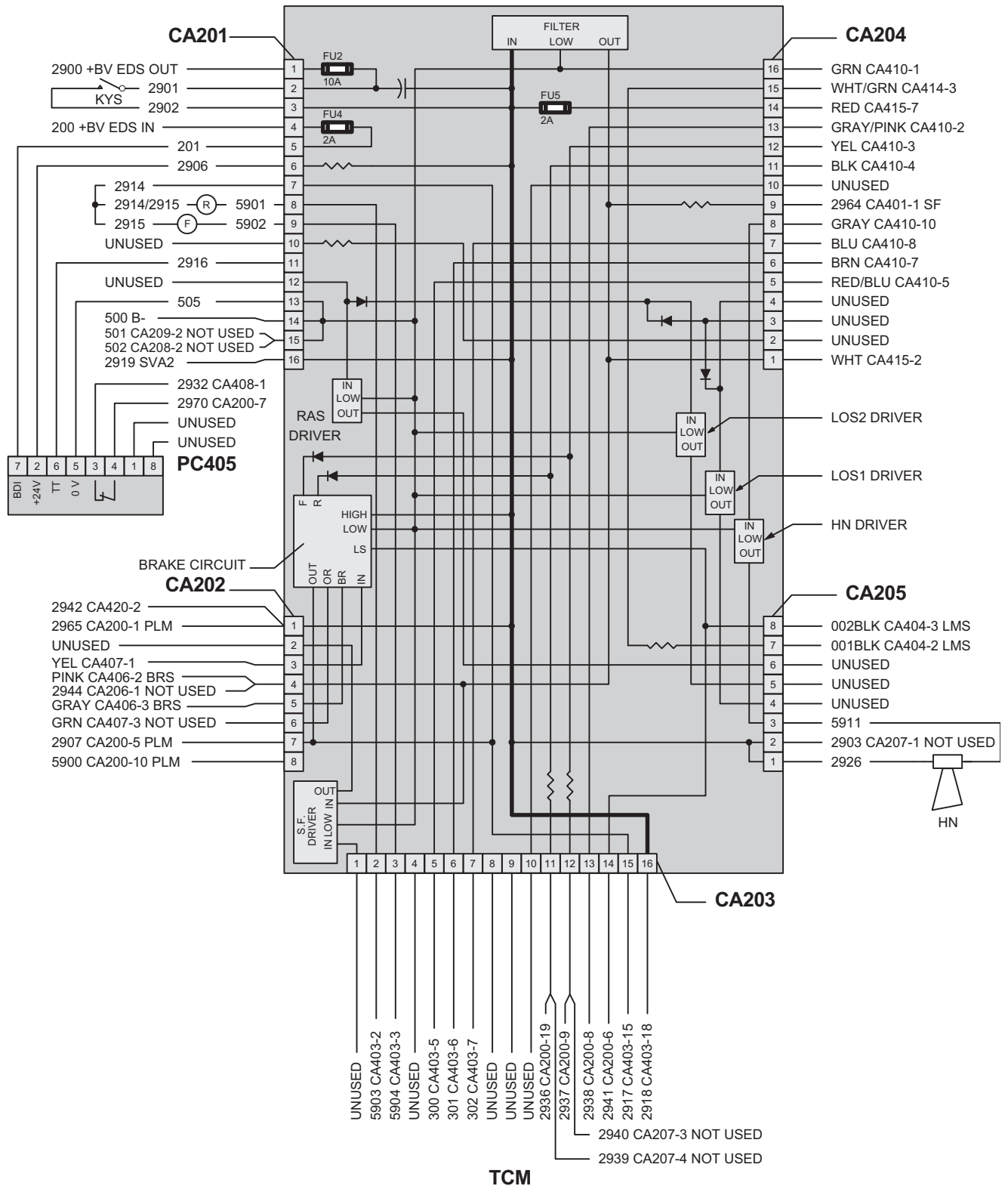
- | | | | |
|----|--------------------------------------|----|---|
| 1 | Curtis Unigage 803 | 2 | Forks higher than 250 - 2300 mm (depends on mast type):
LMS open |
| 3 | Reduced speed: HSS and / or LMS open | 4 | Active: RAS, BRS, SAS, HNS, LOS1 & LOS2 are closed |
| 6 | Hydraulic Control Module | 7 | Walkie Mode: GSCSI & GCSR & PLAS open or PLS closed
& GCSL & GCSR open |
| 8 | LMS2 < 1700 mm closed | 9 | Lift Stop / Soft Landing Option |
| 10 | Power Supply Option | 11 | Fan Option |
| 12 | Travel Alarm / Strobe Light Option | 13 | Platform Logic Module |
| 14 | Curtis Controller 1207 | | |
| A | Shunt Field Driver | B | Brake Circuit |
| C | Horn Driver | D | RAS Driver |
| E | LOS1 Driver | | |



SCHEMATIC DIAGRAMS

WE / WS from serial no. 5A134882

Electric Diagram, Standard



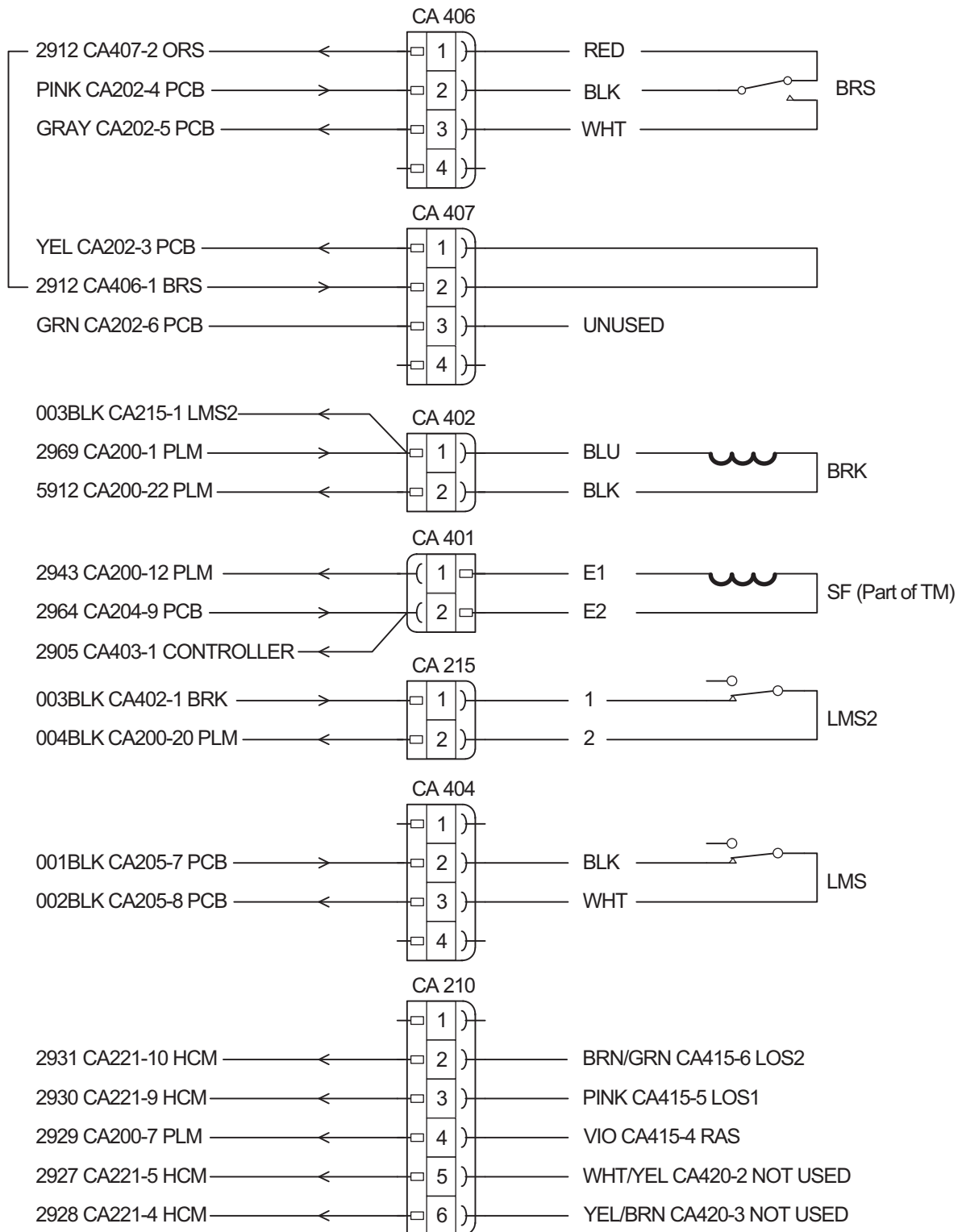
818163_2C_2



SCHEMATIC DIAGRAMS

WE / WS from serial no. 5A134882

Brake Circuit, Standard



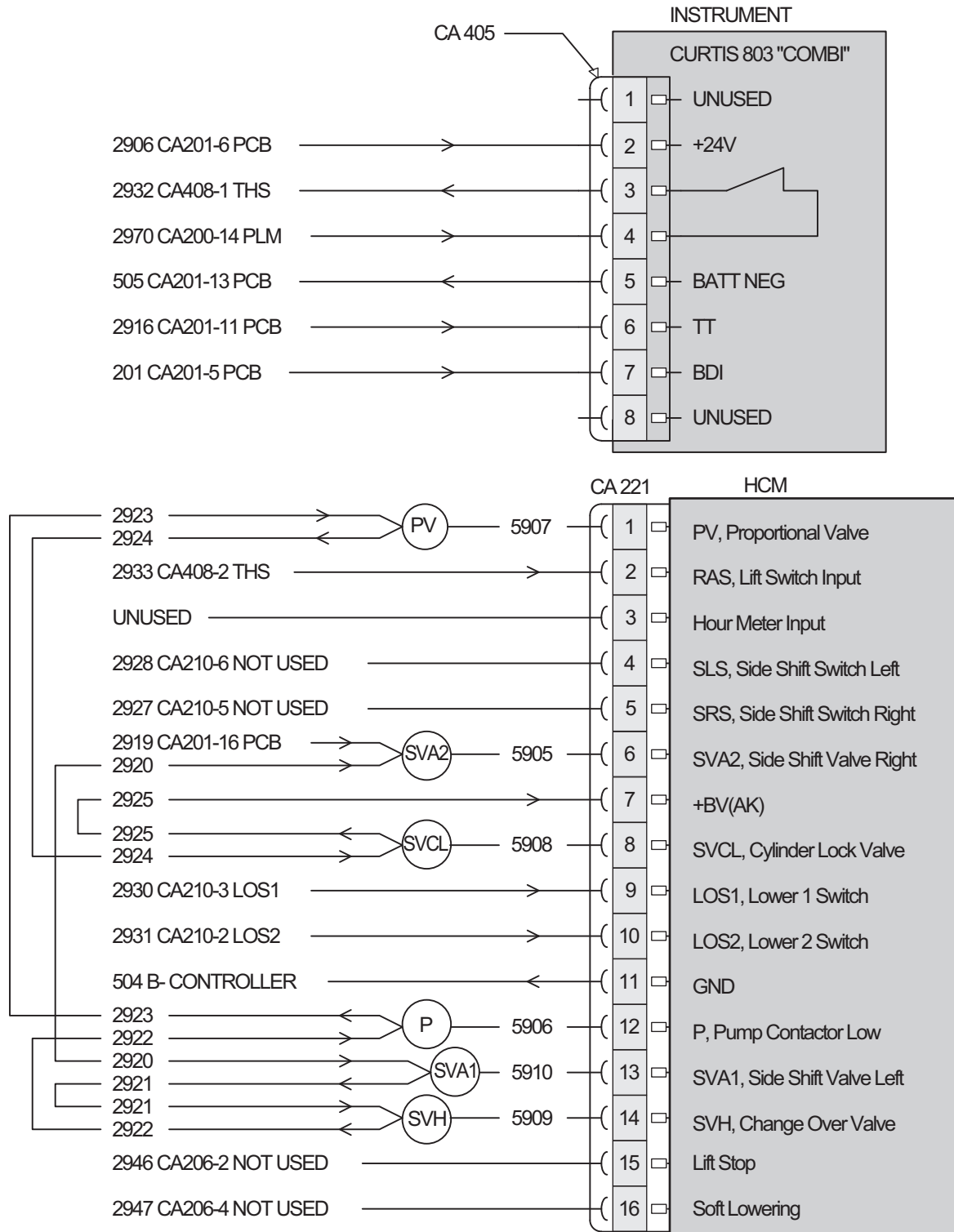
818163_2C_4

SCHEMATIC DIAGRAMS

WE / WS from serial no. 5A134882



Instrument & Proportional Electronic Circuit, Standard



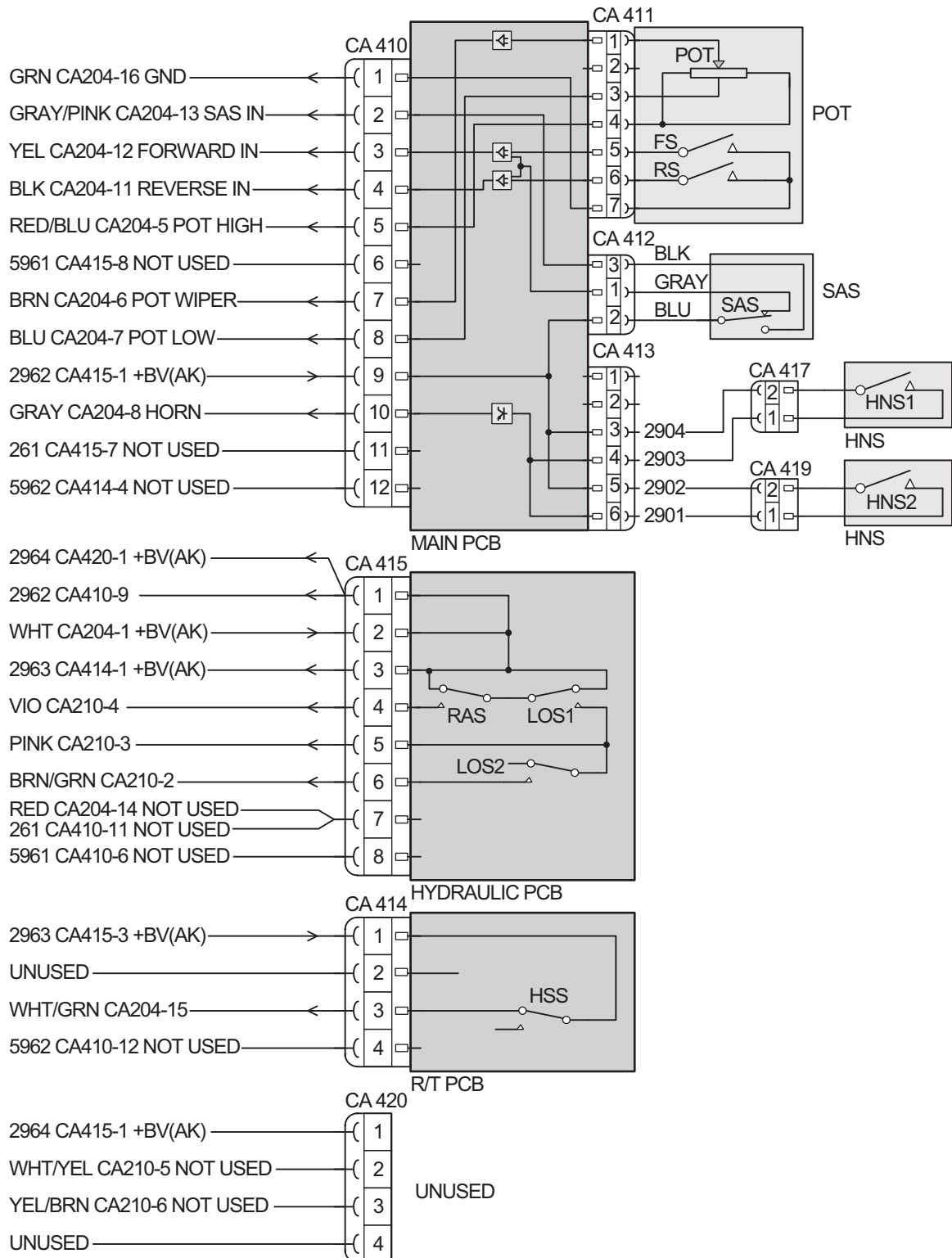
818163_2C_5



SCHEMATIC DIAGRAMS

WE / WS from serial no. 5A134882

Control Handle Circuit, Standard



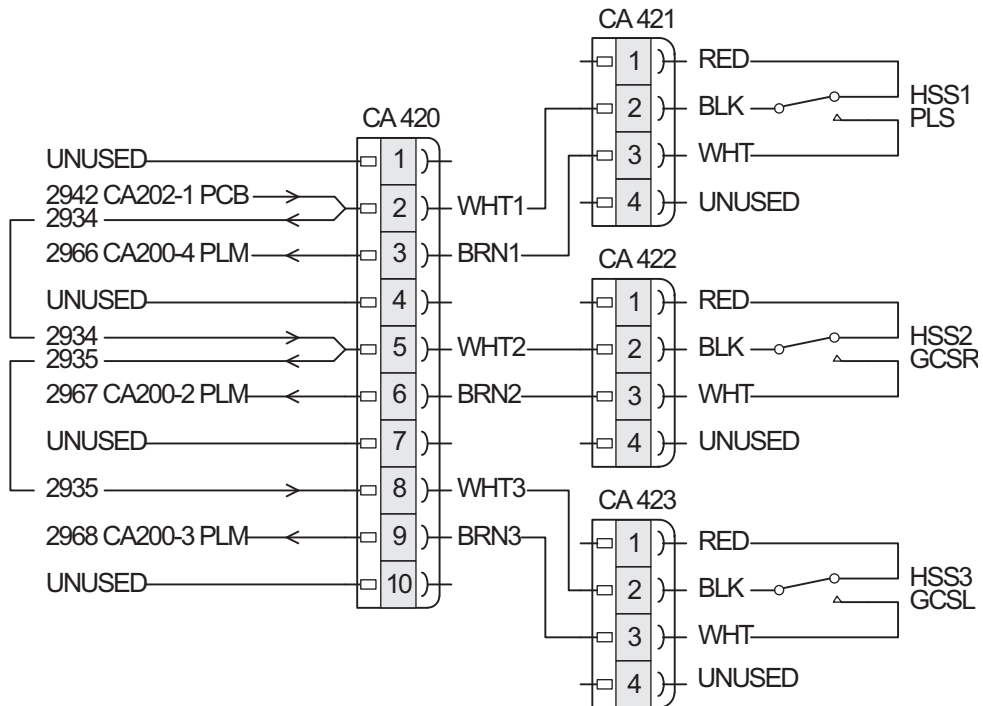
818163_2C_6

SCHEMATIC DIAGRAMS

WE / WS from serial no. 5A134882



PLM - Platform Logic Module, Walkie / Rider Circuit

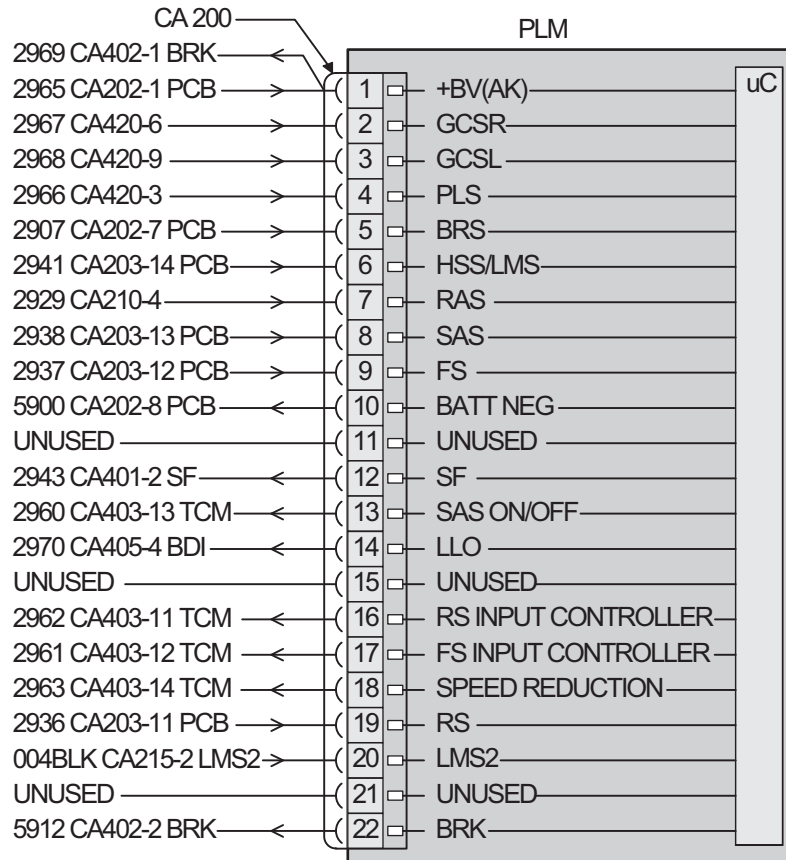


818163_2C_7



SCHEMATIC DIAGRAMS

WE / WS from serial no. 5A134882



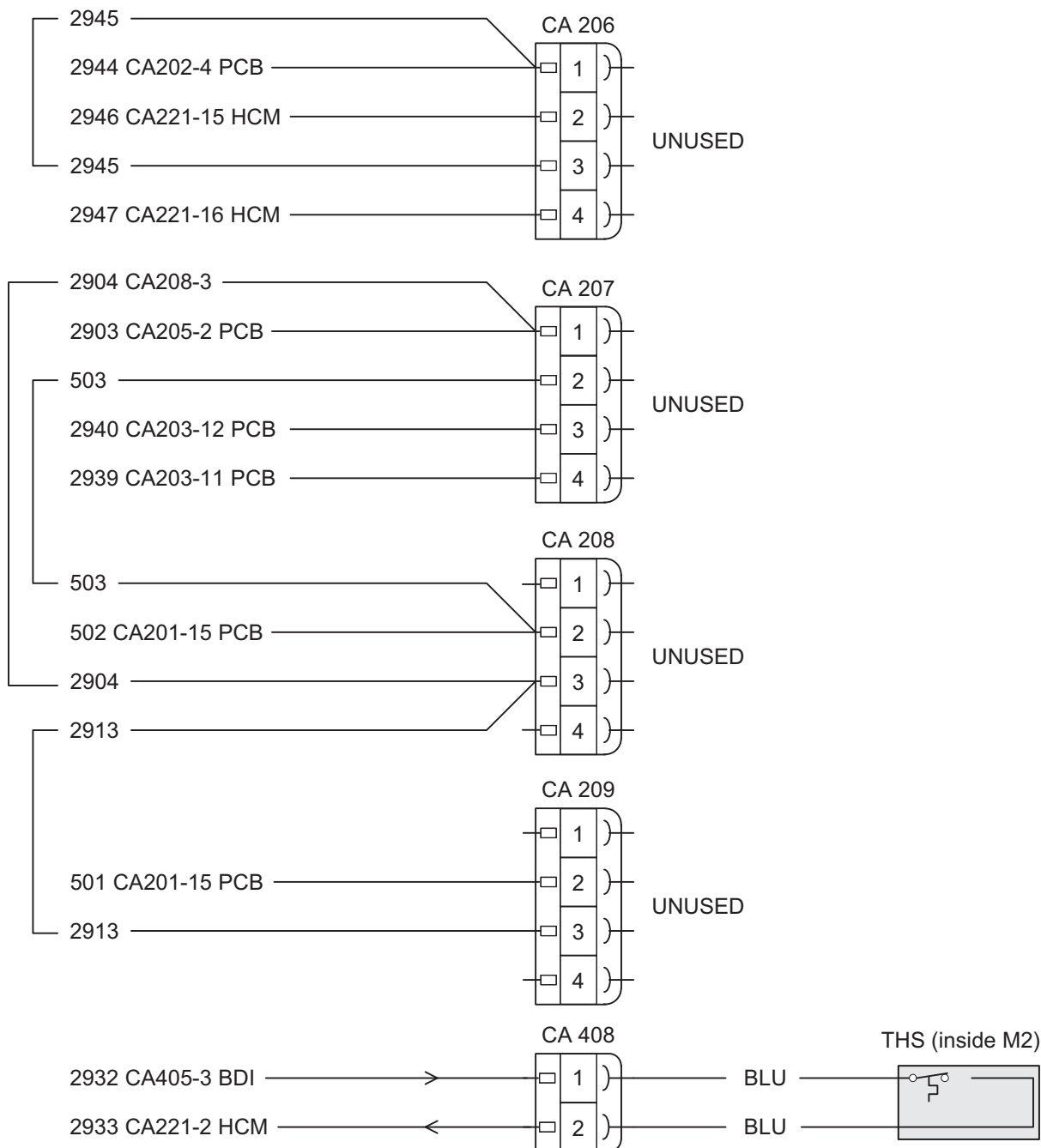
818163_2C_7-2

SCHEMATIC DIAGRAMS

WE / WS from serial no. 5A134882



Option Connection, Thermal Switch, Standard



818163_2C_8

NOTE

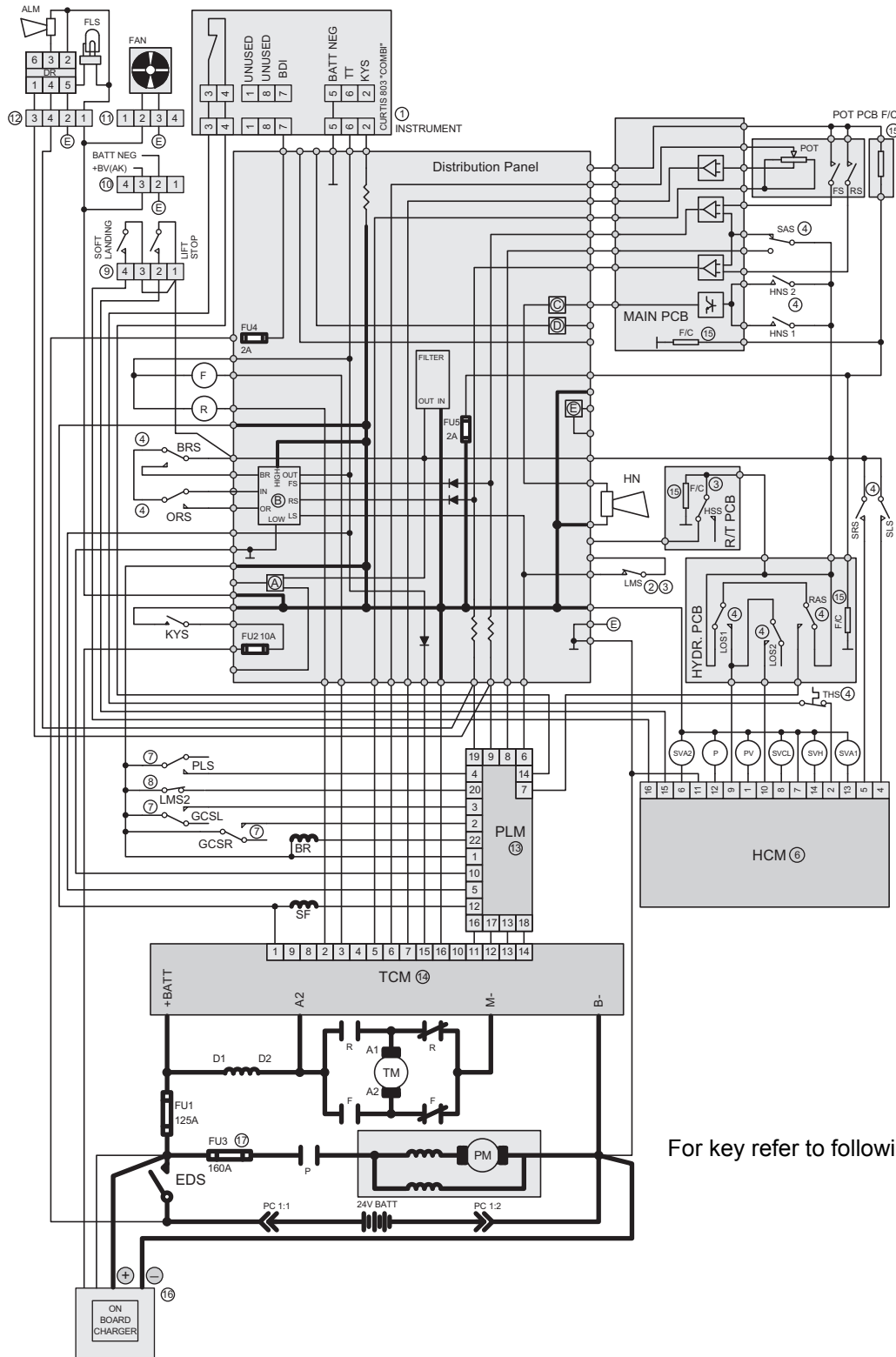
For WE 1.25 t a jumper is used instead of THS



SCHEMATIC DIAGRAMS

WE / WS from serial no. 5A134882

Schematic Diagram, Standard



818164_2D_1

SCHEMATIC DIAGRAMS

WE / WS from serial no. 5A134882



Key to Fig. 818164_2D_1 (see page 379)

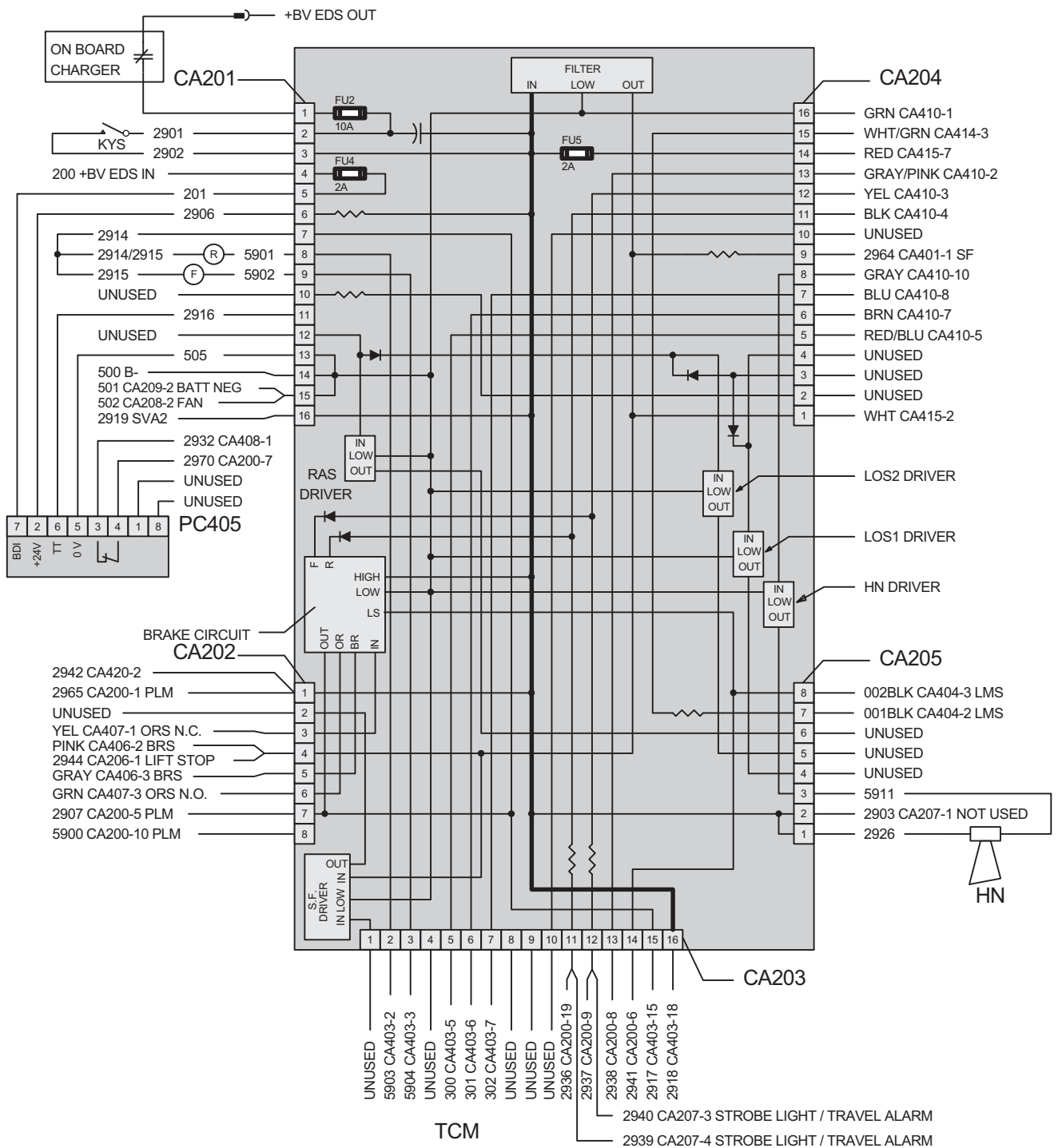
- | | | | |
|----|--------------------------------------|----|---|
| 1 | Curtis Unigage 803 | 2 | Forks higher than 250 - 2300 mm (depends on mast type):
LMS open |
| 3 | Reduced speed: HSS and / or LMS open | 4 | Active: RAS, BRS, ORS, SAS, HNS, LOS1 & LOS2 are
closed |
| 6 | Hydraulic Control Module | 7 | Walkie Mode: GSCSI & GCSR & PLAS open or PLS closed
& GCSL & GCSR open |
| 8 | LMS2 < 1700 mm closed | 9 | Lift Stop / Soft Landing Option |
| 10 | Power Supply Option | 11 | Fan Option |
| 12 | Travel Alarm / Strobe Light Option | 13 | Platform Logic Module |
| 14 | Curtis Controller 1207 | 15 | F / C package: active below 5 °C |
| 16 | On-board charger connection | 17 | For North American truck only: FU3 = 125 A |
| | | | |
| A | Shunt Field Driver | B | Brake Circuit |
| C | Horn Driver | D | RAS Driver |
| E | LOS1 Driver | | |



SCHEMATIC DIAGRAMS

WE / WS from serial no. 5A134882

Distribution Panel, Options



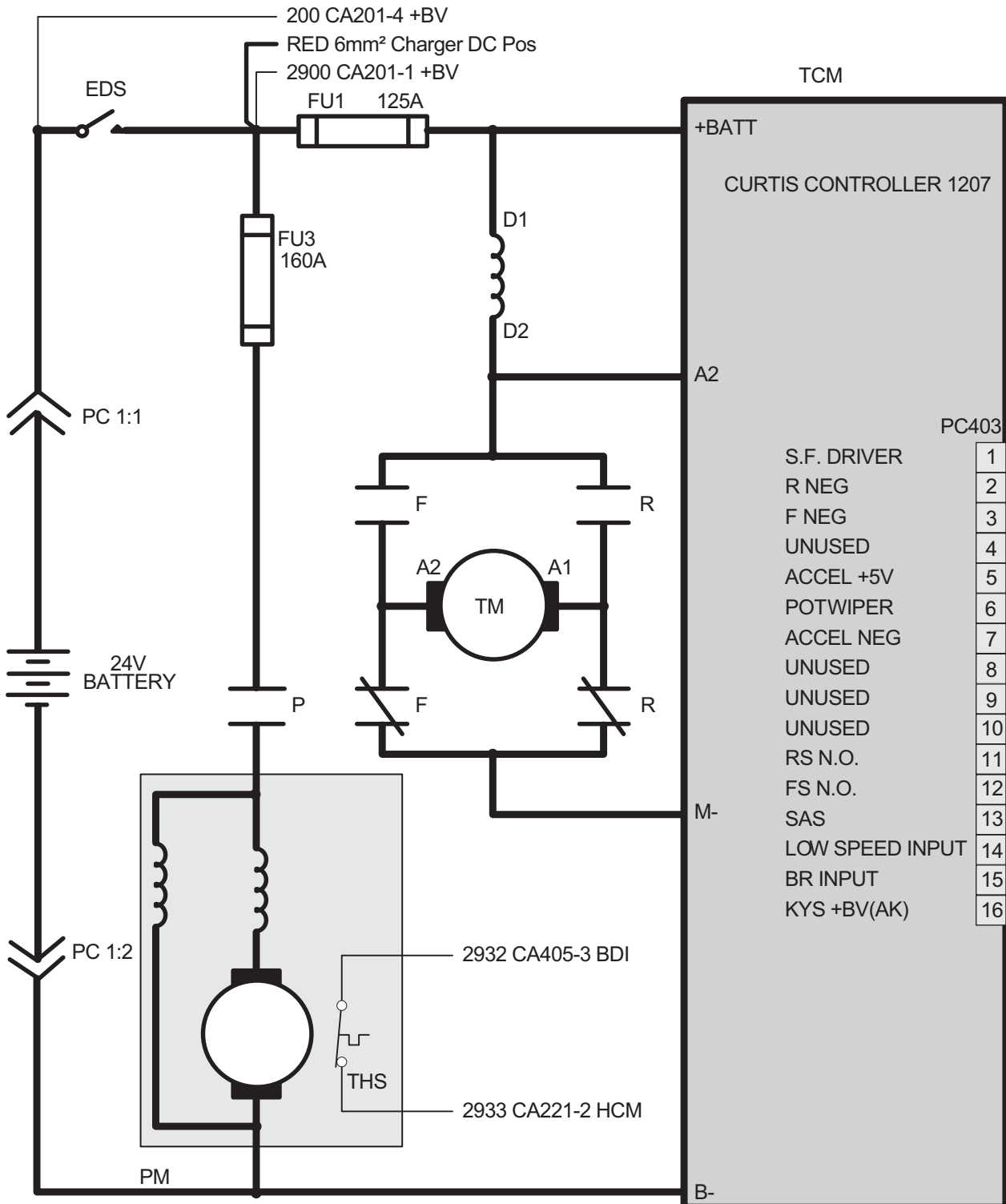
818164_2D_2

SCHEMATIC DIAGRAMS

WE / WS from serial no. 5A134882



Traction Controller - Power Side, Options



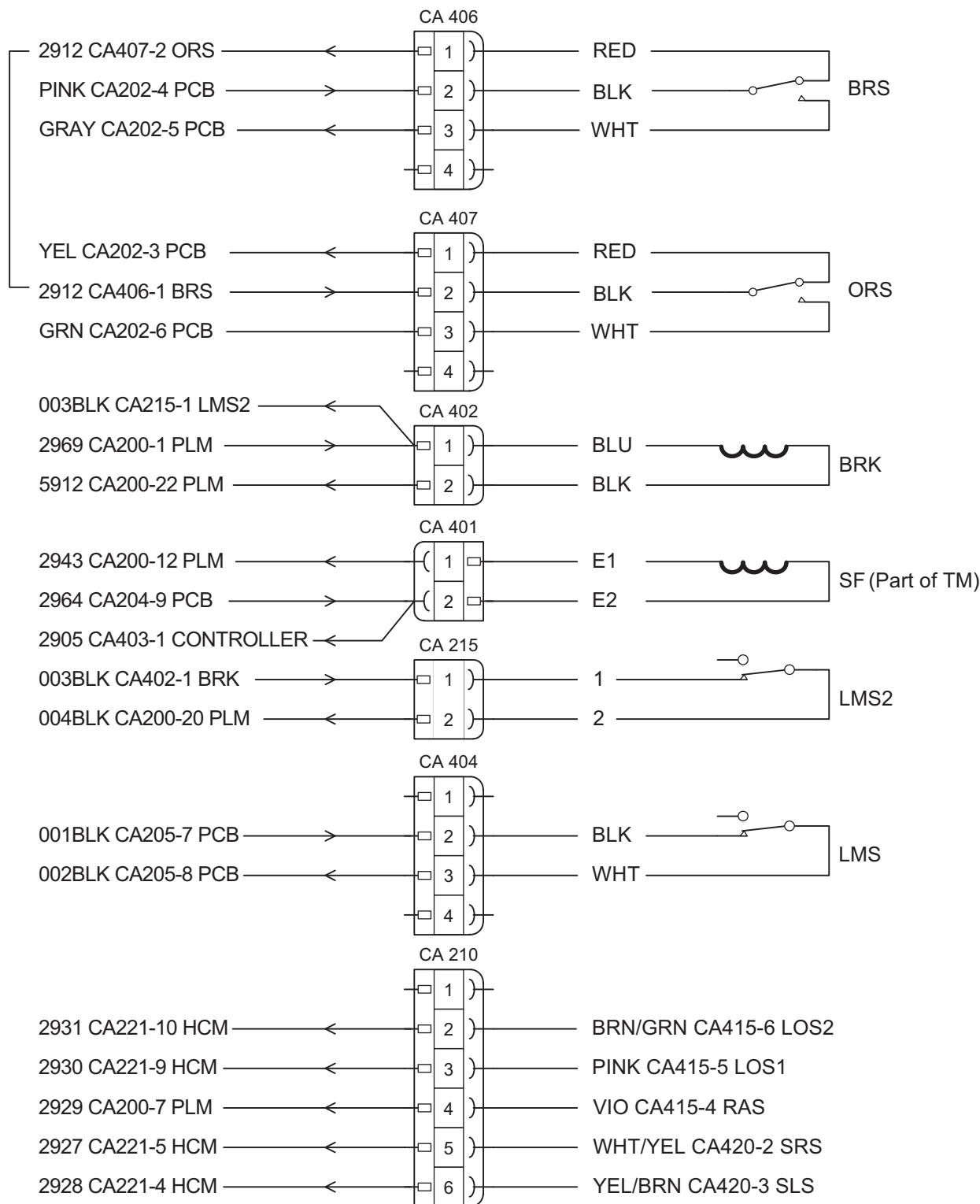
818164_2D_3



SCHEMATIC DIAGRAMS

WE / WS from serial no. 5A134882

Brake Circuit, Options



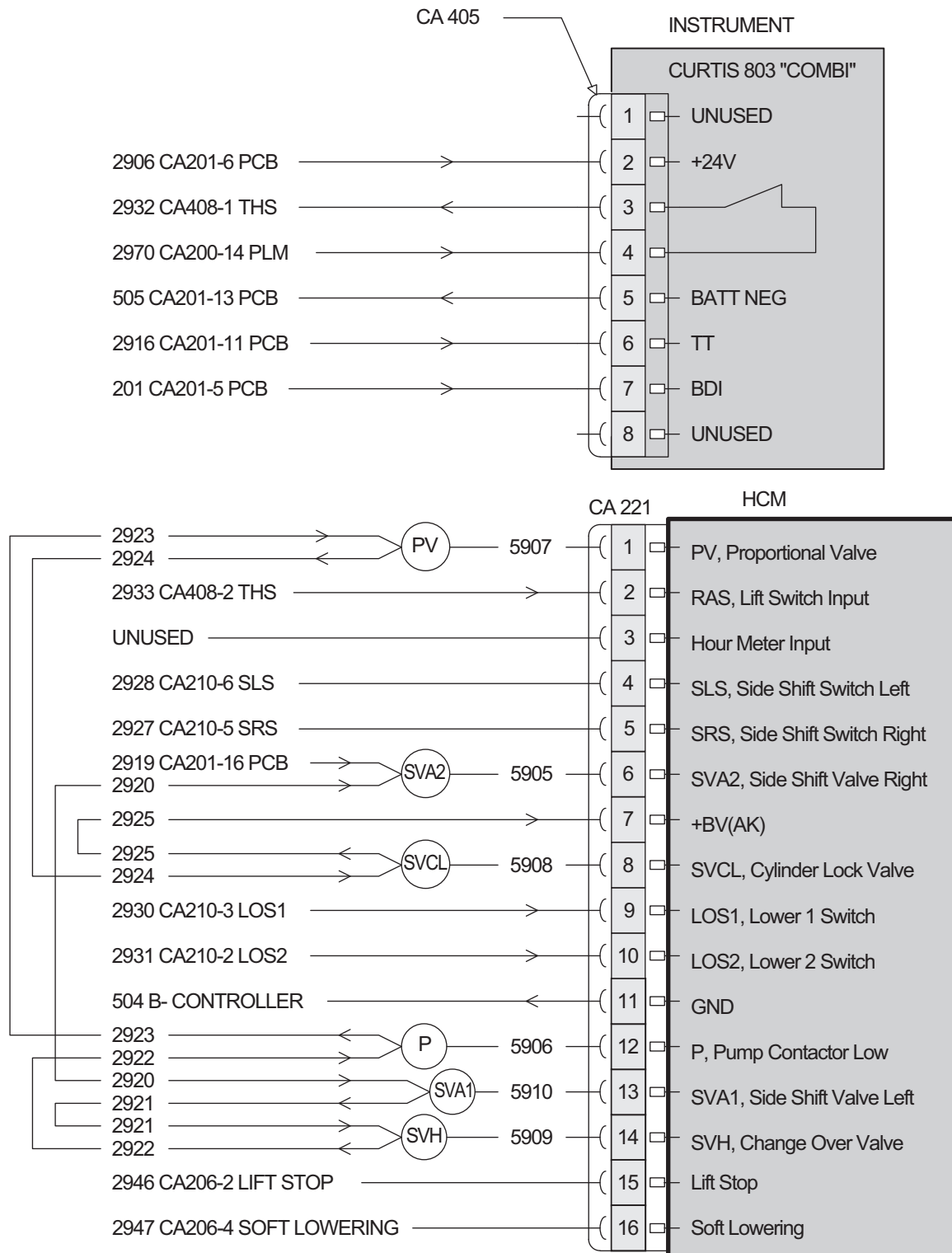
818164_2D_4

SCHEMATIC DIAGRAMS

WE / WS from serial no. 5A134882



Instrument & Proportional Electronic Circuit, Options



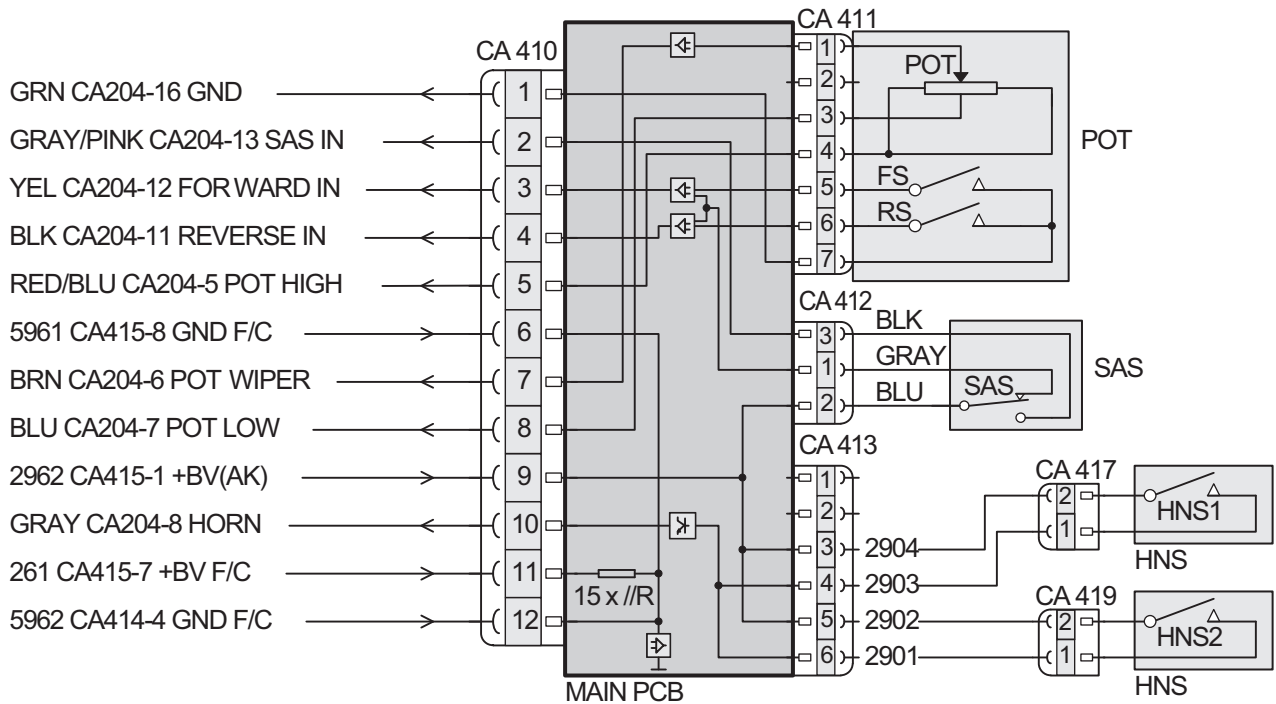
818164_2D_5



SCHEMATIC DIAGRAMS

WE / WS from serial no. 5A134882

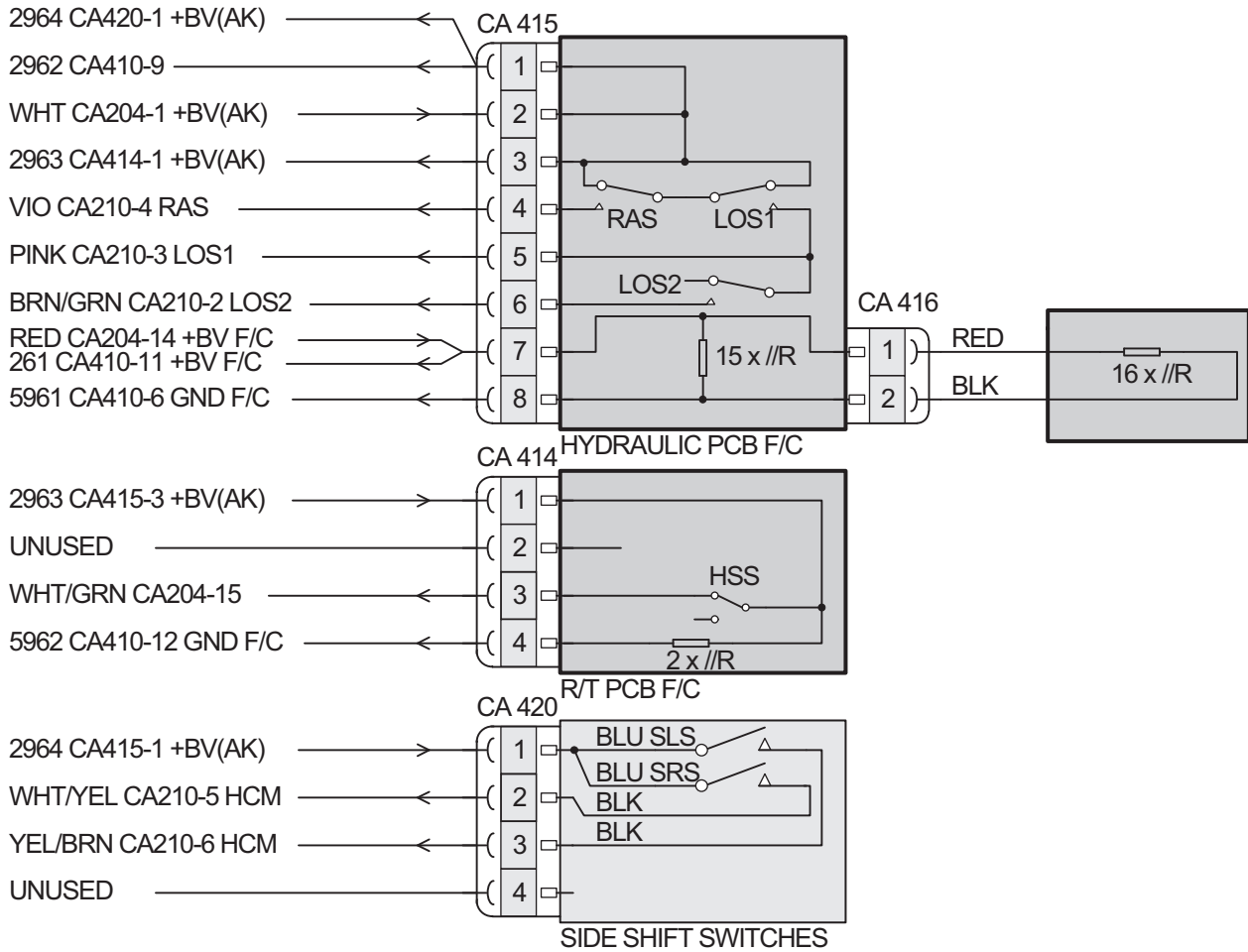
Control Handle Circuit, Options



818164_2D_6-1

SCHEMATIC DIAGRAMS

WE / WS from serial no. 5A134882



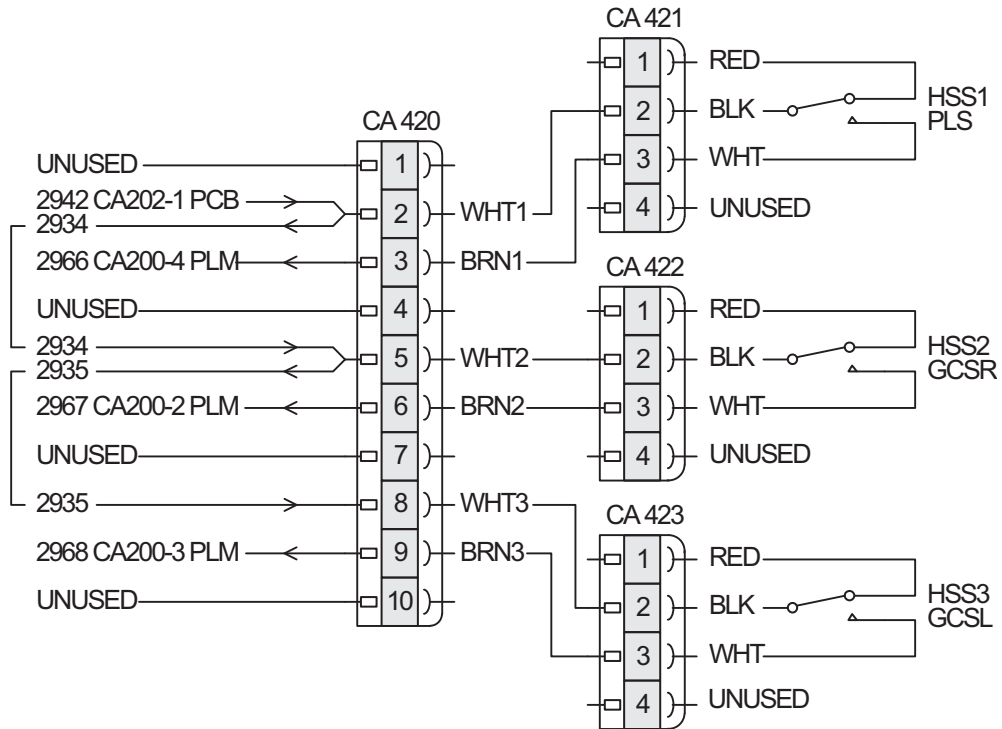
818164_2D_6-2



SCHEMATIC DIAGRAMS

WE / WS from serial no. 5A134882

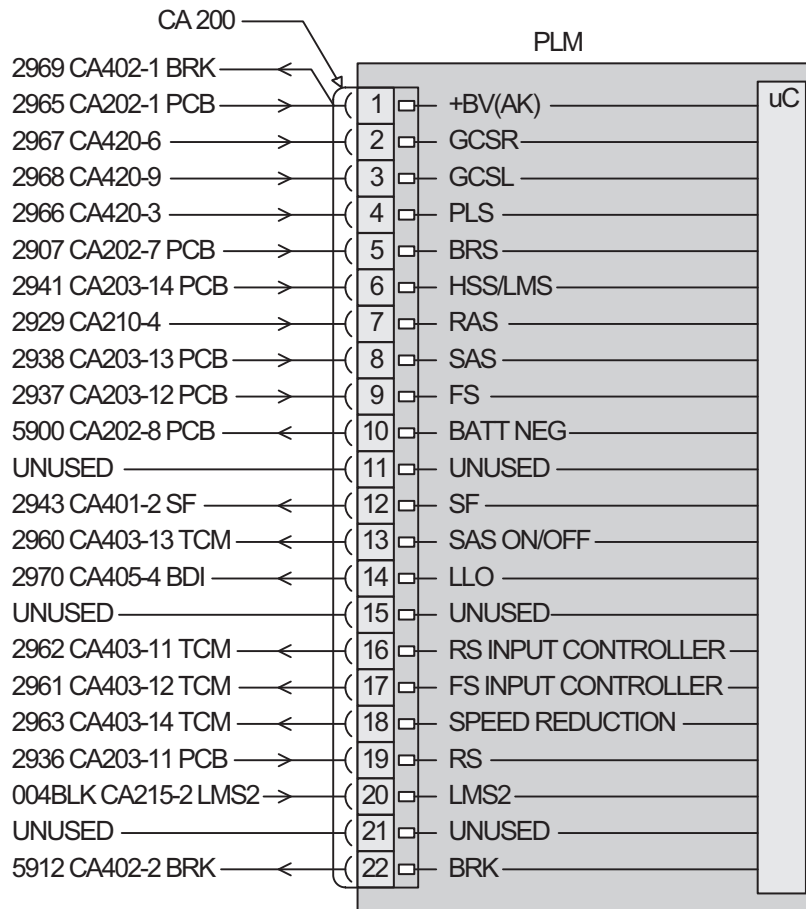
**PLM - Platform Logic Module,
Walkie / Rider Circuit, Options**



818164_2D_7-1

SCHEMATIC DIAGRAMS

WE / WS from serial no. 5A134882



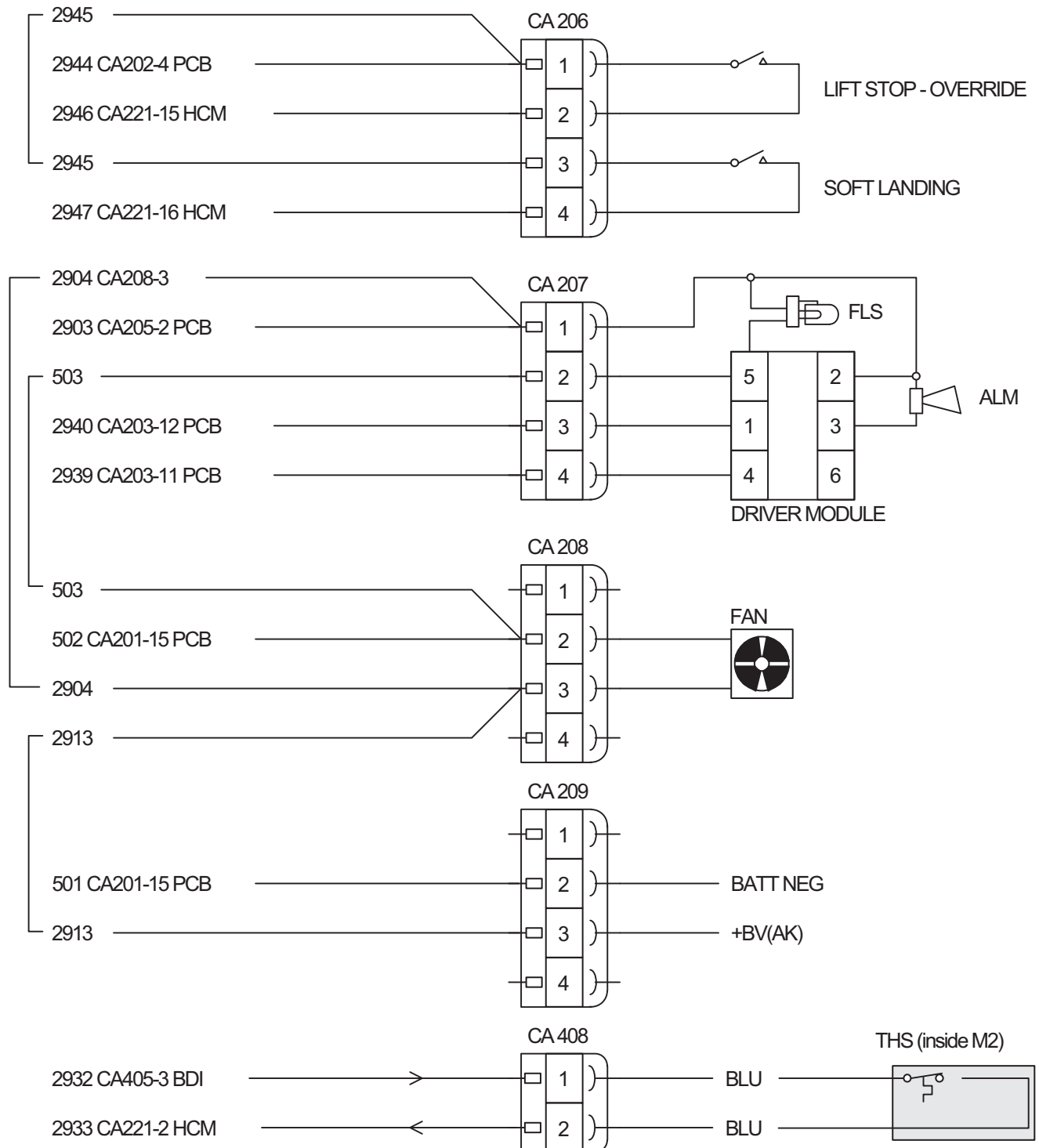
818164_2D_7-2



SCHEMATIC DIAGRAMS

WE / WS from serial no. 5A134882

Option Connection, Thermal Switch, Options



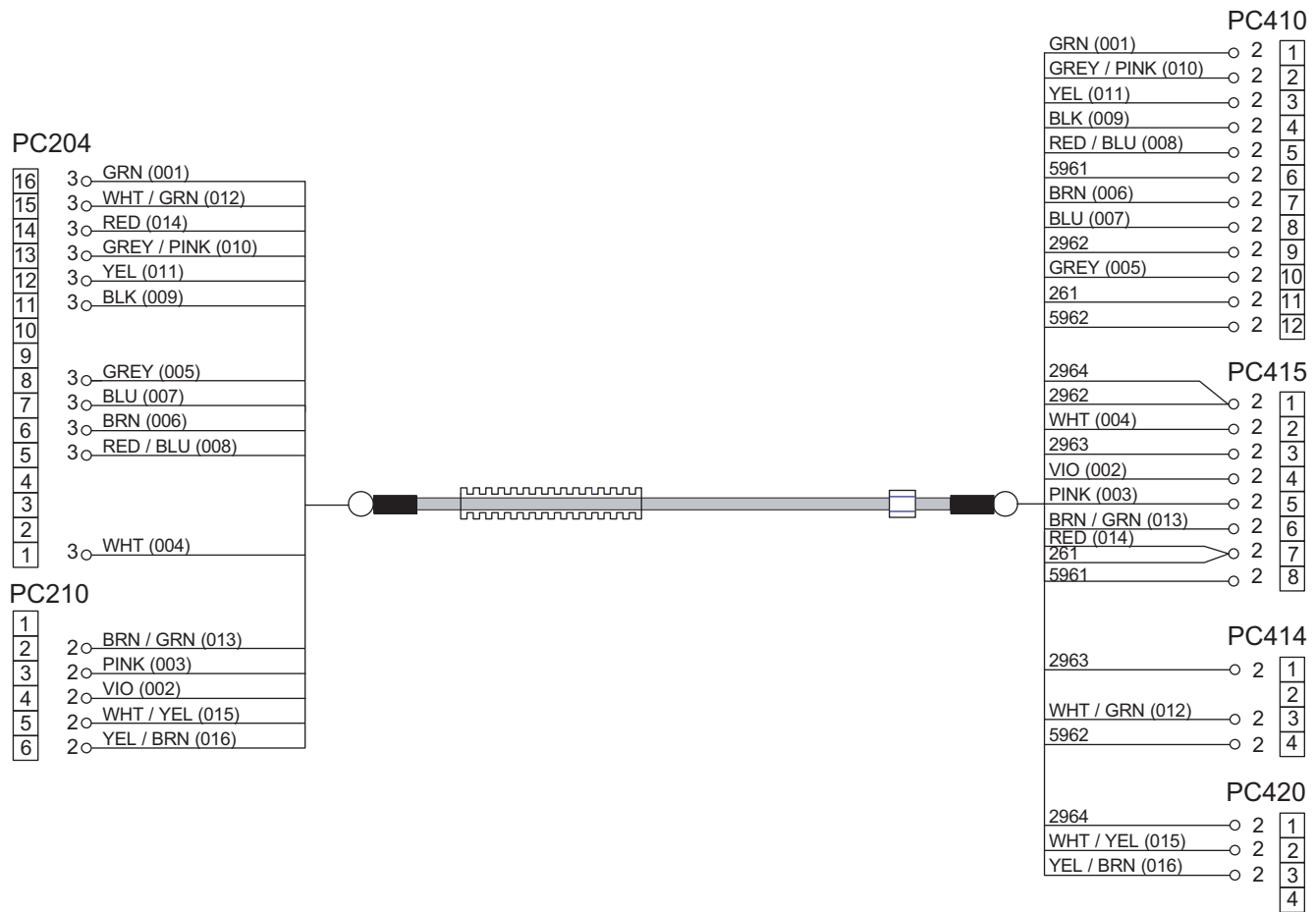
818164_2D_7-2

SCHEMATIC DIAGRAMS

WE / WS from serial no. 5A134882



Control Handle Wire Harness



813426_2C

Connector housing

Housing	Order Number
PC204	803452-002
PC210	803450-007
PC410	803450-009
PC414	803450-020
PC415	803450-008
PC420	803450-006

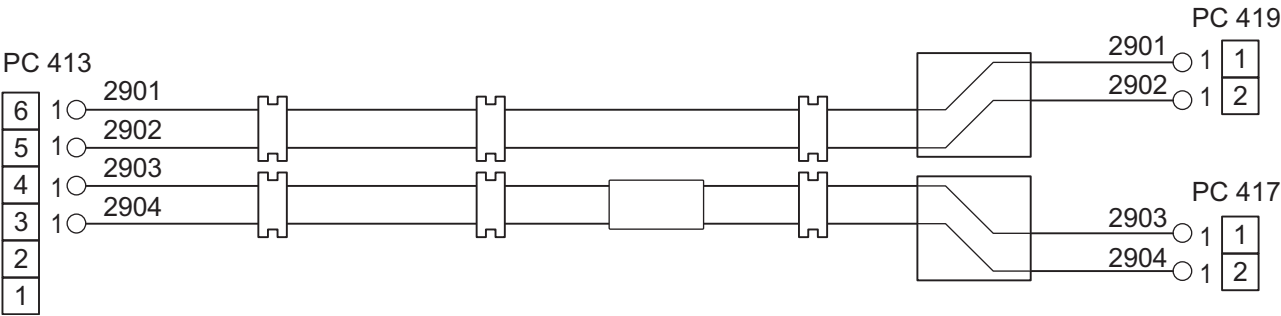
Contact pins

Item No.	Order Number
2	116858
3	803452-005



SCHEMATIC DIAGRAMS
WE / WS from serial no. 5A134882

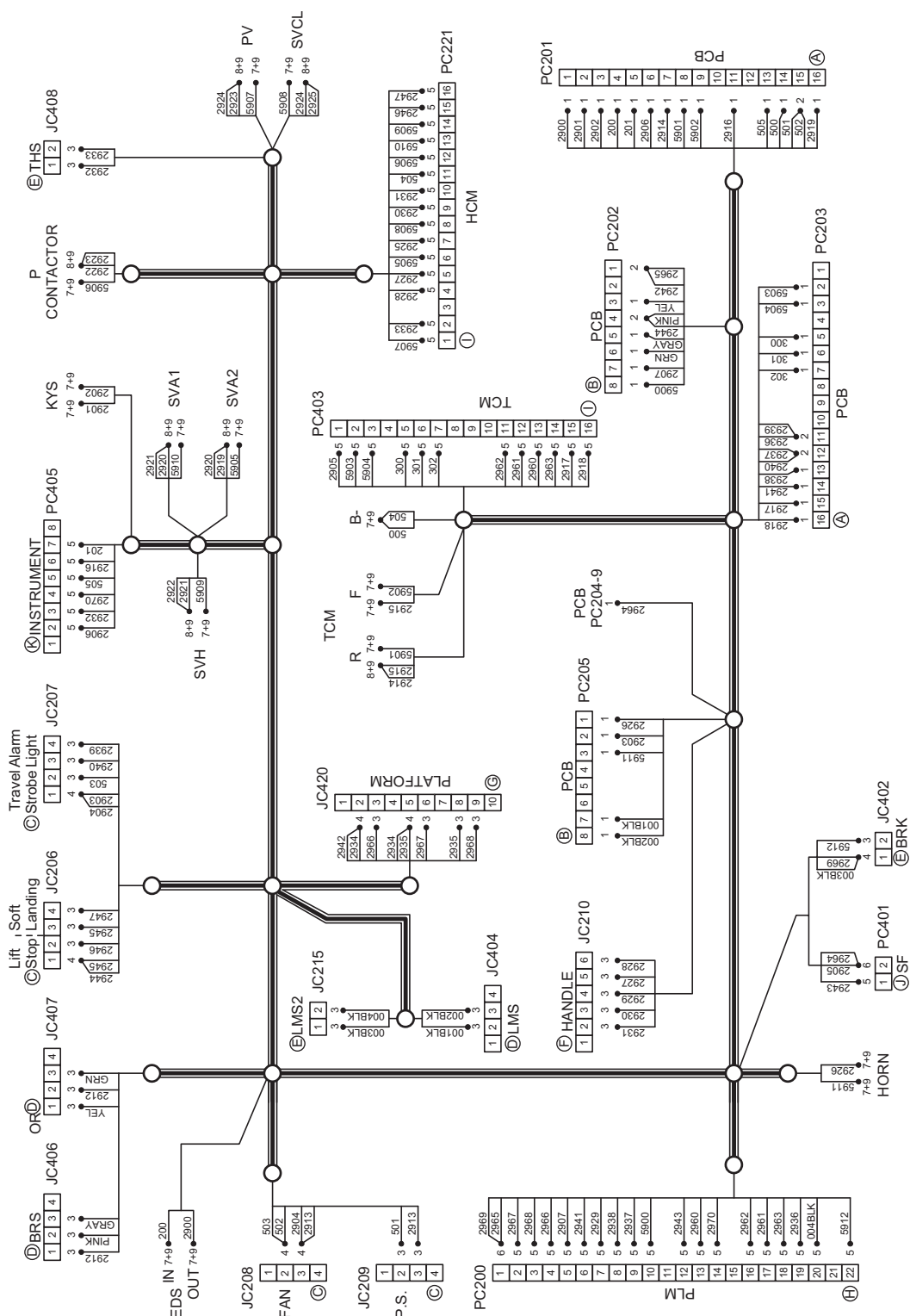
Horn Harness



811931_2E_1

Connector housing

Housing	Order Number
PC413	803450-021
PC419	803450-023
PC417	803450-023



For tables refer to following page



SCHEMATIC DIAGRAMS

WE / WS from serial no. 5A134882

Connector housing

Housing	Order Number
PC201, PC203	803452-002
PC202, PC205	803452-001
JC206, JC207, JC208, JC209	803450-034
JC404, JC406, JC407	803450-002
JC215, JC402, JC408	803450-001
JC210	803450-003
JC420	803450-025
PC200	803450-047
PC221, PC403	116858
PC401	803450-005
PC405	803450-008

Contact pins

Item No.	Order Number
1	803452-005
2	803452-008
3	803450-010
4	803450-087
5	116858
6	803450-049

Cable lugs and rings

Item No.	Order Number
7	816812-004
8	816812-001
9	816812-075

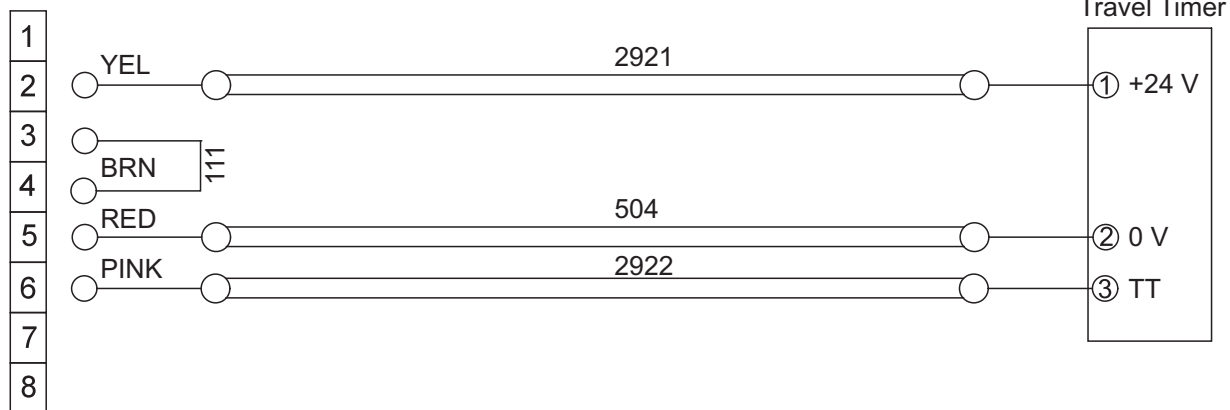
SCHEMATIC DIAGRAMS

WE / WS from serial no. 5A134882



Hourmeter Harness

PC405



803545_2C

Connector housing

Housing	Order Number
PC405	803450-004

Contact pins

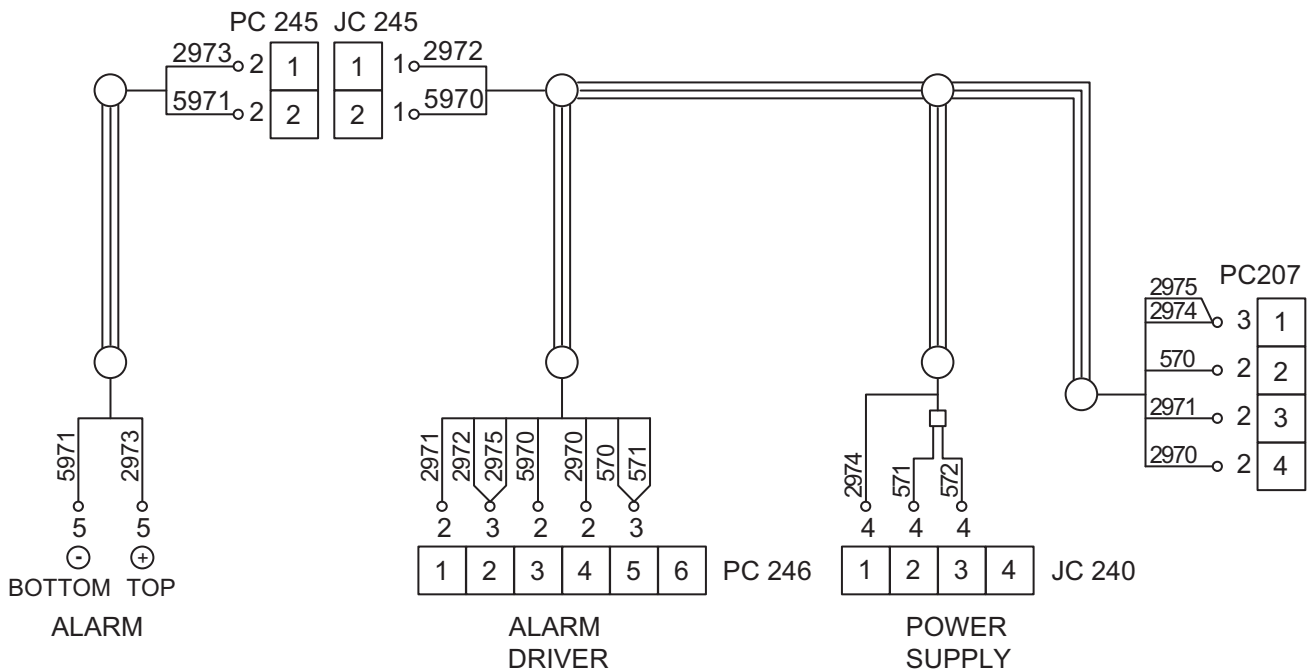
Item No.	Order Number
---	062007-043



SCHEMATIC DIAGRAMS

WE / WS from serial no. 5A134882

Strobe & Alarm Signal Optional Harness



818947_XA

Connector housing

Housing	Order Number
JC245	803450-001
PC207	803450-006
PC245	803450-005
PC246	803450-007
JC240	---

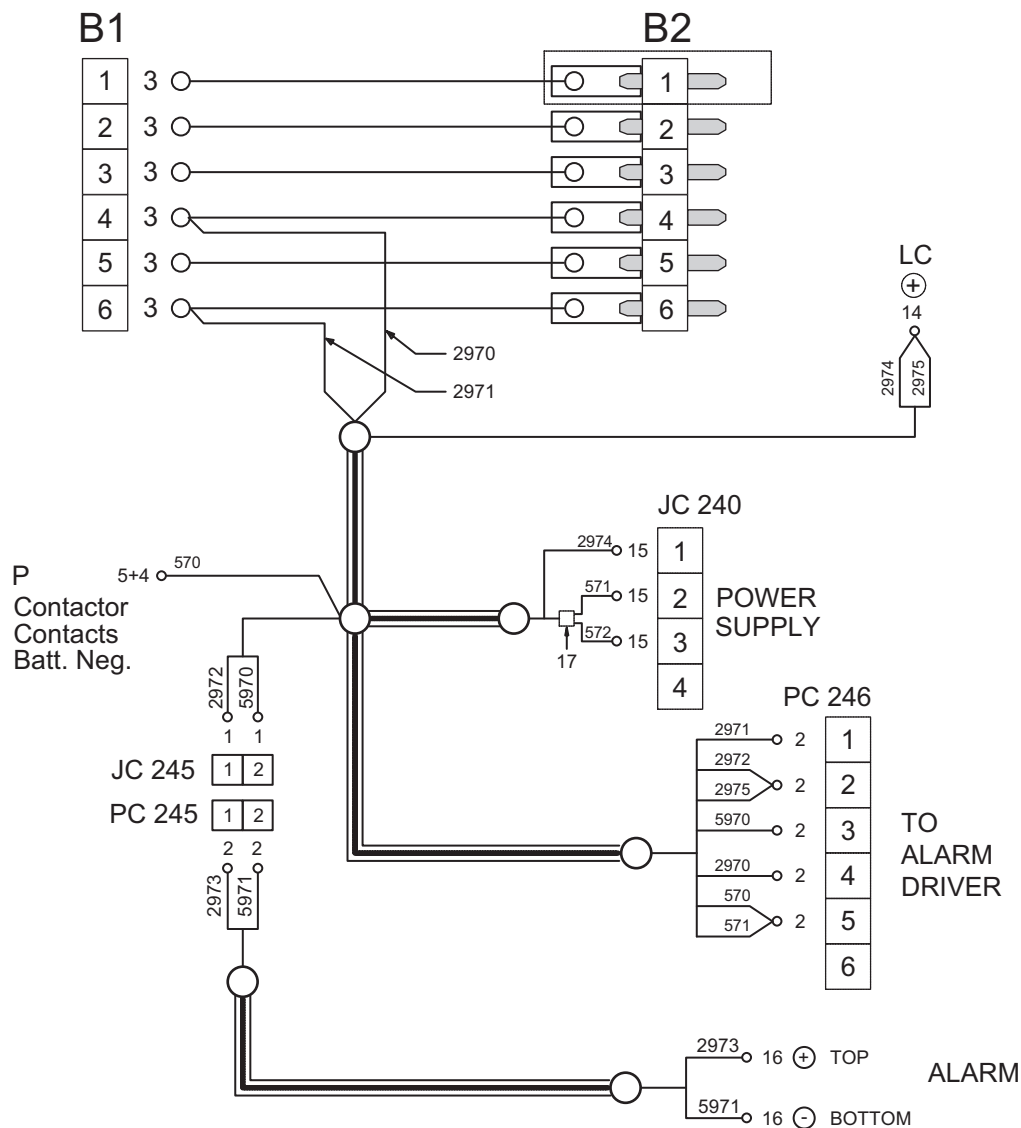
Cable lugs and rings

Item No.	Order Number
5	062007-32
6	---

Contact pins

Item No.	Order Number
1	803450-010
2	116858
3	803450-049
4	---

Strobe & Alarm Signal Optional Harness



814992_2B

NOTE

*Strobe Light is active for KYS On
Alarm is active on FS or RS actuation*

See next page for tables



SCHEMATIC DIAGRAMS

WE / WS from serial no. 5A134882

Connector housing

Housing	Order Number
JC240	---
JC245	803450-001
PC245	803450-005
PC246	803450-007
B1	803450-017
B2	---

Contact pins

Item No.	Order Number
1	803450-010
2	116858
3	803450-019
4	062007-021
5	803678-006
14	062007-054
15	---
16	062007-032
17	---

SCHEMATIC DIAGRAMS

WE / WS from serial no. 5A134882

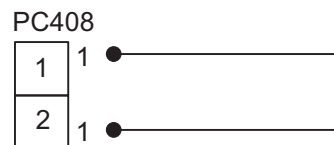


Mast Cable for Strobe Light



813407_2D

Jumper 1.25 t



818919_2B



SCHEMATIC DIAGRAMS

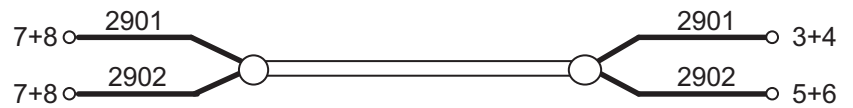
WE / WS from serial no. 5A134882

Harness, On-board charger

810528-001
Ground Lead



810528-002



810528_XB

Contact pins

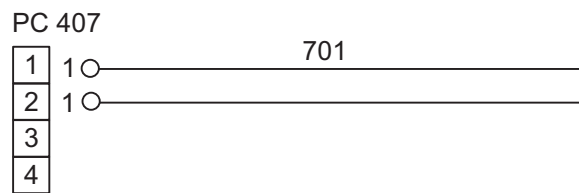
Item No.	Order Number
1	062007-044
2	062007-003
3	062007-021
4	803488-003
5	803448-004
6	803448-005
7	062007-043
8	803452-005
9	062007-051

SCHEMATIC DIAGRAMS

WE / WS from serial no. 5A134882



ORS Jumper



808133_2A

Contact pins

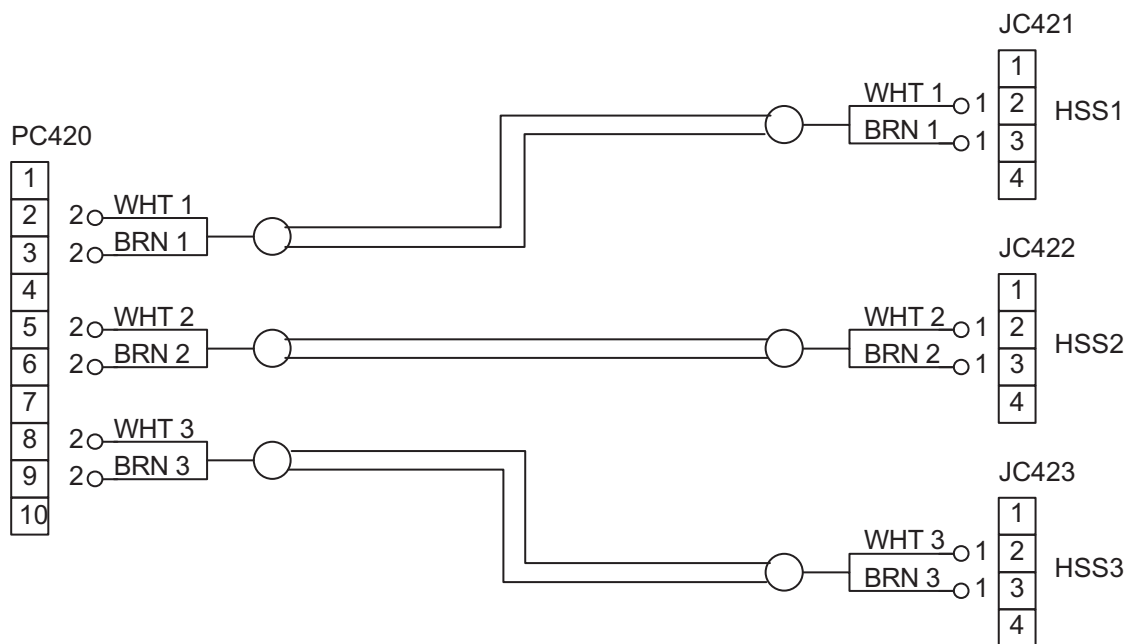
Item No.	Order Number
1	116858
PC407	803450-006



SCHEMATIC DIAGRAMS

WE / WS from serial no. 5A134882

Platform Cable 2



815407_2B

Connector housing

Housing	Order Number
PC420	803450-015
JC421	803450-002
JC422	803450-002
JC423	803450-002

Contact pins

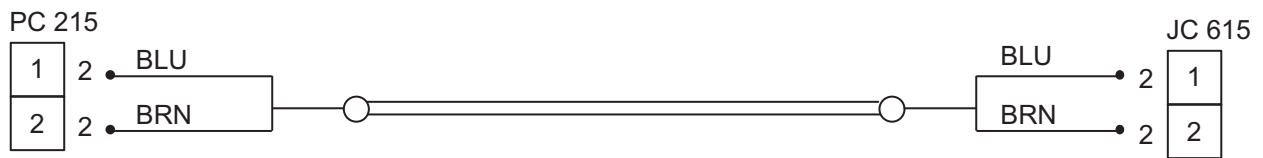
Item No.	Order Number
1	803450-010
2	116858

SCHEMATIC DIAGRAMS

WE / WS from serial no. 5A134882



Cable, LMS2



814988_2G

Connector housing

Housing	Order Number
JC615	803450-001
PC215	803450-005

Contact pins

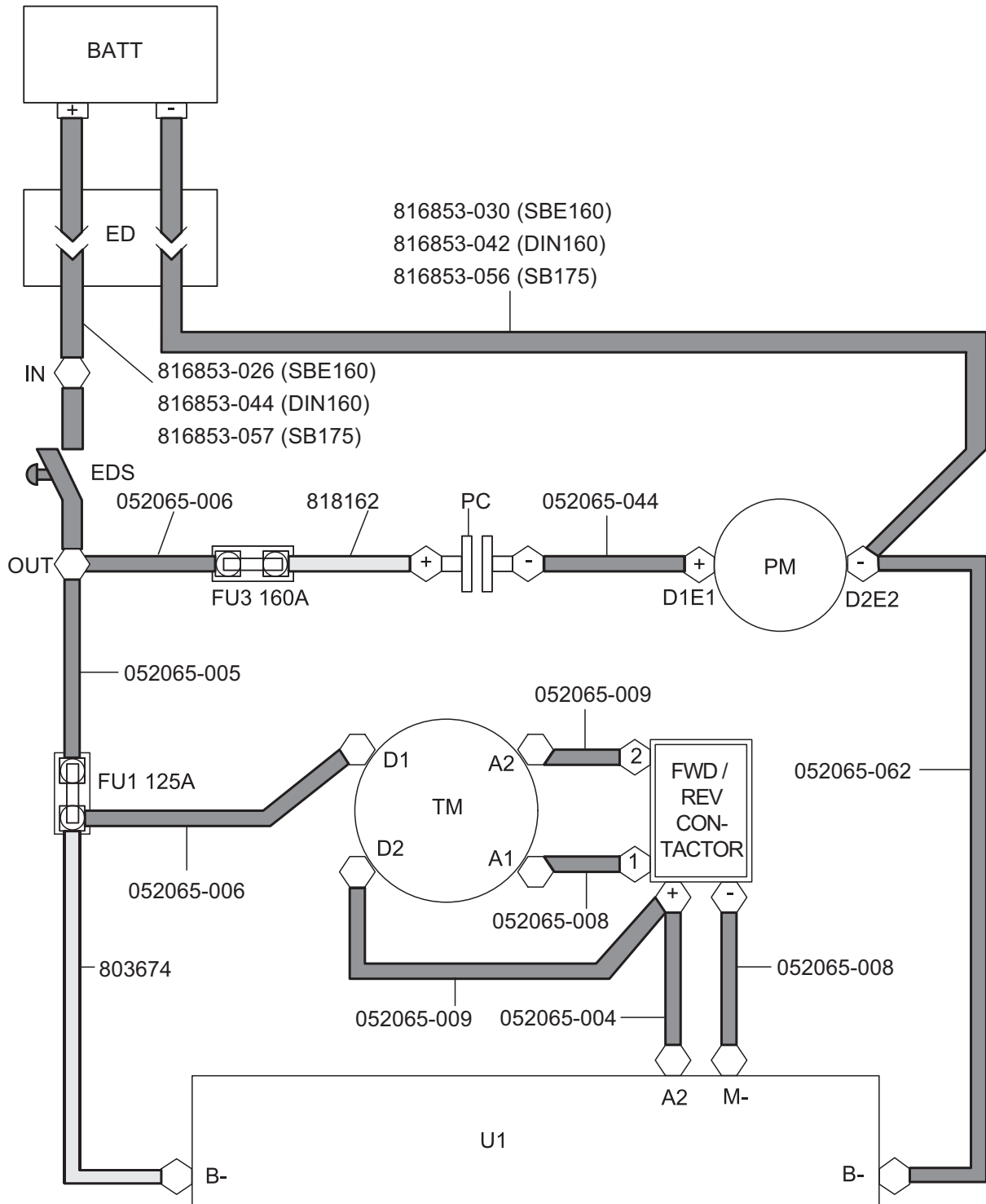
Item No.	Order Number
1	803450-010
2	116858



SCHEMATIC DIAGRAMS

WE / WS from serial no. 5A134882

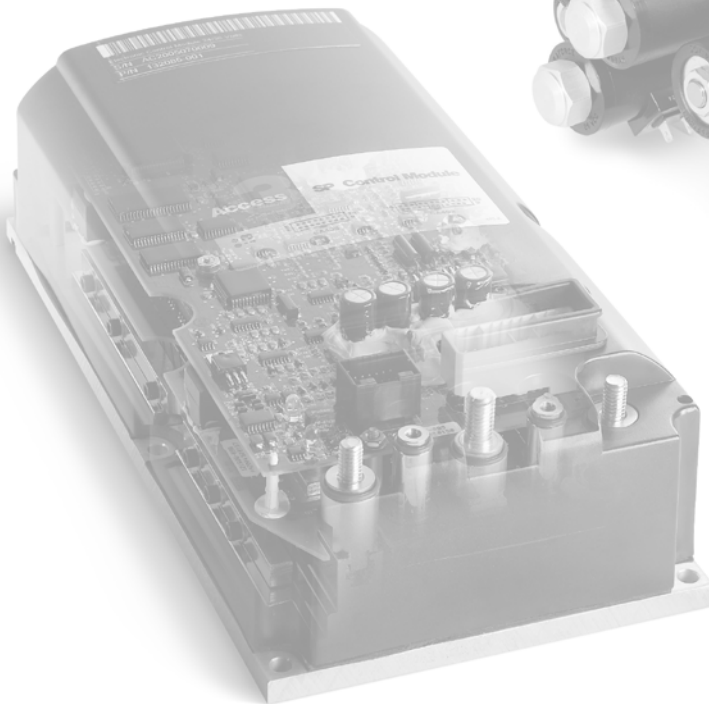
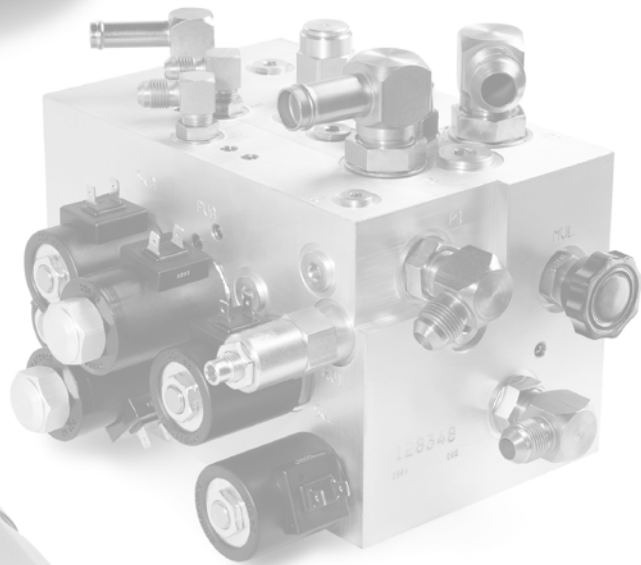
Power Cables



816897_2B



Notes:



HYDRAULIC SCHEMATIC



Notes:



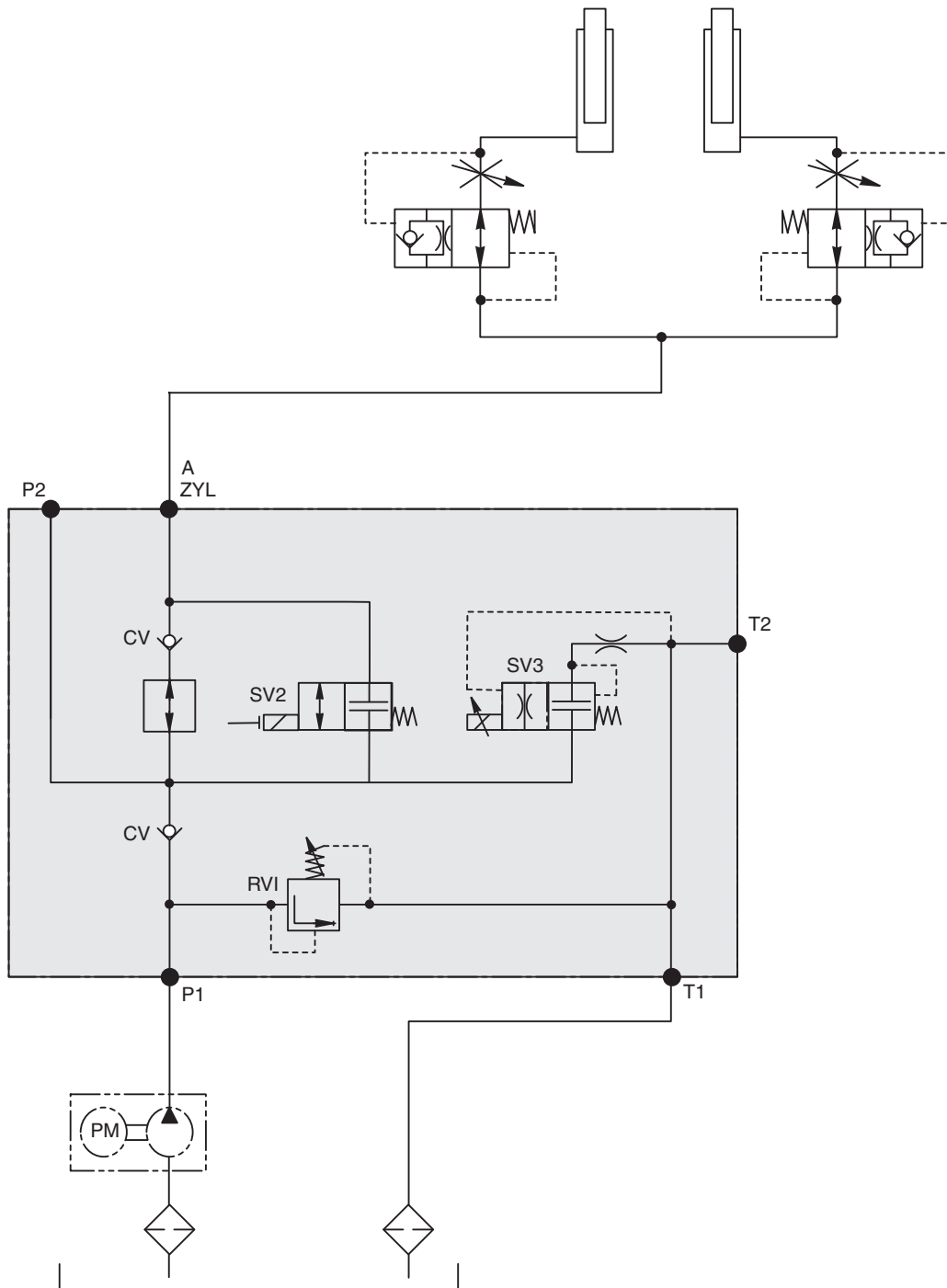
HYDRAULIC SCHEMATIC

Hydraulic Diagrams

Hydraulic Diagrams

WE/WS TL

Up to serial no. 5A134880



M0440

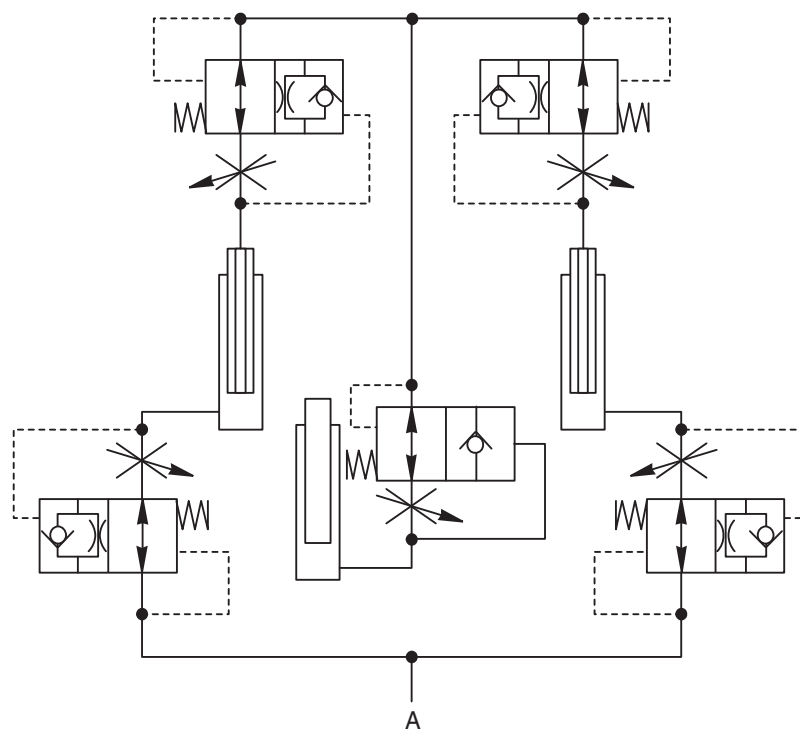
HYDRAULIC SCHEMATIC

Hydraulic Diagrams



WE/WS TF

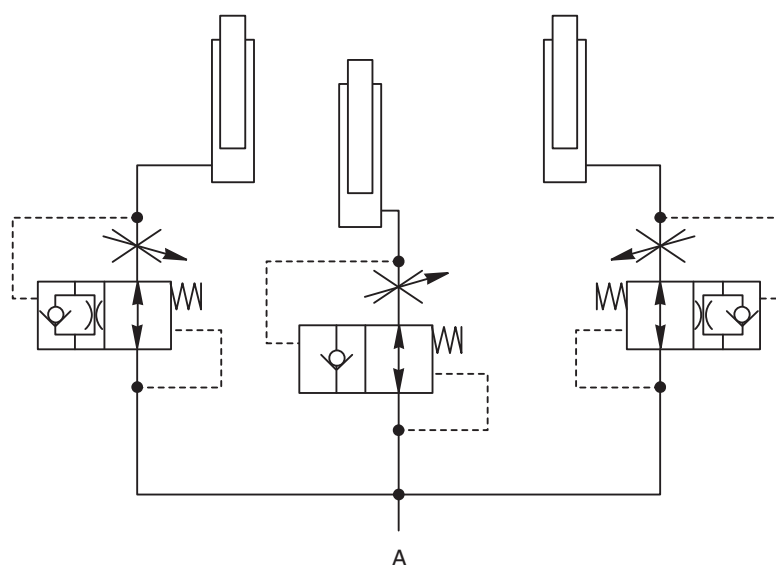
Up to serial no. 5A134880



MS-4223-056

WE/WS TT

Up to serial no. 5A134880



MS-4223-057

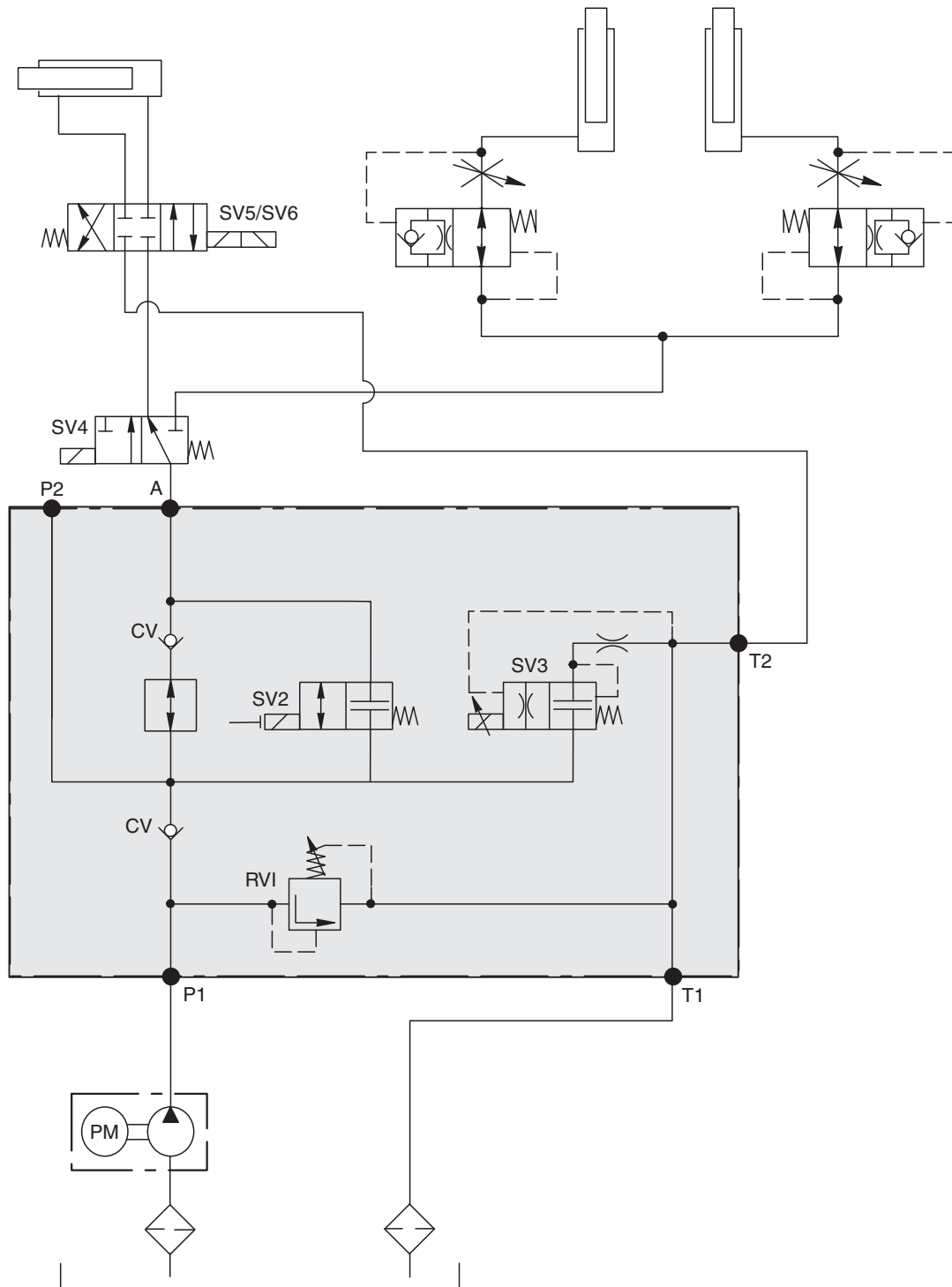


HYDRAULIC SCHEMATIC

Hydraulic Diagrams

WS Auxiliary Hydraulics TL Mast

Up to serial no. 5A134880



M1996

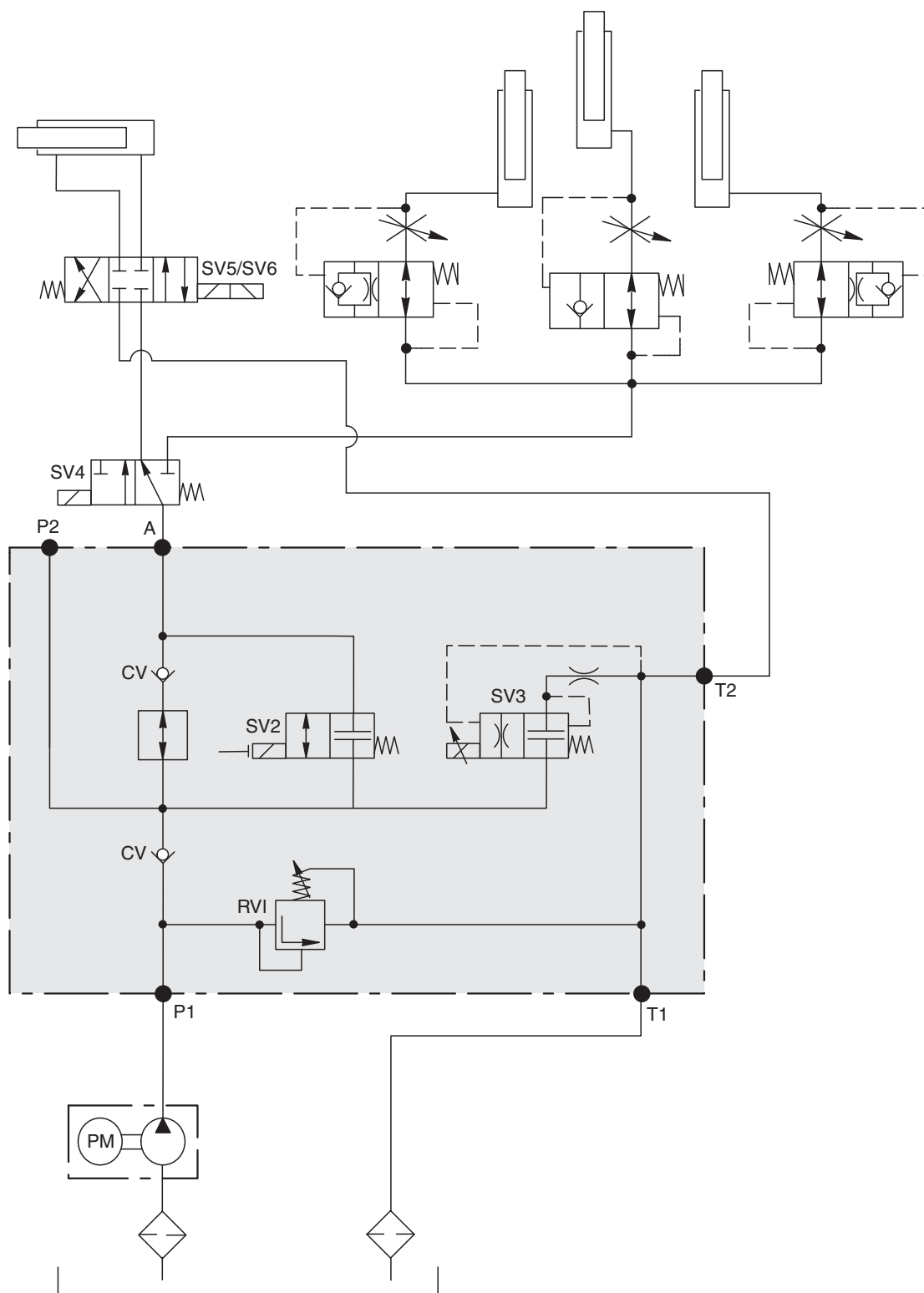
HYDRAULIC SCHEMATIC

Hydraulic Diagrams



WS Auxiliary Hydraulics TT Mast

Up to serial no. 5A134880



M1997



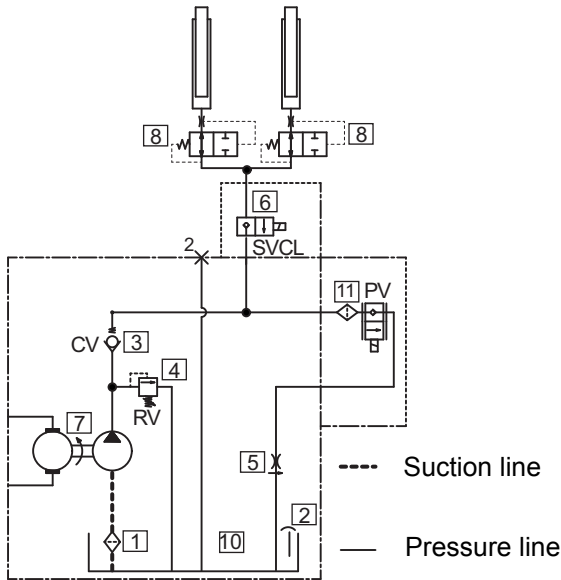
HYDRAULIC SCHEMATIC

Hydraulic Diagrams

WE/WS

TL Mast

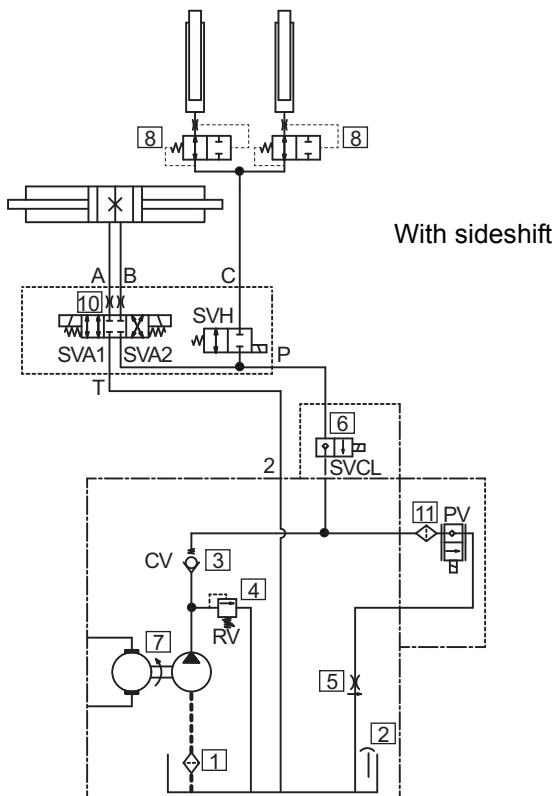
From serial no. 5A134882



- 1 Suction filter
- 2 Reservoir ventilation
- 3 Check valve (CV)
- 4 Relief valve (RV)
WE 1.25 t 17,000 MPa (2465 psi.)
WE/WS 1.4 t, 1.6 t, 1.8 t, 18,000 MPa (2610 psi.)
- 5 Flow restrictor
- 6 Two-way valve (SVCL)
- 7 Pump & motor
- 8 Lift cylinder line break safety device
- 10 Flow restrictor, fixed setting
- 11 Filter
- 12 Line break safety device on lift cylinder output

Abbreviations

- SVCL Cylinder shutoff valve
 PV Proportional valve
 RV Relief valve
 CV Check valve
 SVA1 Left sideshift valve (AUX)
 SVA2 Right sideshift valve (AUX)
 SVH Mast lift valve (AUX)



MS-4223-053

WE/WS 2300

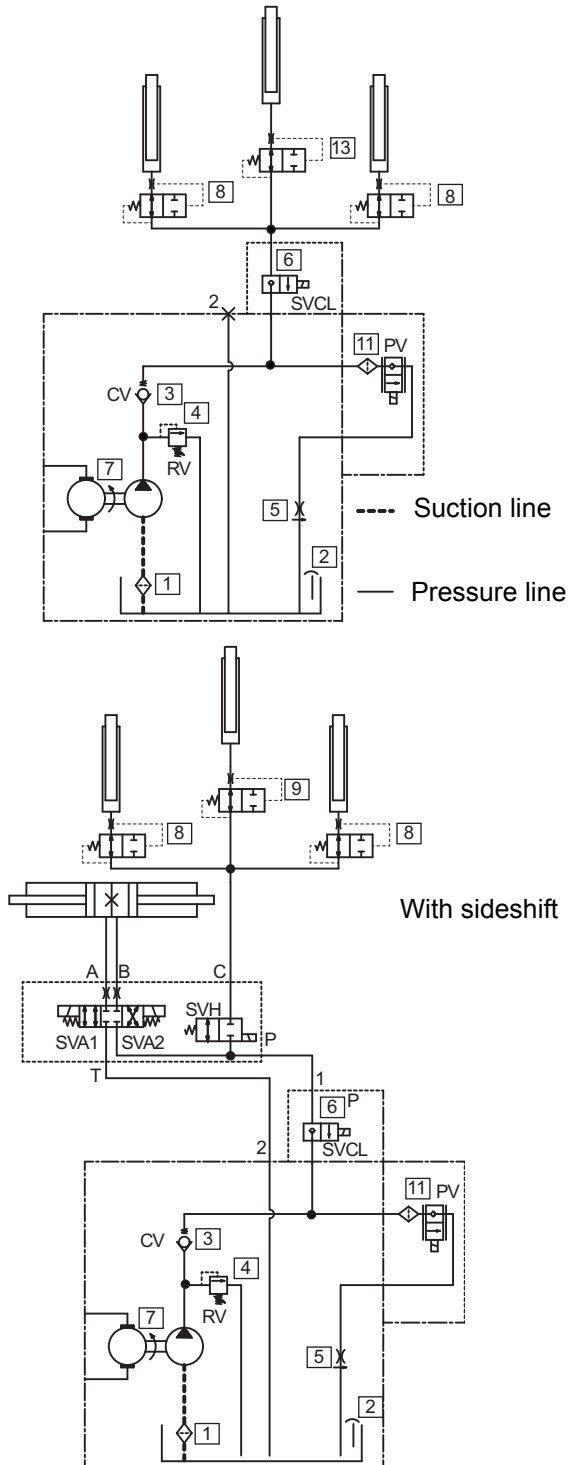
HYDRAULIC SCHEMATIC

Hydraulic Diagrams



TT mast

From serial no. 5A134882



- 1 Suction filter
- 2 Reservoir ventilation
- 3 Check valve (CV)
- 4 Relief valve (RV)
WE 1.25 t 17,000 MPa (2465 psi.)
WE/WS 1.4 t, 1.6 t, 1.8 t, 18,000 MPa (2610 psi.)
- 5 Flow restrictor
- 6 Two-way valve (SVCL)
- 7 Pump & motor
- 8 Lift cylinder line break safety device
- 9 Free lift cylinder line break safety device
- 10 Flow restrictor, fixed setting
- 11 Filter
- 13 Sideshift line break safety device

Abbreviations

- SVCL Cylinder shutoff valve
 PV Proportional valve
 RV Relief valve
 CV Check valve
 SVA1 Left sideshift valve (AUX)
 SVA2 Right sideshift valve (AUX)
 SVH Mast lift valve (AUX)

MS-4223-054

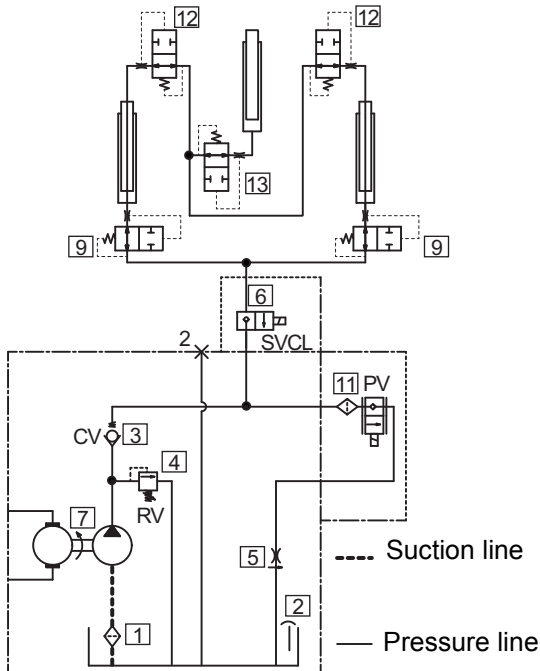


HYDRAULIC SCHEMATIC

Hydraulic Diagrams

TF mast

From serial no. 5A134882



MS-4223-055

- 1 Suction filter
- 2 Reservoir ventilation
- 3 Check valve (CV)
- 4 Relief valve (RV)
WE 1.25 t 17,000 MPa (2465 psi.)
WE/WS 1.4 t, 1.6 t, 1.8 t, 18,000 MPa (2610 psi.)
- 5 Flow restrictor
- 6 Two-way valve (SVCL)
- 7 Pump & motor
- 9 Free lift cylinder line break safety device
- 11 Filter
- 12 Line break safety device on lift cylinder output
- 13 Sideshift line break safety device

Abbreviations

- SVCL Cylinder shutoff valve
 PV Proportional valve
 RV Relief valve
 CV Check valve



Notes: