

Technical Manual

ZT MK2

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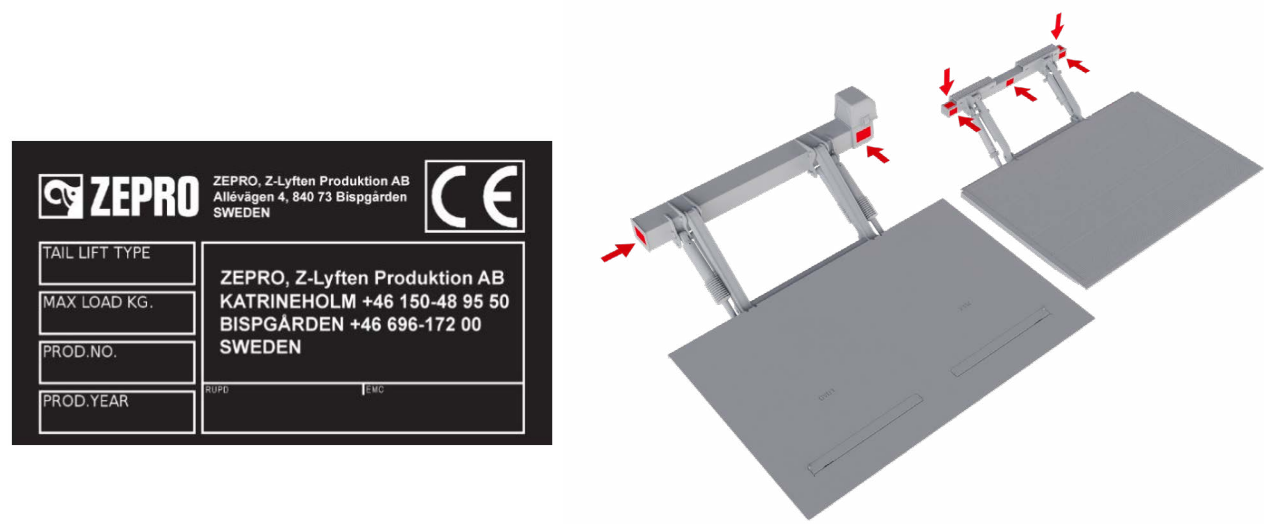
1 Product overview

1.1 Product variants and identification

1.1.1 The type sign

Zepro offers a number of model families each consisting of a number of different variants with varying levels of functionality. The control systems, hydraulic configurations, available control devices and sensors can vary between models and even between variants of the same model. It is therefore crucial to always identify the model and the variant before working on a tail lift. By first identifying the tail lift, the correct information for that particular tail lift can be found.

The first step in the process of identifying the variant is locating the type sign and reading the information in the tail lift type-field. The location of the typesign varies between different tail lift models but it is always riveted onto the support frame of the lift, with the most common location being shown on the figure below. There should also be a sticker showing the same information in the users manual and on the door sill on the drivers side of the vehicle.



For the ZT MK2 models covered in this document, the following nomenclature is used. The "ZT" denotes the model designation followed by the "Mk2" which denotes second generation design of the ZT product. "SLI" stands for slimline, a configuration with a slightly different mounting brackets and motor/driveshaft location. The four digit number denotes the capacity of the tail lift, in kilograms, and the three digit number that follows it denotes the maximum lifting height, in centimeters.

	Model	Capacity		Lifting height
		1500		
	ZT-MK2	/		135
ZEPRO	/	2000	-	/
	ZT-MK2 SLI	/		155
		2500		

1.1.2 Main components

All ZT MK2 variants consist of the same main components shown below. The support frame contains the hydraulic unit and the control system and serves as the main attachment point for the lift arm and the cylinders, two of which are used to lift and the other two to tilt the platform. The support frame is secured by two mounting brackets which slide along two slide profiles which are bolted onto the vehicle. The sliding motion is accomplished by chains and sprockets on each side which are driven by a hydraulic motor. The platform is foldable and is manually folded in half when the tail lift is not in use.

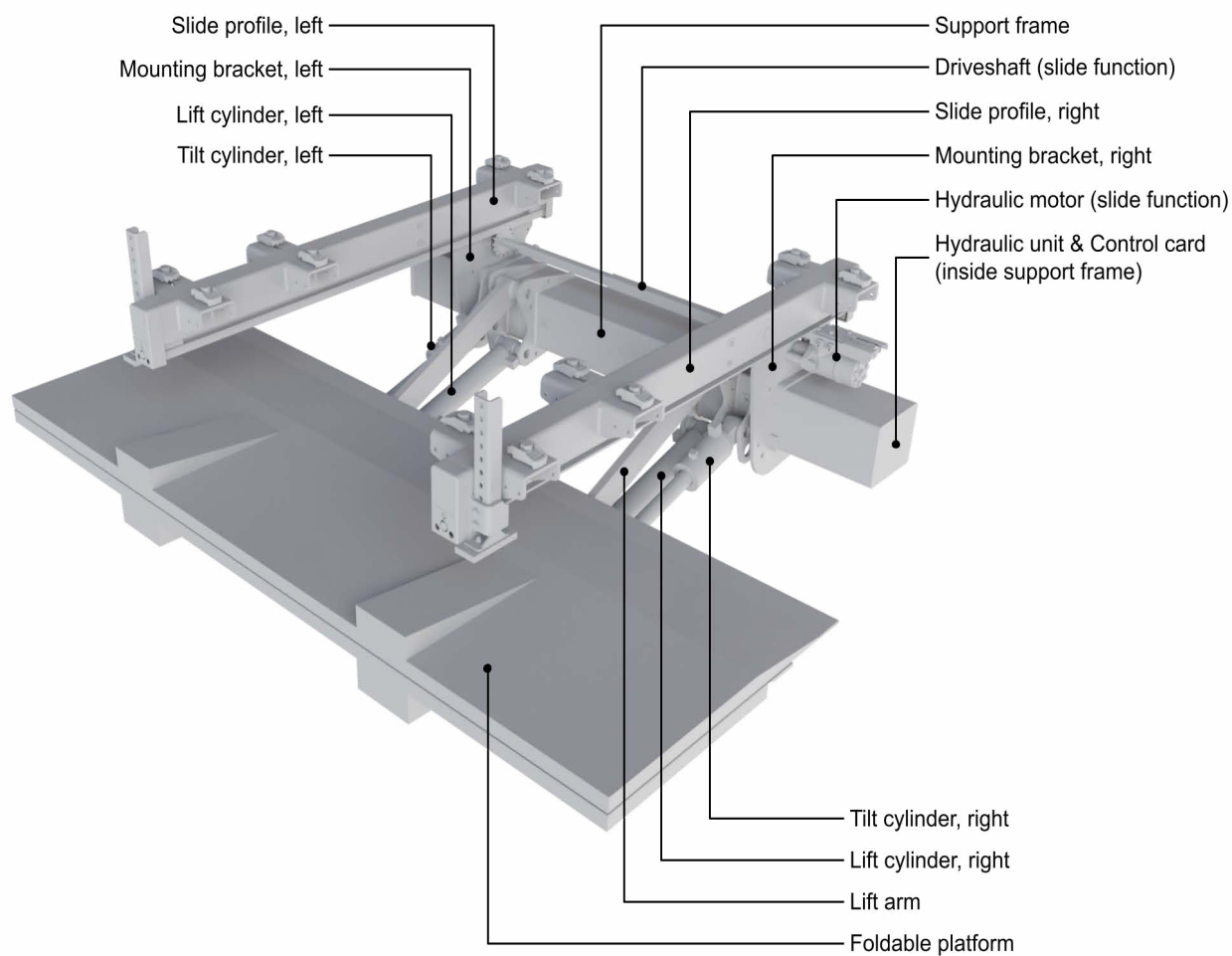


Fig 1. Main components for ZT MK2

1.1.3 Auto tilt

The ZT MK2 sliders can be configured with auto tilt functionality which means that the tail lift will automatically tilt the platform down when it reaches the ground and it will tilt it back to horizontal before raising it from the ground without any additional user input. Whether the tail lift is equipped with auto tilt or not cannot be determined by reading the typesign. Instead, the platform should be checked for sensors. If there's a rectangular angle sensor installed, then the tail lift is equipped with auto tilt.

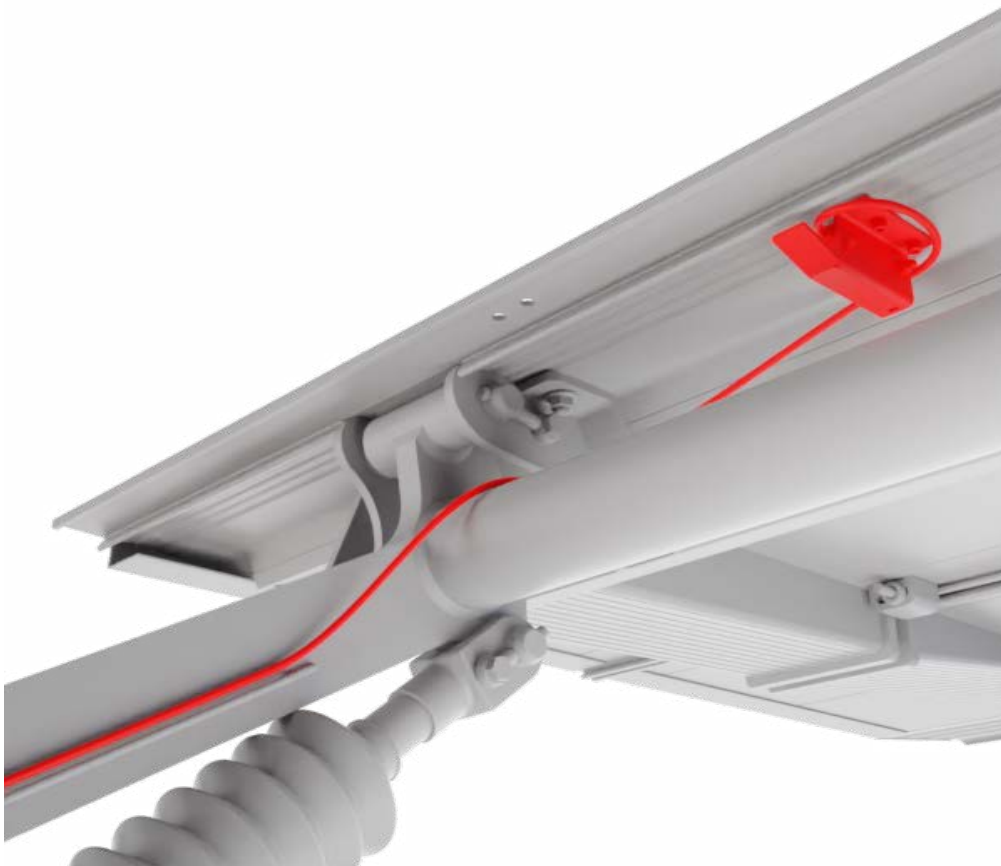


Fig 2. Rectangular angle sensor.

1.1.4 Control cards

The control card receives inputs from the control device and the sensors and converts them into outputs to the solenoid and magnets which produce in the desired motion. All ZT MK2 variants are equipped with the TLC-B1 control card based on solid state relay technology. The card is used in other Zepro tail lifts as well and has a few different configurations depending on which tail lift it is meant to control. It is therefore crucial to always make sure that the configuration of the installed card is correct, especially when replacing the card. The configuration can be read on the decal on the card itself or if the decal is missing, by examining the position of the three switches on the block in the middle of the card, see ""2.1.6 Card configuration"" section. The correct configuration for all ZT MK2 model family is "010".

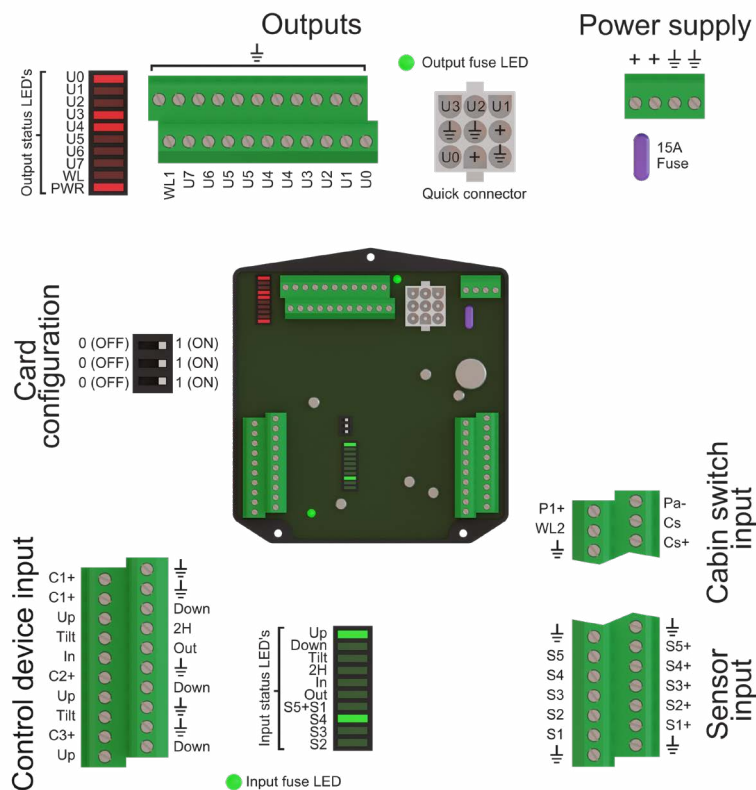
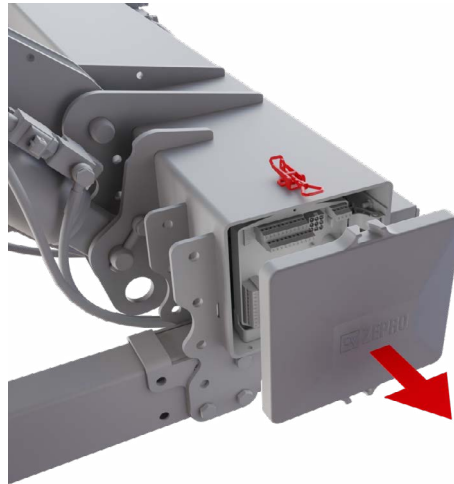


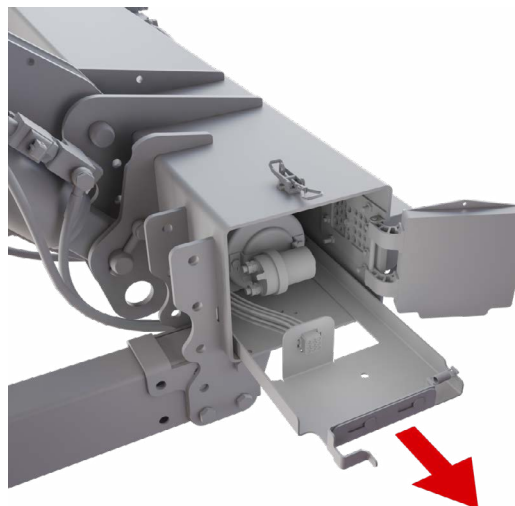
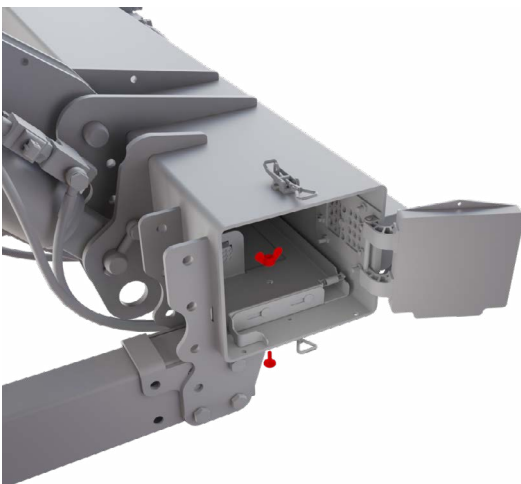
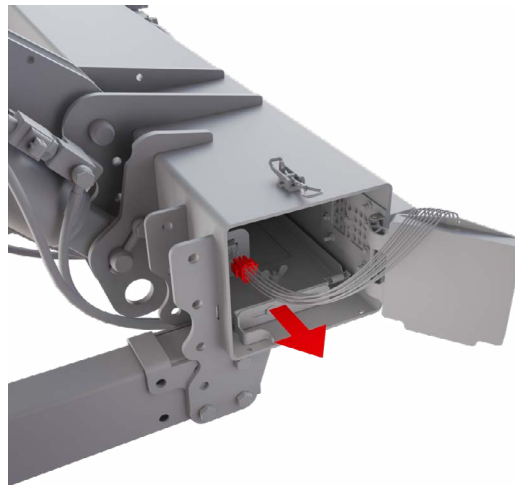
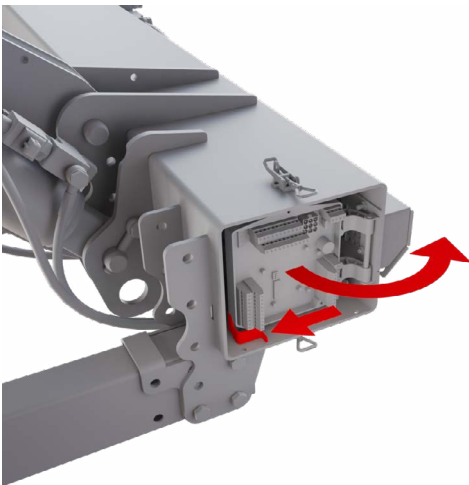
Fig 3. TLC B1 control card

1.2 Accessing the card and hydraulic unit

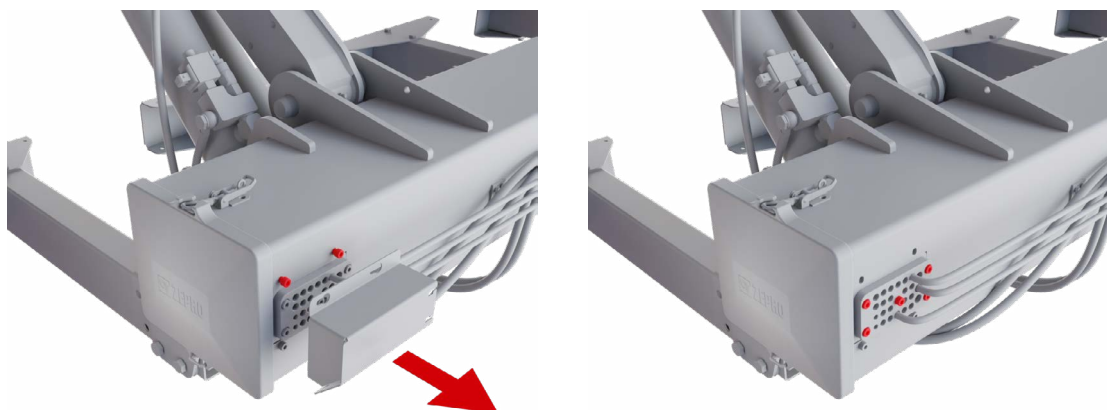
The control card and the hydraulic unit are housed inside the main support frame of the tail lift. The control card is accessed by unlocking the two locks on the top and the bottom of the support frame and removing the plastic cover.



With the cover removed, the hydraulic unit is accessed by swinging the card out of the way, disconnecting the quick connector for the cable harness, removing the securing nut for the hydraulic unit tray and sliding the tray out.



On the front of the support frame there is a cable grommet for cable pass-through from the outside to the inside of the tail lift. Cables going from the card to the sensors, control devices, cabin switch and outer valves are passed through the grommet. Access to the cable grommet is achieved by loosening the two screws holding the protective cover in place. Loosening the five screws in the rubber seal reduces its grip on the cables.

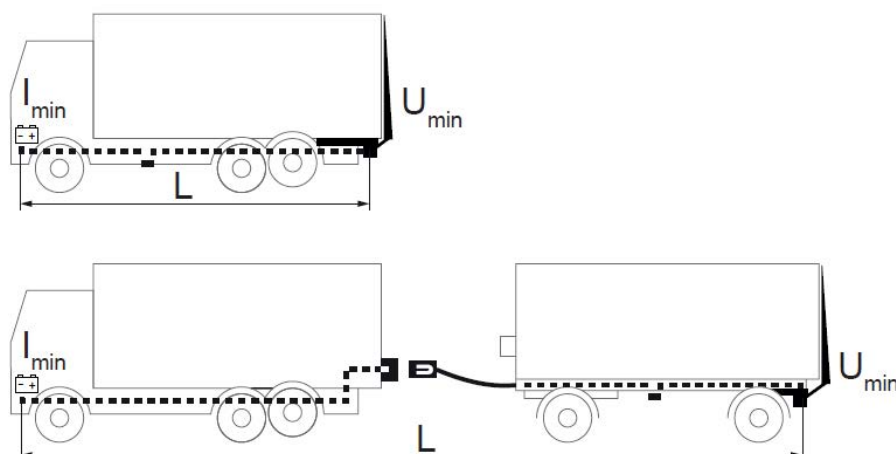


1.3 Battery and cable requirements

For proper function of the tail lift the electrical system needs to be sized per the following:

Item	12V	24V
Minimum battery capacity (I_{min})	180Ah	170Ah
Minimum voltage during operation (U_{min})	9V	18V
Cross sectional area of power cable, length up to 8m	35mm ²	35mm ²
Cross sectional area of power cable, length 8-15m	50mm ²	35mm ²
Cross sectional area of power cable, length over 15m	Not possible	50mm ²

The given cross sectional areas are valid for copper cables. If other conductor material is used proper conversion needs to be made in order to properly size the connection. The total length of the cable is measured according to the following figure.



Some vehicle models have restrictions regarding the amount of current the lift can access from the existing battery. Some vehicle models do not fully charge the battery. It may therefore be necessary to switch to a battery and sometimes also to a charger with a larger capacity.

2 Control cards

2.1 TLC B1 relay card

2.1.1 Overview

The TLC B1 control card can be split into different functional sections as shown in the following figure. In-depth explanations of each section are contained in the following chapters.

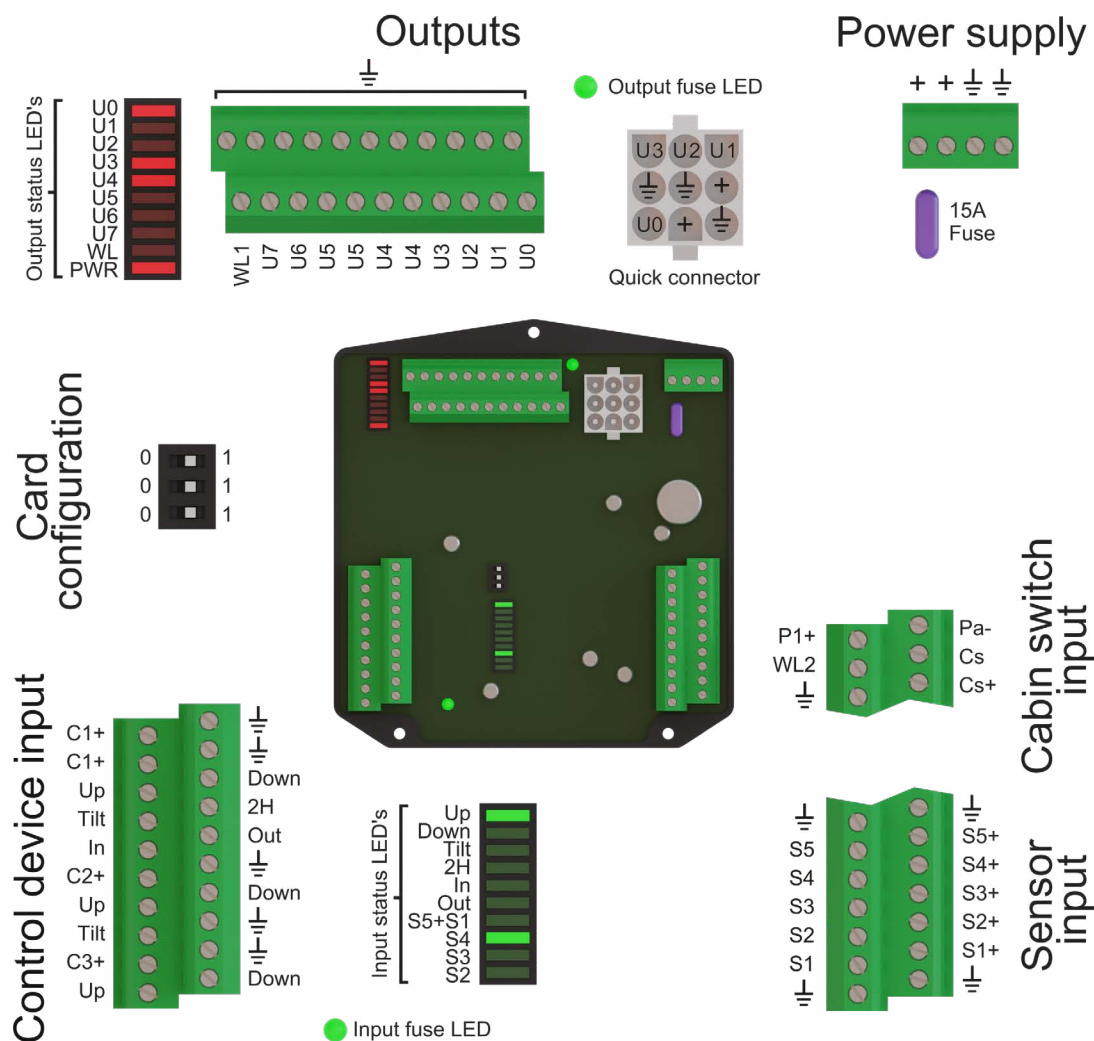


Fig 4. TLC B1 relay card

2.1.2 Power supply

The control card is powered through the power supply block in the top right corner of the card and is protected by the 15A fuse right beneath it.

Power supply

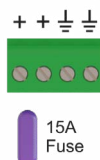


Fig 5. Supply socket protected with 15A fuse.

2.1.3 Cabin switch input

For countries where the EN 1756-standard is in effect, the tail lift shall be equipped with a system to prevent any unauthorized operation in the absence of the operator. This can be achieved by locking and unlocking with a code or an On/Off switch inside lockable driver's cab.

The Zepro solution consists of a cab switch, which when active, sends power to the CS pin in the cab switch section of the card. When the switch is in its "Off" position any inputs are disregarded and the tail lift is effectively locked.

On installations where the use of a cab switch is not possible due to absence of a driver's cab, the CS pin is powered directly from a power source through a 2-3A fuse and the tail lift is disabled by other means, a lockable power switch on the main battery cable for example.

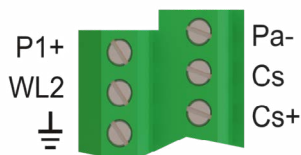


Fig 6. Supply socket for the cabin switch

2.1.4 Sensor input

Sensors are used to provide added functionality when certain conditions are met or limit certain functionality for safety reasons. The TLC B1 control card has input pins for up to 4 different sensors, S2 through S5. The S1 input is used to power the S5 so together they act as a single input. The S1+S5 input is most often used for the auto tilt functionality on some variants.

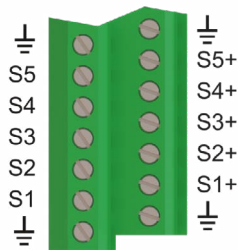


Fig 7. Supply socket for different sensors

The TLC B1 card can accommodate the sensor types shown in the table below. Different variants of the ZT MK2 use different types and number of sensors depending on functionality. See the functional descriptions and schematics chapter for connection information.

Type	Picture	Explanation
Digital angle sensor (ball type)		<p>An angle sensor that uses an articulating ball to output an On/Off signal for certain angle ranges.</p> <p>Usually mounted on the platform and used to control the two hand safety requirement.</p>
Digital angle sensor (liquid type)		<p>A sensor that uses a fluid to measure the angle and outputs an On/Off signal for certain angle values. More accurate than the ball type sensor.</p> <p>Mounted on the platform on tail lifts equipped with digital auto tilt on which it is used to stop the auto tilt up motion of the platform when it reaches horizontal level.</p>
Pressure sensor		<p>Outputs an On/Off signal if the pressure exceeds (rising pressure sensor) or falls below (falling pressure sensor) a predetermined value.</p> <p>It is most often used for the open platform alarm, in which case it is mounted on the positive hydraulic connection to the right tilt cylinder. It can also be used for the auto tilt function in which case it is mounted on the positive hydraulic connection to the right lift cylinder.</p>

2.1.5 Control device input

The control devices are connected to the control device input section and powered by the control device power section of the control card. They are used to input user commands into the control card so that they can be interpreted and executed. The control devices can be grouped into two groups depending on their functionality:

primary and secondary devices. Primary devices are fixed on the outside of the box body or on the tail lift itself and can operate all functions of the tail lift without any limitations. The most common primary control devices for the ZT MK2 are shown below.



Fig 8. CD 20

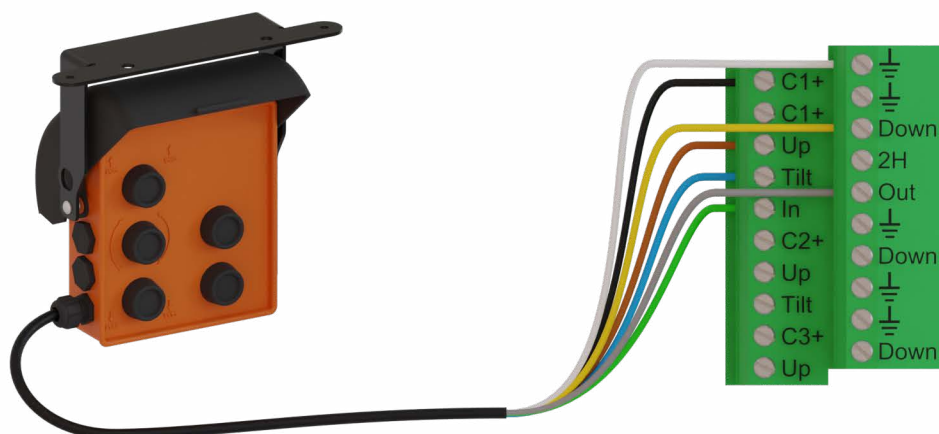


Fig 9. CD 3

Secondary devices on the other hand, are usually accessible from the platform and are in some cases mobile. Therefore, they have certain limitations for safety or practical reasons and cannot operate all functions of the tail lift. The most common secondary control devices for the ZT MK2 are shown below.

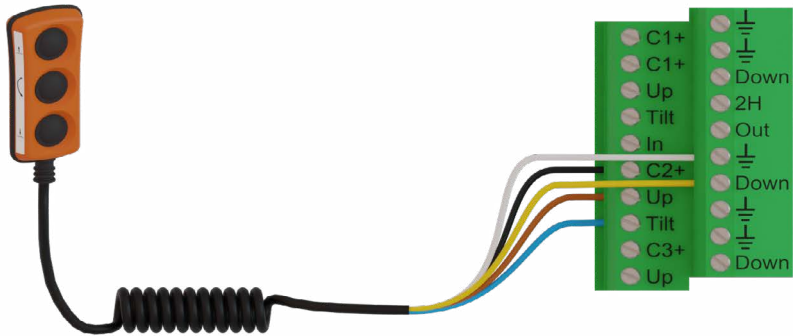


Fig 10. CD 9



Fig 11. CD 10



Fig 12. CD 11

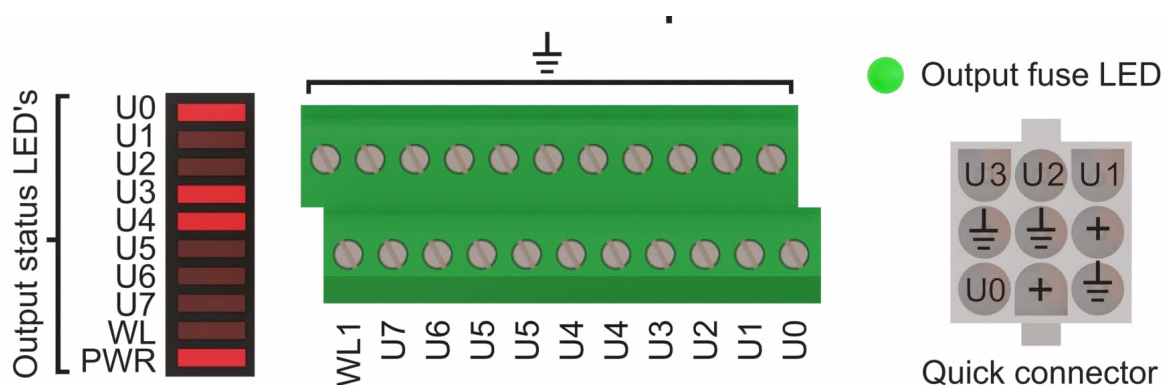
2.1.6 Card configuration

The card configuration block is a block with three two-position switches that determine the configuration of the card. A switch is in its ON-position when pushed to the right side of the slot and in its OFF-position when pushed to the left. For the ZS MK2 only the 010 configuration is used which means that the first and the last switch are in their OFF-positions and the middle one is in its ON-position, as shown below.



2.1.7 Outputs

The output section is used for power delivery to the solenoid and the coils that control the valves and thereby the motion of the tail lift. The output block consists of 22 pins in total split into 2 rows. The top row consists of 11 ground points used for the coils and the solenoid. Four of these pins are interconnected in two pairs for cases where two coils need the same signal. The bottom row consists of 11 pins for power delivery to the coils, solenoid and in some cases warning lights. On the right side of the output block there is a square white quick connector that is sometimes used for output to U0 through U3 instead of the output pins on the output block. To the right of the output block there is a single LED used for output fuse status indication. It lights up green when there is voltage to outputs. Unlit LED means a short circuit or that the relay card is switched off. To the left of the output block there is a LED strip with 10 LED's used for active output indication. The bottom LED lights up when the control card is powered. It should stay lit constantly during normal operation. The top 9 LED's are used to indicate active output with each output having its own dedicated LED.

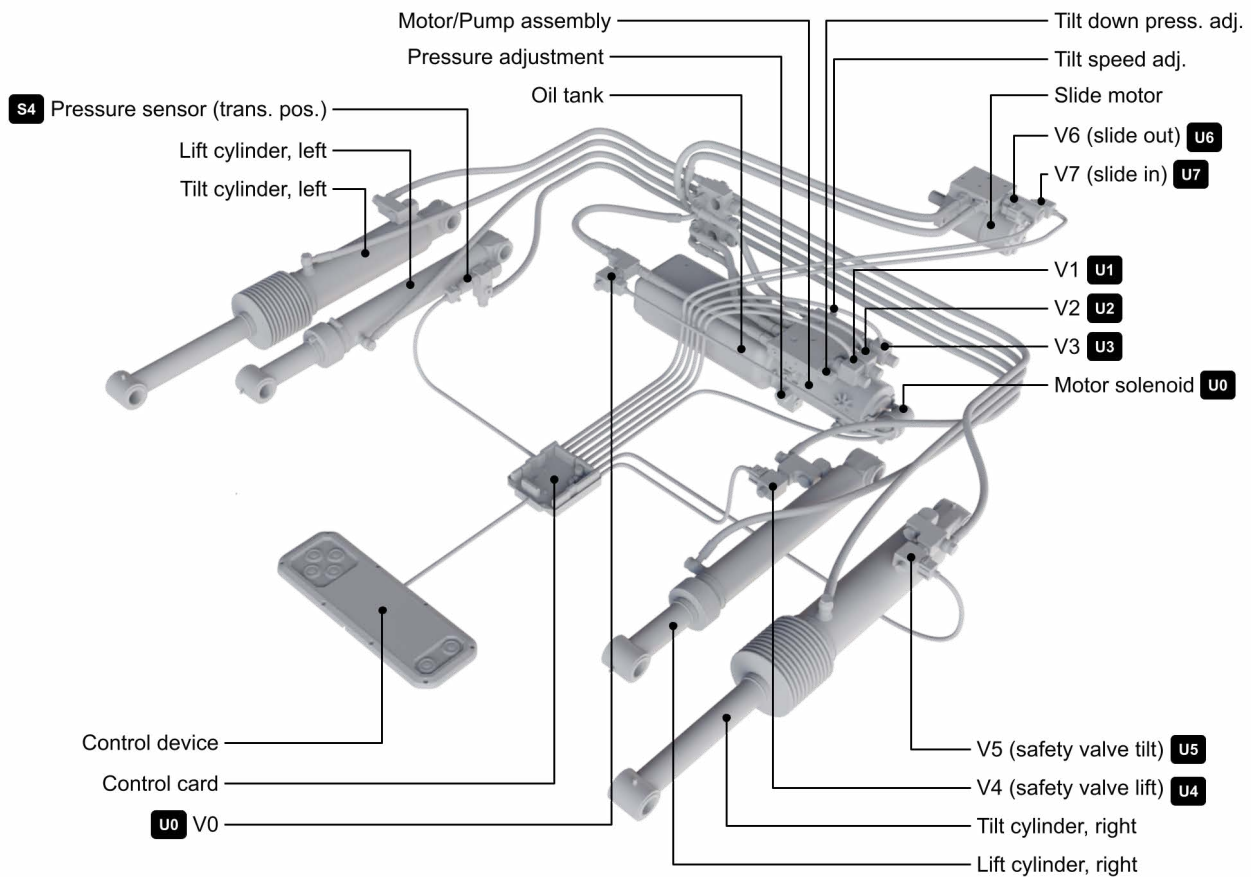


3 Functional descriptions and schematics

3.1 ZT MK2

3.1.1 Description

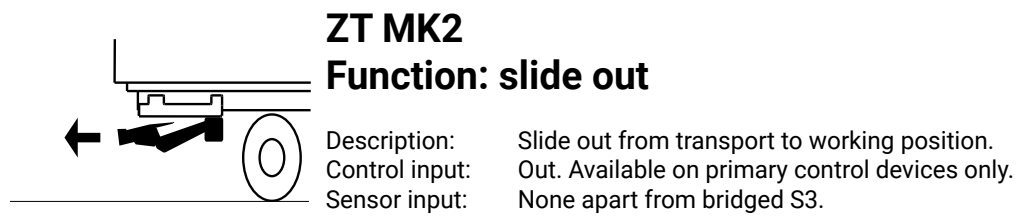
A ZT MK2 variant with double acting tilt cylinders, single acting lift cylinders and no auto tilt functionality.



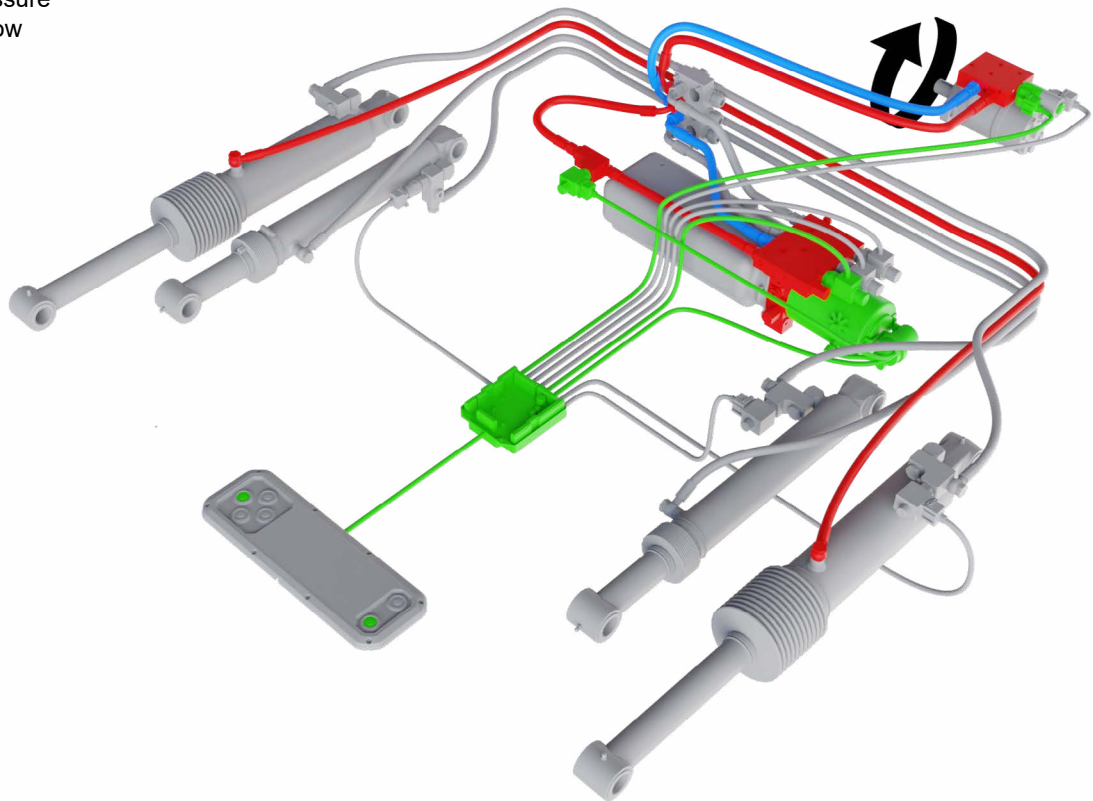
Sensor inputs:

S3 - The S3 sensor input is bridged to the S3+ sensor power output.

S4 - Pressure sensor located on the positive hydraulic feed to the left lift cylinder used to activate the open platform alarm. The sensor is active when the pressure in the cylinder drops below 60 bar which enables the Pa+ and Pa- pins on the control card.



■ High pressure
■ Return flow
■ Active



Card indication:

Output status LED's

U0	
U1	
U2	
U3	
U4	
U5	
U6	
U7	
WL	
PWR	

Output fuse

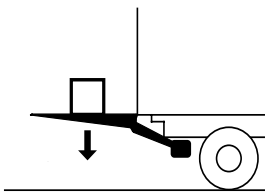
Input status LED's

	UP
	DOWN
	TILT
	2H
	IN
	OUT
	S5(+S1)
	S4
	S3
	S2

Input fuse

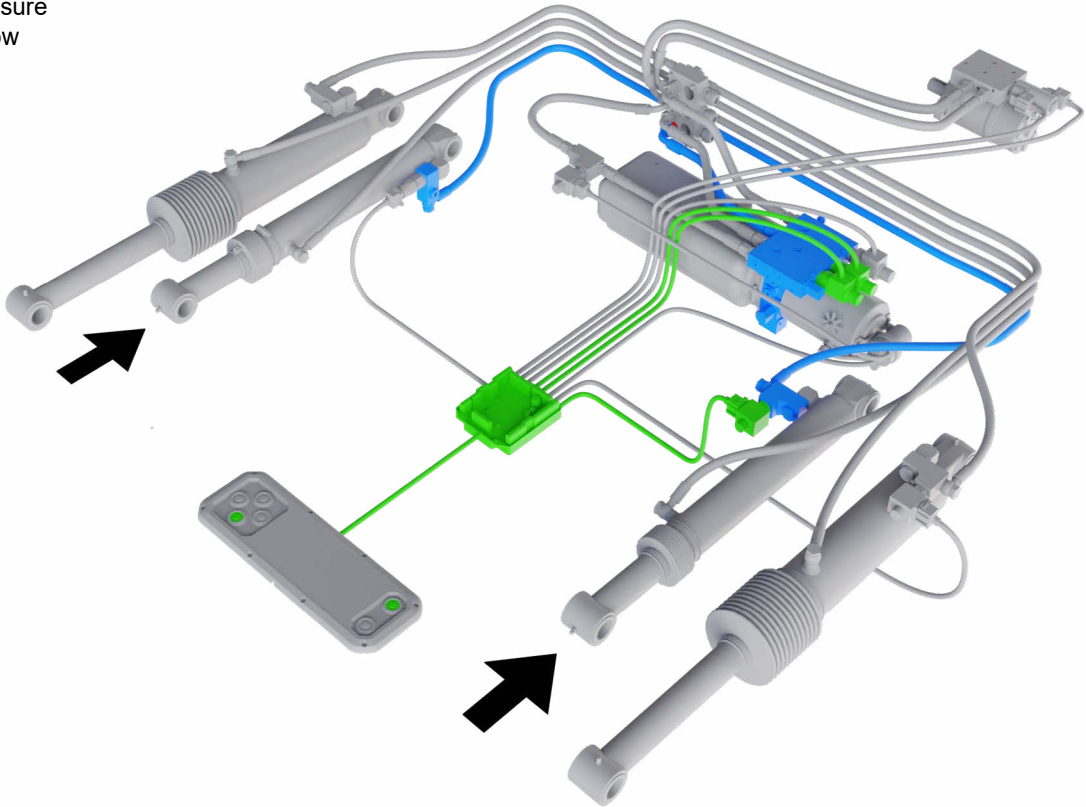
- Must be active for the function to be executed.
- Must be inactive for the function to be executed.
- May be active or inactive, the function will be executed either way.

ZT MK2
Function: lower



Description: Vertical platform lowering.
Control input: Down. Available on all control devices.
Sensor input: None apart from bridged S3.

- High pressure
- Return flow
- Active



Card indication:

Output status LED's

U0	
U1	
U2	
U3	
U4	
U5	
U6	
U7	
WL	
PWR	

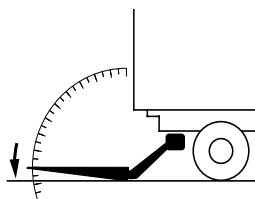
Output fuse

Input status LED's

	UP
	DOWN
	TILT
	2H
	IN
	OUT
	S5(+S1)
	S4
	S3
	S2

Input fuse

- Must be active for the function to be executed.
- Must be inactive for the function to be executed.
- May be active or inactive, the function will be executed either way.

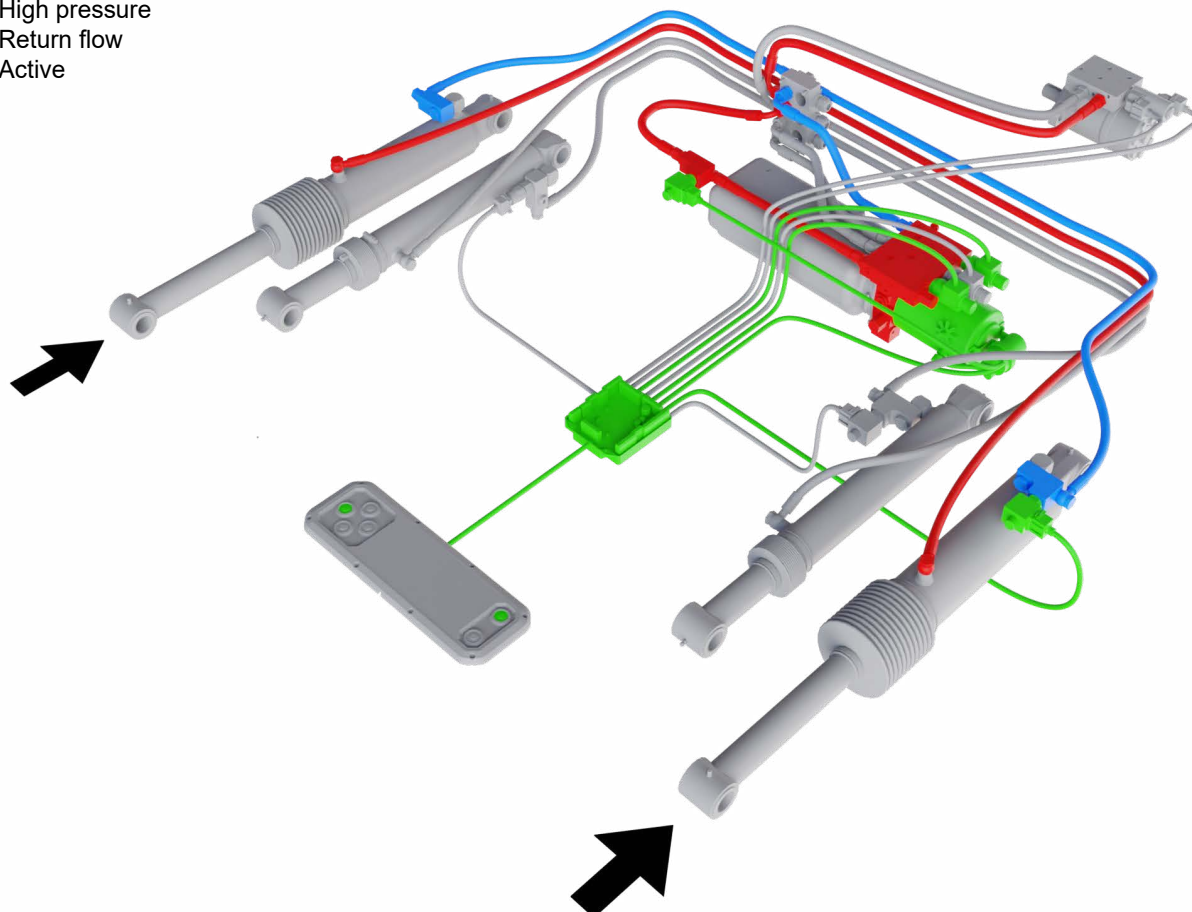


ZT MK2

Function: tilt down

Description: Platform tilt down.
 Control input: Down + Tilt. Available on all control devices.
 Sensor input: None apart from bridged S3.

■ High pressure
 ■ Return flow
 ■ Active



Card indication:

Output status LED's

U0	■
U1	■
U2	□
U3	■
U4	□
U5	■
U6	□
U7	□
WL	□
PWR	■

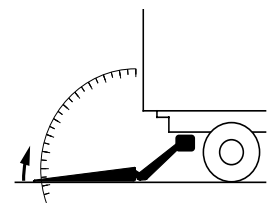
● Output fuse

Input status LED's

□	UP
■	DOWN
■	TILT
□	2H
□	IN
□	OUT
□	S5(+S1)
▨	S4
■	S3
□	S2

● Input fuse

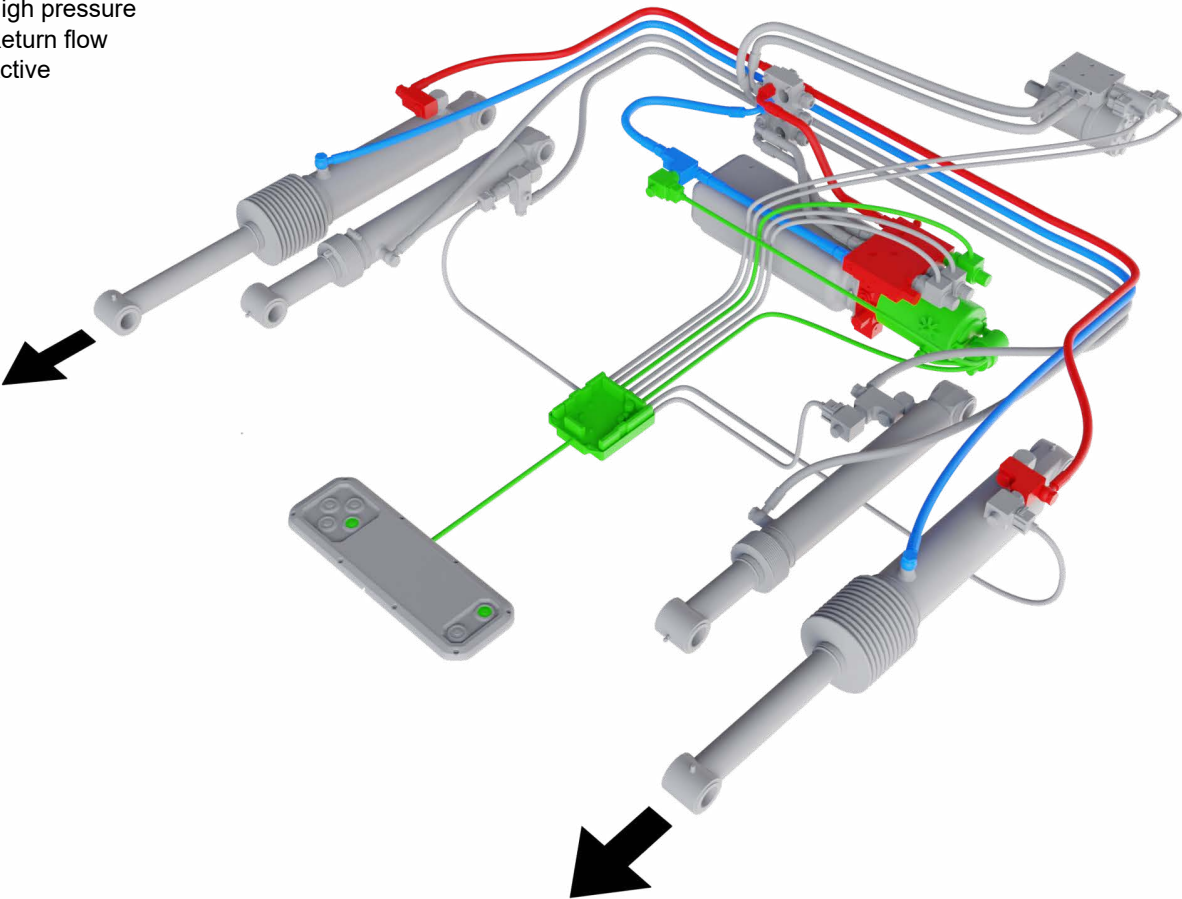
■ Must be active for the function to be executed.
 □ Must be inactive for the function to be executed.
 ▨ May be active or inactive, the function will be executed either way.



ZT MK2
Function: tilt up

Description: Platform tilt up.
Control input: Up + Tilt. Available on all control devices.
Sensor input: None apart from bridged S3.

- High pressure
- Return flow
- Active



Card indication:

Output status LED's

U0	
U1	
U2	
U3	
U4	
U5	
U6	
U7	
WL	
PWR	

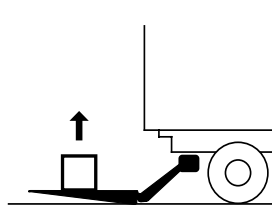
Output fuse

Input status LED's

	UP
	DOWN
	TILT
	2H
	IN
	OUT
	S5(+S1)
	S4
	S3
	S2

Input fuse

- Must be active for the function to be executed.
- Must be inactive for the function to be executed.
- May be active or inactive, the function will be executed either way.

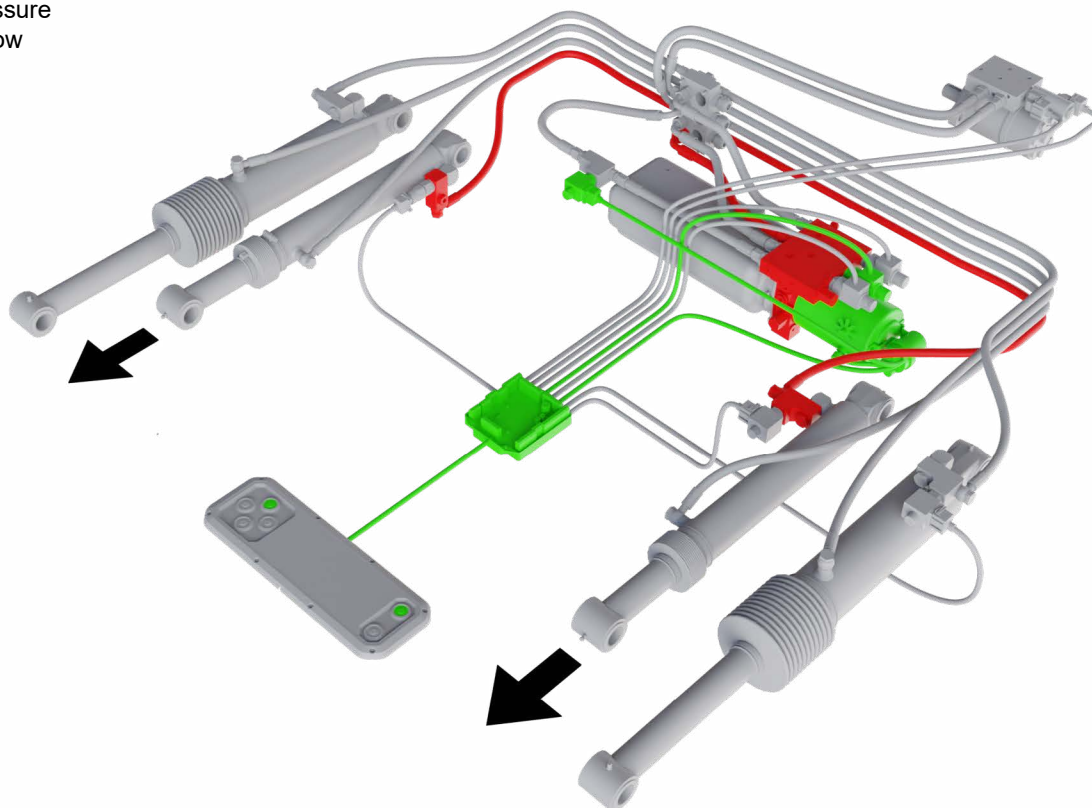


ZT MK2

Function: raise

Description: Vertical platform raising.
Control input: Up. Available on all control devices.
Sensor input: None apart from bridged S3.

■ High pressure
■ Return flow
■ Active



Card indication:

Output status LED's

U0	■
U1	□
U2	■
U3	□
U4	□
U5	□
U6	□
U7	□
WL	□
PWR	■

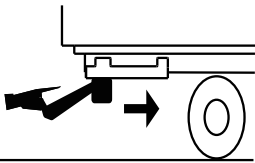
● Output fuse

Input status LED's

■	UP
□	DOWN
□	TILT
□	2H
□	IN
□	OUT
□	S5(+S1)
▨	S4
■	S3
□	S2

Input fuse ●

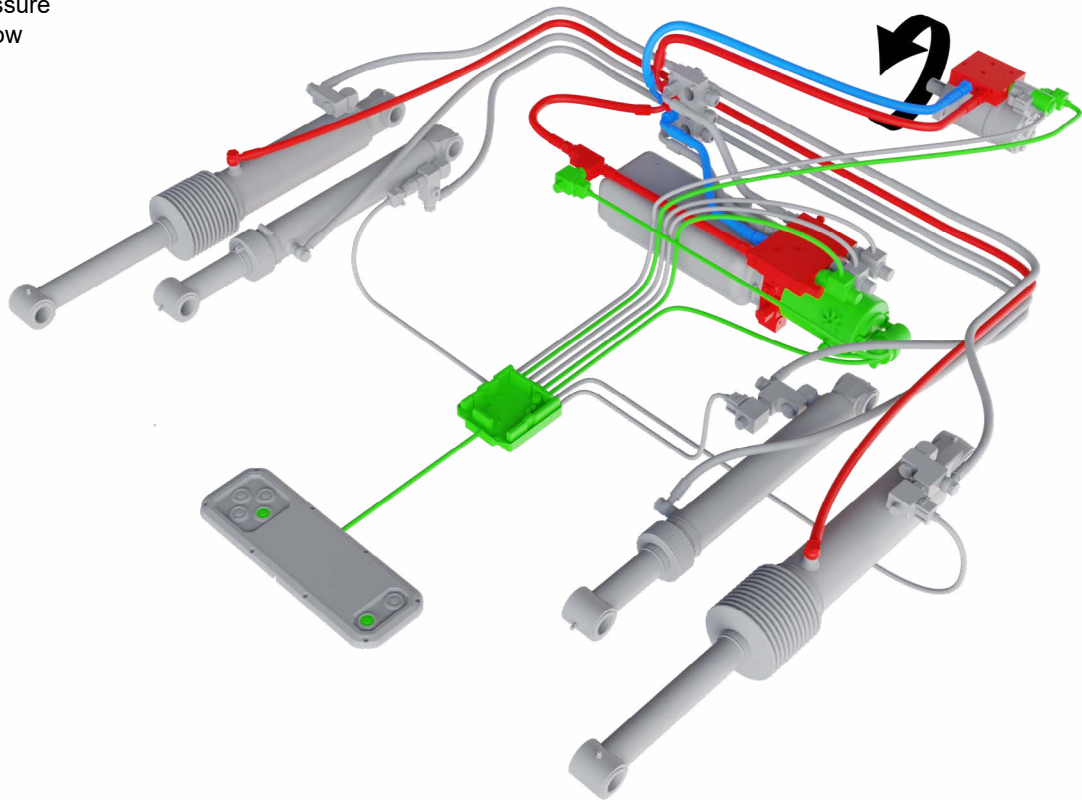
■ Must be active for the function to be executed.
□ Must be inactive for the function to be executed.
▨ May be active or inactive, the function will be executed either way.



ZT MK2
Function: slide in

Description: Slide in from working to transport position.
Control input: In. Available on primary control units only.
Sensor input: None apart from bridged S3.

- High pressure
- Return flow
- Active



Card indication:

Output status LED's

U0	
U1	
U2	
U3	
U4	
U5	
U6	
U7	
WL	
PWR	

Output fuse

Input status LED's

	UP
	DOWN
	TILT
	2H
	IN
	OUT
	S5(+S1)
	S4
	S3
	S2

Input fuse

- Must be active for the function to be executed.
- Must be inactive for the function to be executed.
- May be active or inactive, the function will be executed either way.

3.1.2 Summary of active valves ZT MK2

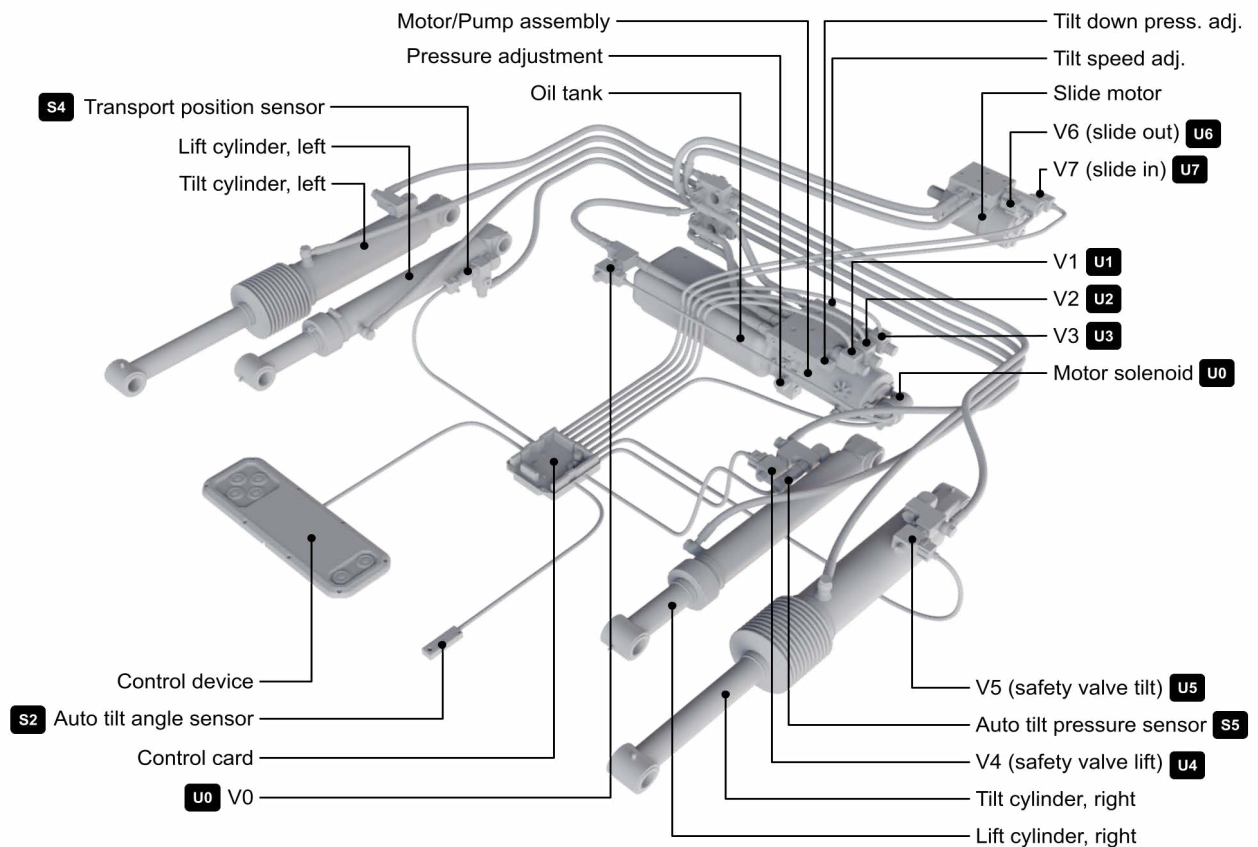
	Motor Soleonid	Valve 0	Valve 1	Valve 2	Valve 3	Safety Valve lift, V4	Safety Valve lift, V5	Slide out V6	Slide in V7
Slide out	✓	✓	✓					✓	
Lower			✓	✓		✓			
Tilt Down	✓	✓	✓		✓		✓		
Tilt up	✓	✓			✓				
Raise	✓	✓		✓					
Slide in	✓		✓						✓



3.2 ZT MK2 with digital auto tilt

3.2.1 Description

A ZT MK2 variant with double acting tilt cylinders, single acting lift cylinders and digital auto tilt functionality. .



Sensor inputs in use:

S1 - The S1 sensor input is bridged to the S1+ sensor power output.

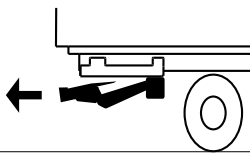
S2 - Liquid-based angle sensor located on the platform used to control the auto tilt functionality. The sensor is activated when the platform is tilted down from horizontal and stays active until it is tilted back up to horizontal. As long as the sensor is active, the tail lift will automatically tilt the platform up when the Up-button is pressed.

S3 - The S3 sensor input is bridged to the S3+ sensor power output.

S4 - Pressure sensor located on the positive hydraulic feed to the left lift cylinder used to activate the open platform alarm. The sensor is active when the pressure in the cylinder drops below 60 bar which enables the Pa+ and Pa- pins on the control card.

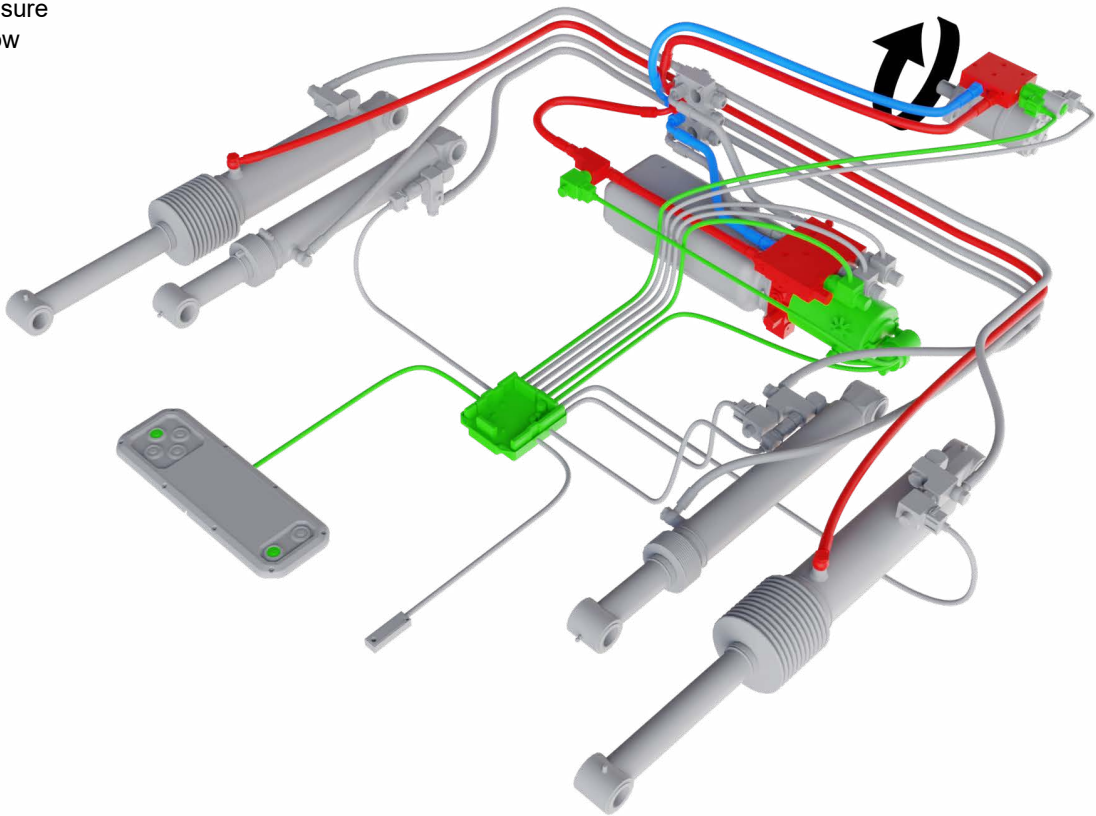
S5 - Pressure sensor located on the positive hydraulic feed to the lift cylinder used to control the auto tilt functionality. Once the tail lift has reached ground level, the pressure in the cylinder drops below 2,5 bar which activates the sensor which stays active until the pressure exceeds 2,5 bar again. As long as the sensor is active, the tail lift will automatically tilt the platform down when the Down-button is pressed.

ZT MK2 with digital auto tilt
Function: slide out



Description: Slide out from transport to working position.
Control input: Out. Available on primary control devices only.
Sensor input: None apart from bridged S3.

- High pressure
- Return flow
- Active



Card indication:

Output status LED's

U0	Red
U1	Red
U2	White
U3	White
U4	White
U5	White
U6	Red
U7	White
WL	White
PWR	Red

Output fuse

Input status LED's

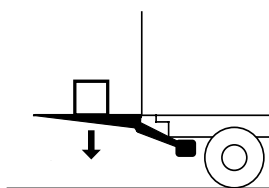
White	UP
White	DOWN
White	TILT
White	2H
White	IN
Green	OUT
White	S5(+S1)
Diagonal lines	S4
Green	S3
Diagonal lines	S2

Input fuse

- Must be active for the function to be executed.
- Must be inactive for the function to be executed.
- May be active or inactive, the function will be executed either way.

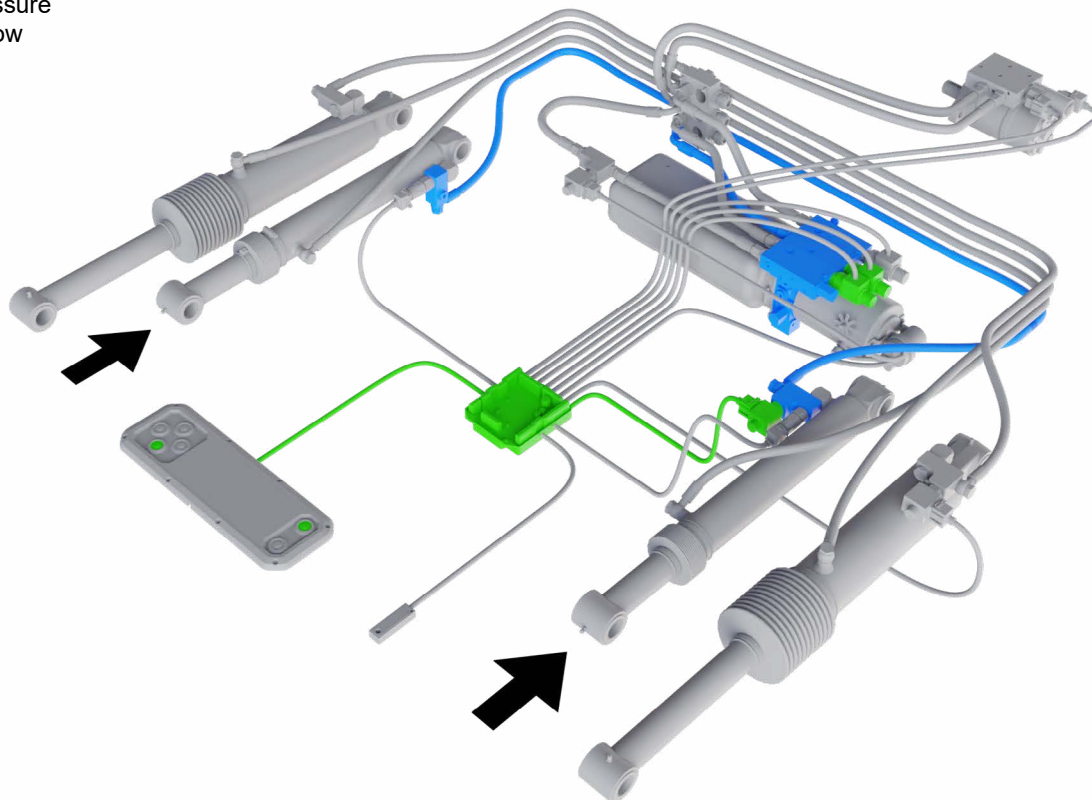
ZT MK2 with digital auto tilt

Function: lower



Description: Vertical platform lowering.
Control input: Down. Available on all control devices.
Sensor input: None apart from bridged S3.

■ High pressure
■ Return flow
■ Active



Card indication:

Output status LED's

U0	<input type="checkbox"/>
U1	<input checked="" type="checkbox"/>
U2	<input checked="" type="checkbox"/>
U3	<input type="checkbox"/>
U4	<input checked="" type="checkbox"/>
U5	<input type="checkbox"/>
U6	<input type="checkbox"/>
U7	<input type="checkbox"/>
WL	<input type="checkbox"/>
PWR	<input checked="" type="checkbox"/>

● Output fuse

Input status LED's

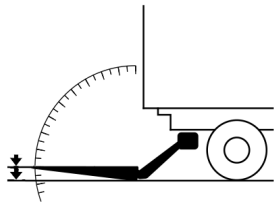
<input type="checkbox"/>	UP
<input checked="" type="checkbox"/>	DOWN
<input type="checkbox"/>	TILT
<input type="checkbox"/>	2H
<input type="checkbox"/>	IN
<input type="checkbox"/>	OUT
<input type="checkbox"/>	S5(+S1)
<input checked="" type="checkbox"/>	S4
<input checked="" type="checkbox"/>	S3
<input checked="" type="checkbox"/>	S2

● Input fuse

■ Must be active for the function to be executed.
□ Must be inactive for the function to be executed.
▨ May be active or inactive, the function will be executed either way.

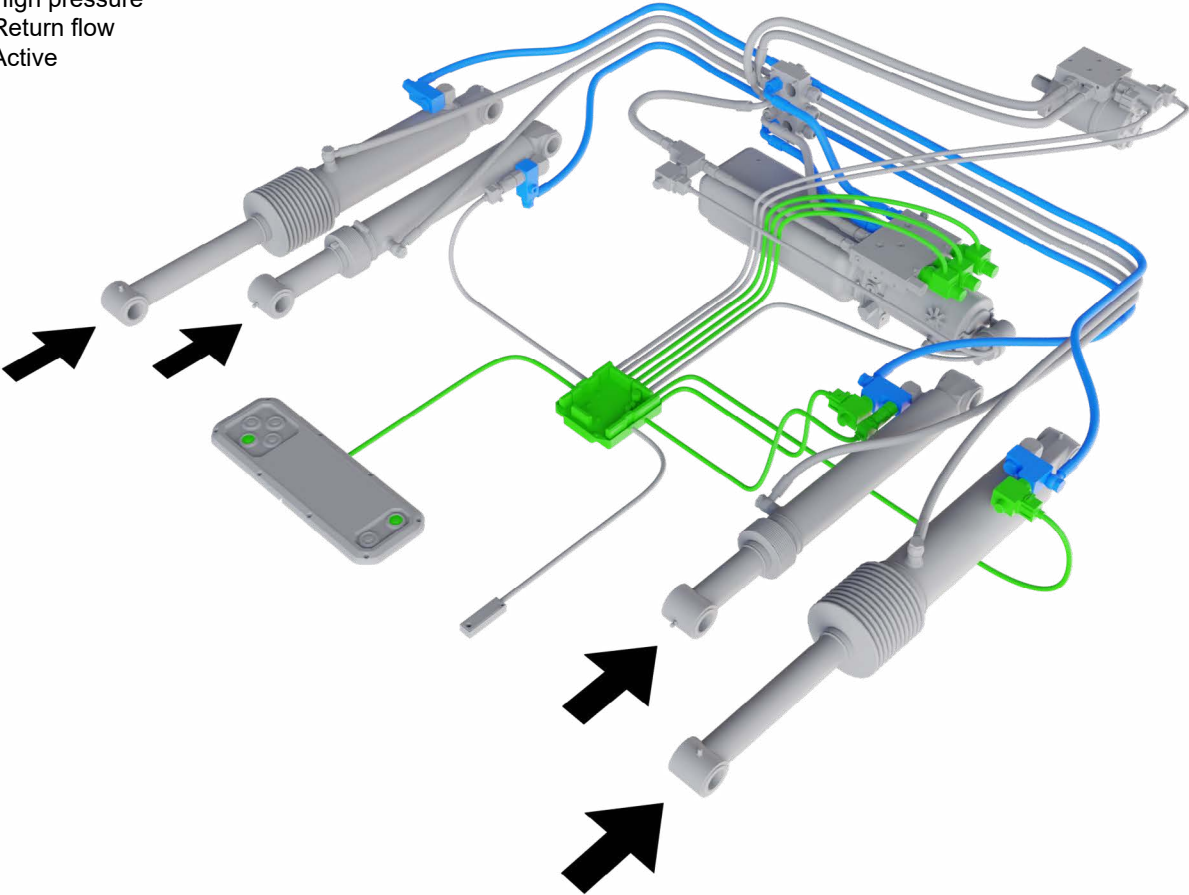
ZT MK2 with digital auto tilt

Function: auto tilt down



Description: Automatic tilting down once ground level has been reached.
Control input: Down. Available on all control devices.
Sensor input: Active S5 pressure sensor, bridged S1 and S3.

- High pressure
- Return flow
- Active



Card indication:

Output status LED's

U0	
U1	
U2	
U3	
U4	
U5	
U6	
U7	
WL	
PWR	

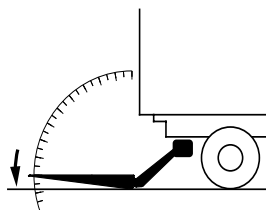
Output fuse

Input status LED's

	UP
	DOWN
	TILT
	2H
	IN
	OUT
	S5(+S1)
	S4
	S3
	S2

Input fuse

- Must be active for the function to be executed.
- Must be inactive for the function to be executed.
- May be active or inactive, the function will be executed either way.

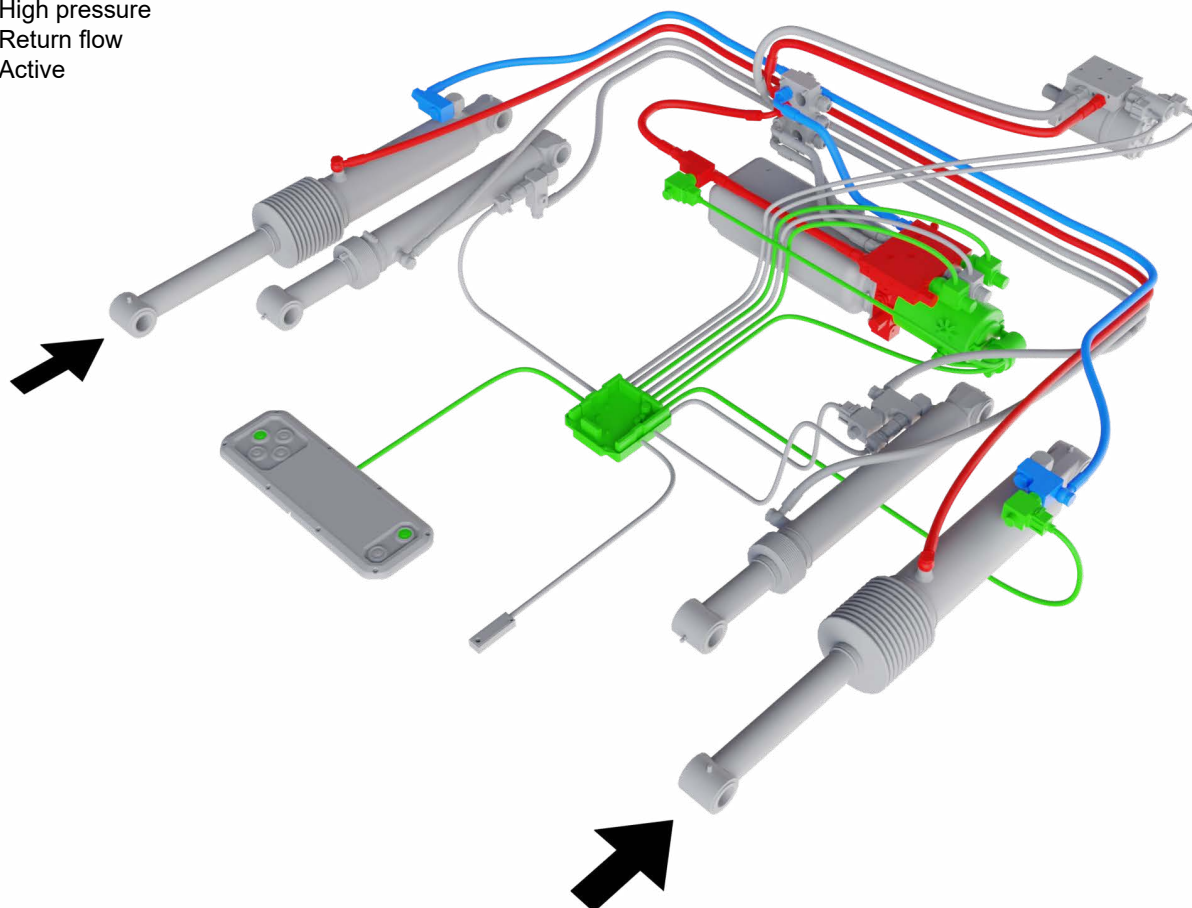


ZT MK2 with digital auto tilt

Function: manual tilt down

Description: Platform tilting down from horizontal.
Control input: Down + Tilt. Available on all control devices.
Sensor input: None apart from bridged S3.

High pressure
Return flow
Active



Card indication:

Output status LED's

U0	Red
U1	Red
U2	White
U3	Red
U4	White
U5	Red
U6	White
U7	White
WL	White
PWR	Red

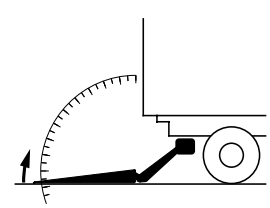
Output fuse

Input status LED's

White	UP
Green	DOWN
Green	TILT
White	2H
White	IN
White	OUT
White	S5(+S1)
Green	S4
Green	S3
Green	S2

Input fuse

Must be active for the function to be executed.
Must be inactive for the function to be executed.
May be active or inactive, the function will be executed either way.

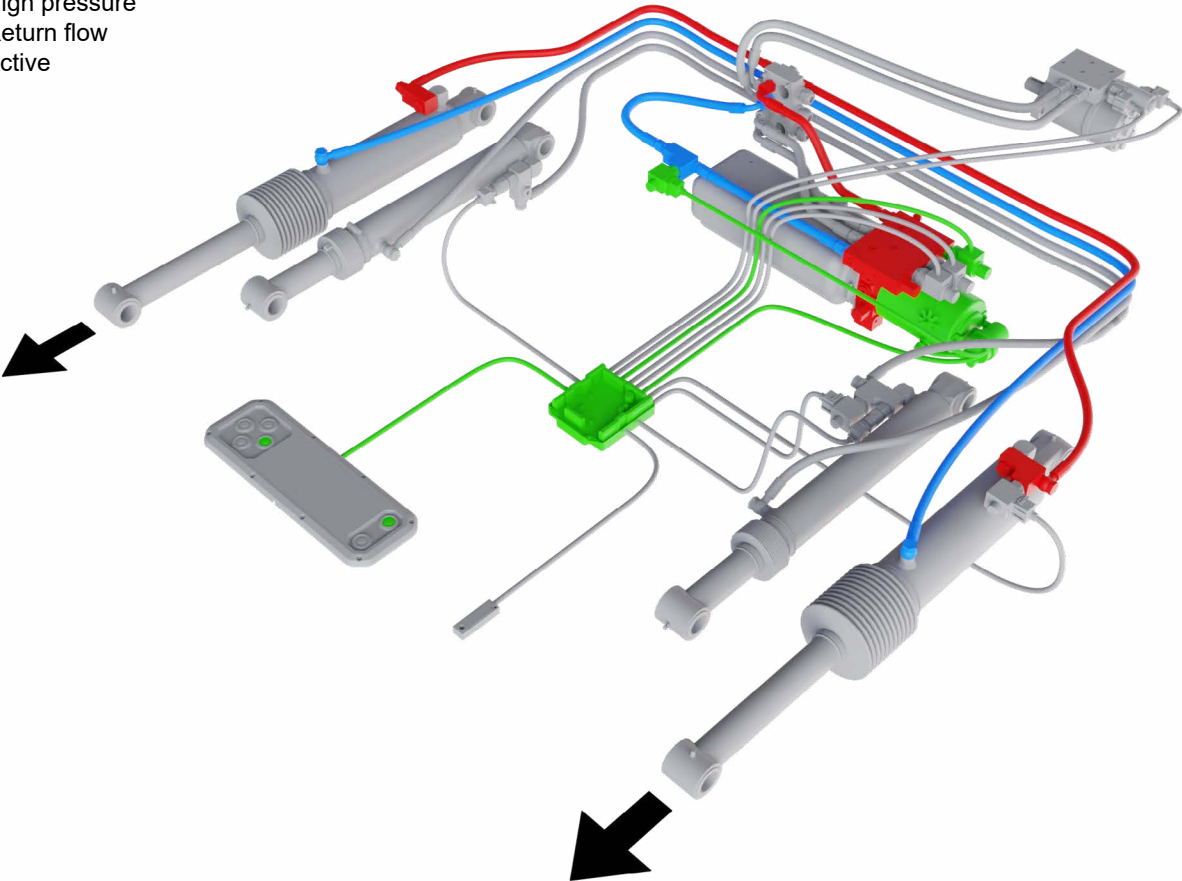


ZT MK2 with digital auto tilt

Function: manual tilt up

Description: Platform tilting up from horizontal.
Control input: Up + Tilt. Available on all control devices.
Sensor input: None apart from bridged S3.

- High pressure
- Return flow
- Active



Card indication:

Output status LED's

U0	
U1	
U2	
U3	
U4	
U5	
U6	
U7	
WL	
PWR	

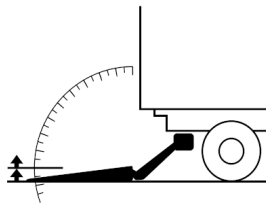
Output fuse

Input status LED's

	UP
	DOWN
	TILT
	2H
	IN
	OUT
	S5(+S1)
	S4
	S3
	S2

Input fuse

- Must be active for the function to be executed.
- Must be inactive for the function to be executed.
- May be active or inactive, the function will be executed either way.

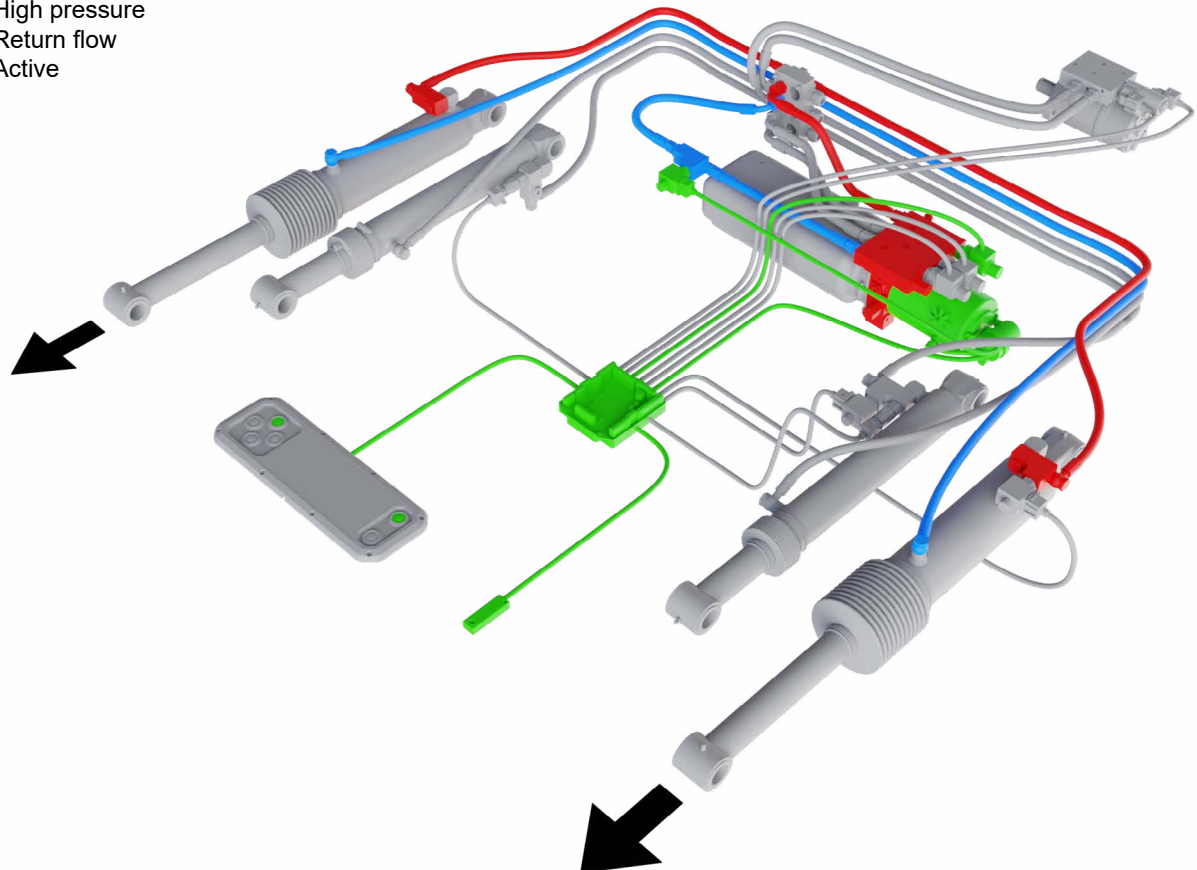


ZT MK2 with digital auto tilt

Function: auto tilt up

Description: Automatic tilting up until platform is horizontal.
 Control input: Up. Available on all control devices.
 Sensor input: Active S2 angle sensor, bridged S3.

■ High pressure
 ■ Return flow
 ■ Active



Card indication:

Output status LED's

U0	■
U1	□
U2	□
U3	■
U4	□
U5	□
U6	□
U7	□
WL	□
PWR	■

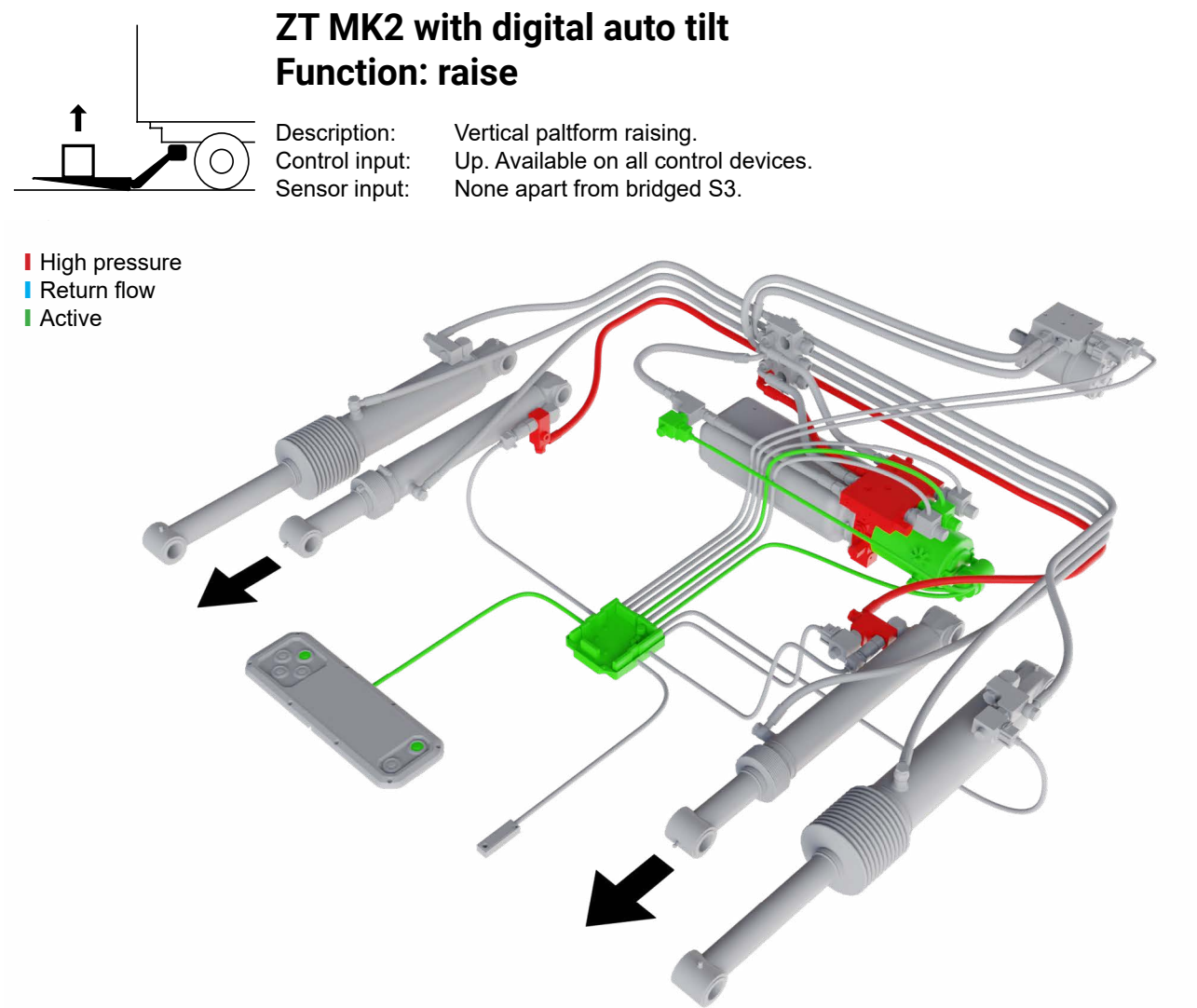
● Output fuse

Input status LED's

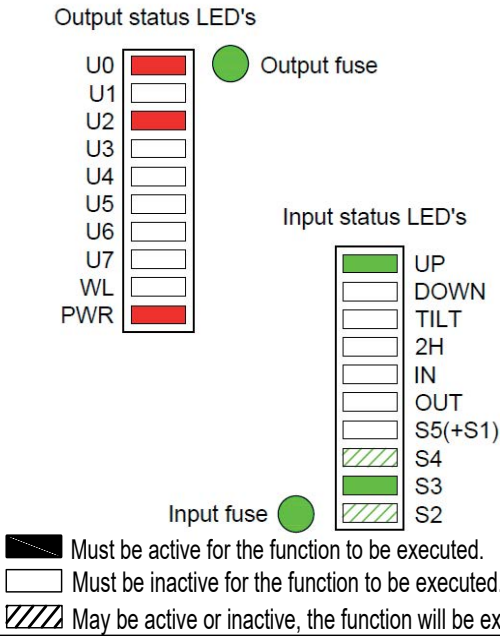
■	UP
□	DOWN
□	TILT
□	2H
□	IN
□	OUT
□	S5(+S1)
▨	S4
■	S3
■	S2

● Input fuse

- Must be active for the function to be executed.
- Must be inactive for the function to be executed.
- ▨ May be active or inactive, the function will be executed either way.

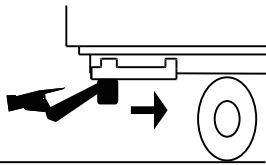


Card indication:



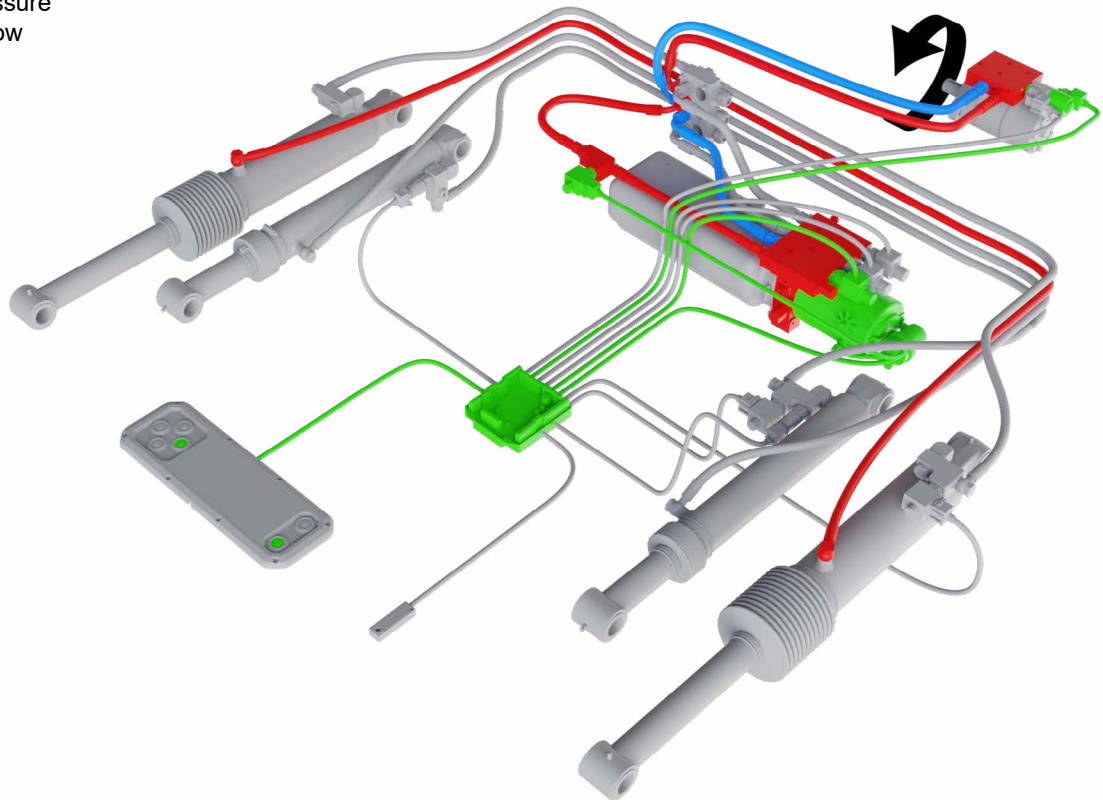
ZT MK2 with digital auto tilt

Function: slide in



Description: Slide in from transport to working position.
Control input: In. Available on primary control units only.
Sensor input: None apart from bridged S3.

■ High pressure
■ Return flow
■ Active



Card indication:

Output status LED's

U0	■
U1	■
U2	□
U3	□
U4	□
U5	□
U6	□
U7	■
WL	□
PWR	■

● Output fuse

Input status LED's

□	UP
□	DOWN
□	TILT
□	2H
■	IN
□	OUT
□	S5(+S1)
▨	S4
■	S3
▨	S2

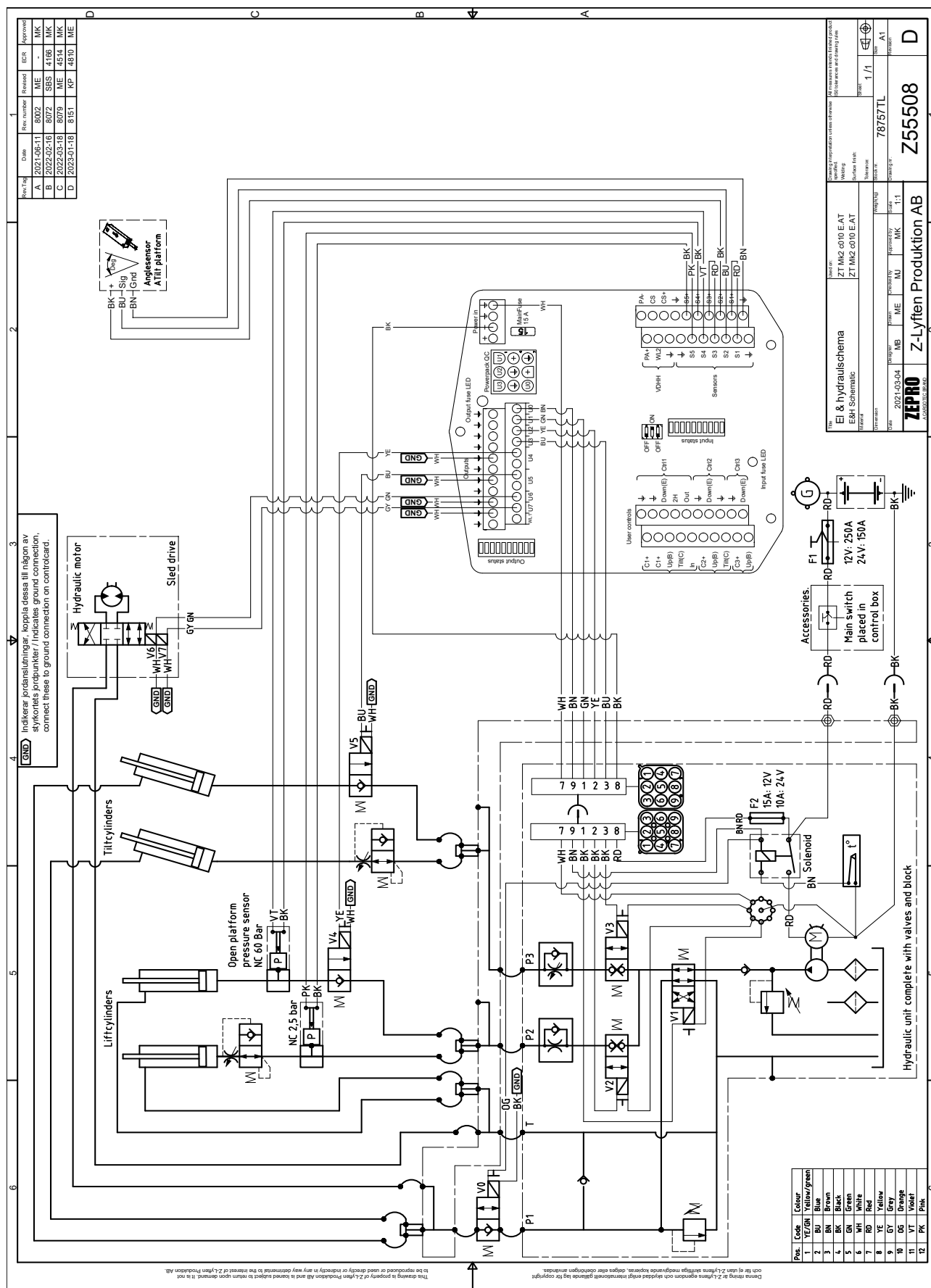
● Input fuse

■ Must be active for the function to be executed.
□ Must be inactive for the function to be executed.
▨ May be active or inactive, the function will be executed either way.

3.2.2 Summary of active valves ZT MK2

	Motor Soleonid	Valve 0	Valve 1	Valve 2	Valve 3	Safety Valve lift, V4	Safety Valve lift, V5	Slide out V6	Slide in V7
Slide out	✓	✓	✓					✓	
Lower			✓	✓		✓			
Auto tilt down			✓	✓	✓	✓			
Tilt Down	✓	✓	✓		✓		✓		
Tilt up	✓	✓			✓				
Auto tilt up		✓			✓				
Raise	✓	✓		✓					
Slide in	✓		✓						✓

3.2.3 Schematic ZT, TLC-B1



4 Troubleshooting

4.1 Causes of malfunctions

There are three categories of issues that can lead to a malfunctioning tail lift: electrical, hydraulic and mechanical. Electrical issues are fairly common and include but are not limited to damaged wiring, sensors, magnets and solenoids. Control card failures also fall in this category but are very rare in normal circumstances. Hydraulic issues include stuck or damaged valves and other oil flow obstructions or leaks within the hydraulic system. Mechanical issues include bent, seized or damaged structural components and are the least common of the three and the most easily detectable.

4.2 Troubleshooting strategy

Since the control card is a central part of the system and is responsible for turning the input signals into usable output signals which drive the desired function of the tail lift, it is the best starting point for the troubleshooting process. Following the steps listed below when troubleshooting is recommended.

Step 1: Control card power

Is the card powered on?

No: there is an issue with the power supply to the card. The fuse on the power cable to the card might be tripped or the wiring is damaged or disconnected.

Yes: the card is powered on, proceed to next step.

Step 2: Control device inputs

Is the card indicating the correct control device inputs as shown in the functional description?

No: there is an electrical issue with the control device or with the wiring between the device and the control card.

Yes: the card is receiving the correct inputs, proceed to next step.

Step 3: Sensor inputs

Is the card indicating the correct sensor inputs as shown in the functional description?

No: there is an electrical issue with a sensor or with the wiring between the sensor and the control card.

Yes: the card is receiving the correct inputs, proceed to next step.

Step 4: Outputs

Is the card indicating the correct outputs as shown in the functional description?

No: there is an issue with the control card. It might be damaged or of a wrong configuration.

Yes: the card is sending the correct output signals but there is

- a) an electrical issue such as a damaged magnet, solenoid, motor or damaged wiring to those components,
- b) a hydraulic issue such as a stuck valve, a leakage or an obstruction of the oil flow or
- c) a mechanical issue such as a stuck, bent or in other way damaged structure.

Note that the troubleshooting steps listed above require the tail lift to be powered on and the cabin switch (if present) to be in the "ON" position. If the tail lift is completely dead, use a multimeter to troubleshoot the power supply starting at the tail lift and moving towards the battery. Possible causes include but are not limited to a dead battery, a tripped fuse or disconnected or damaged power and/or ground cables.



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