



# W11E WHEEL LOADER OPERATION MANUAL



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## 1.2 General warning

### Foreword

These operating instructions apply to all users of the loader: company manager, department head, driver and other personnel associated with or working near the loader.

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### WARNING

1. Read this manual and follow the instructions in the manual before using the loader.
  2. Read the instructions on the loader carefully and keep the text legible.
  3. All operators must read this manual.
  4. All personnel qualified to use the loader can operate the loader in accordance with safe use regulations.
  5. When the machine is idle, do not let other people touch the machine.
  6. Do not use if the loader does not work properly.
  7. Do not use the loader for work that exceeds its maximum load or maximum capacity.
  8. Do not use the loader to perform work beyond its scope of use.
  9. Be familiar with the safe operating rules associated with using this loader and follow the rules exactly.
  10. The manufacturer assumes no responsibility for the consequences of dismantling or modifying the loader.
- 

### Obligation to read the manual

The company manager must familiarize the operator with the operating rules of the manual.

Read the entire chapter before attempting to operate the loader. It is the responsibility of the company manager to ensure that the operating rules in the manual are implemented. The operator must read and be familiar with the instruction manual so that it can be operated in accordance with the rules when starting and using the loader. This instruction manual should be kept intact during the life of the loader, even if the machine is resold, replaced by the user or manager, etc.

This manual is not a training manual, but it can also be used as one of the training materials if it is really necessary to train the operator.



### General instructions

The company manager must ensure that the operating manual (including the certificate of conformity issued by the European Community) is delivered with the loader.

- When the product leaves the factory, the manual will be included.
- The product certificate is sent along with the shipping order. Under the authority of the company manager, the trained personnel and the person with the relevant driver's license can operate the loader and the operation must not exceed the scope of the machine design. The loader must be operated in accordance with the conditions specified by the manufacturer in the operating manual. The manufacturer will not be liable for any personal injury, property damage and environmental pollution caused by failure to follow the procedures specified in the instruction manual. The manufacturer's responsibility is to match the assembly structure of the machine to the instructions in the certificate of conformity. Before each use, the driver should check that the machine is all right. It is forbidden to use the loader without checking the machine and without checking the warning decals.



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### **Loader normal use range**

W11E Electric Loader – Maximum allowable load and general conditions of use are included in this document. Do not use the loader to load anything other than the scope of use. This loader is suitable for use in the temperature range - 30 °C - 45 °C

Users should not ignore this rule: EUROTRAC is not responsible for all the dangers and injuries caused by this.

### **Loader modification**

The manufacturer does not assume any responsibility for the modification of the loader and the addition of accessories by equipment not manufactured by Eurotrac. The manufacturer assumes no responsibility for the consequences of the replacement or modification of the machine's features or other mechanical, electrical, hydraulic-related accessories or mechanically welded structures without the written consent of the manufacturer. If the customer needs to modify the machine, please consult the manufacturer. For your safety and your ability to benefit from all warranty terms of manufacture, use spare parts manufactured and warranted by the manufacturer.

### **Notice**

Safe operation is very important to your personal safety and economic efficiency, which means that we have a responsibility to promote safe operation knowledge. EUROTRAC has always regarded product safety as its responsibility, so we pay great attention to the safety of the loader when designing the loader for you.

Your job is to operate safely. The safety of you and others depends on your competent operations, especially on your understanding of the following brief safety rules and voluntary compliance.

### **Security Information**

This manual provides you with some important information to help you familiarize yourself with the safe operation and maintenance of the EUROTRAC loader. Even if you are familiar with the operation of a vehicle similar to a wheel loader, you must read and become familiar with this manual before operating this loader. Safe operation is everyone's responsibility and therefore your primary responsibility. Knowing the operating instructions in this manual will ensure the safety of you and the staff around you.

Safety is a very important part that affects the life of your loader. Read and study this manual before you operate, maintain or otherwise use this loader to know how to safely use the controls of the loader and the safety maintenance you must do. If you have any questions about the safe use or repair of the loader, ask your boss - don't guess - check often!

Remember that a careful driver will not only protect himself, but also protect his colleagues at work; at the same time he will avoid the danger of damaging the loader and cargo at work.

---

## 1.3 Information and operations

### 1.3.1 Standard configuration

Standard loaders have the following features:

1. Travel motor
2. Power Steering
3. Electromagnetic parking brake
4. Electronic shift control
5. Multi-function hydraulic control handle
6. Attachment quick change and locking mechanism
7. Adjustable shock seat (seat belt)
8. Lift arm / boom
9. Non-slip flooring
10. Combination LED headlights
11. Roll cage with sunshade cover
12. Direction indicator
13. Work light
14. Combination meter
15. Adjustable steering wheel
16. Double ball joint hinge
17. SME Controller
18. 51.1V 400Ah Lithium battery

### 1.3.2 Operator responsibility

You must read this chapter and thoroughly understand it, then operate or perform any maintenance on the device.



#### **WARNING**

Failure to observe the following safety precautions can result in serious injury or death, as well as equipment damage.

- 
1. Always follow global safety rules in your field.
  2. Always check for proper operation and lighting, brakes, steering, parking brakes, parking brakes and tires before using this loader.
  3. Do not operate the loader with defective features; refer to the operation and service manual of the maintenance section.
  4. Always wear suitable shoes when handling the device and avoid loose clothing that may get stuck in moving parts.
  5. Before use of the loader, fasten the seat belt and confirm that the lock is fastened.
  6. After the loader has completely stopped, place the gear in the neutral position. Before leaving the loader, turn off the power and pull out the key.
  7. Wait until the vehicle stops completely before the transition goes from forward to backward or from back to forward.
  8. Check the road after reversing.
  9. When loading materials, the speed should be reduced to 5KM/H.
  10. Raise the bucket to the transport position (minimum ground clearance greater than 20cm).
  11. Be extremely careful when in crowded areas and near blind roads and trucking. Be alert to other devices and people.

- 
12. Do not operate if the speed does not meet the operating conditions. Always limit the speed to ensure you have enough time to brake in an emergency.
  13. Do not use the loader to shovel dangerous goods.
  14. Before using this loader, the roll cage must be raised and the latch in the locked position.
  15. Do not allow any form of traction on the loader other than the towing hook.
  16. Do not perform repairs while the motor is running hot, as this can result in severe burns. Please perform maintenance after cooling.
  17. Do not attempt to touch the running motor and pump motor that is running or just stopped, otherwise it will cause severe burns.
  18. After the hood back cover is opened, make sure to not use clean water or other liquids since they can splash into the controller and the battery causing a short circuit.
  19. Do not use the battery of this car to start other vehicles.



**NOTE**

When the vehicle is tilted or rolled over, do not jump, but hold on tight to the steering wheel.

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**NOTE**

The roll cage damaged by rollover is not allowed to be repaired and reused unless it is authorized or approved by EUROTRAC.

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**NOTE**

The rated working load calibrated in this manual is based on the ground level of the machine. When operating on non-standard road surfaces (such as soft, uneven roads or on slopes), the effects of these factors on the load should be fully considered.

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### 1.3.3 Mechanical responsibility

You must read this chapter and thoroughly understand it before performing any maintenance on the device.

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#### WARNING

Failure to observe the following safety precautions can result in serious injury or death, as well as equipment damage.

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1. Always follow local safety regulations.
2. The operator must be familiar with the operation of the machine before using it.
3. Always keep your hands and feet away from rotating parts and tires, and wear safety uniforms.
4. Always wear the right shoes when handling or servicing equipment. Avoid wearing loose clothing, which may get stuck in moving parts.
5. Always ensure the cleanliness of the controller cooling fan.
6. Do not start the machine in an explosive environment.
7. Do not check gear oil when the motor is running.
8. Always disconnect the main power switch of the lithium battery when working on the travel motor.
9. If the lithium battery is overheated or abnormally discharged, do not attempt to perform repairs in private. Please contact a professional for repair.
10. Do not touch the oil pump motor and the travel motor when it is hot, otherwise it will cause severe burns.
11. Do not smoke near a lithium battery. Always keep the lithium battery away from sparks, flames and smoking.
12. Always remove the metal bracelet, watch strap, etc. before installing, removing or maintaining the lithium battery.
13. Do not allow short circuit lithium battery terminals.
14. When connecting a lithium battery, always connect the positive terminal first to prevent sparks.
15. Check all lights.
16. Check the reverse warning alarm.
17. Make sure the machine is in neutral when starting. Put the seat, handlebars and mirrors in the correct position before use.
18. Check tire and wheel conditions for proper inflation pressure. Excessive inflation can cause tires to explode.
19. Tighten the rim nut to a torque of 130 ft-lbs. Check the torque after 5 hours of operation.
20. Use appropriate lifting equipment when removing or replacing heavy parts.
21. When working under the loader, make sure that it is properly supported on the safety crane. Not completely dependent on hydraulic jack support loader.
22. If the loader is raised under a hydraulic or air lift, ensure that the loader has a secure support or fixed position before working under the loader.
23. When checking or repairing the drive system failure, jack up the drive wheel.
24. Do not smoke when injecting oil.
25. Do not use the lithium battery of this car to start other vehicles.

## 2. GENERAL INFORMATION & OPERATING INSTRUCTIONS

### 2.1 Main components

The W11E is a four-wheel drive mini loader. It contains:

- Hydraulic motor
- Travel motor
- Multi-function operating handle
- 12 volt electrical system
- 51.1V400Ah lithium battery

<b>Travel motor</b>	The loader is equipped with a powerful mobile motor that is certified by the manufacturer to meet the job requirements and environmental requirements for zero emissions.
<b>Drive axle</b>	The rear axle of the W11E is driven by the travel motor and then transmitted by the drive shaft to the front drive axle.
<b>Brake system</b>	This wheel loader brakes on the front axle and driving engine by pressing the brake pedal.
<b>Wheels and tires</b>	<p>The loader tires are pneumatic and are able to travel smoothly and effectively maximize traction. Remember to check the pressure on your pneumatic tires regularly.</p> <p>Unbalanced tire pressure will not only increase tire wear, but also reduce traction performance.</p> <p>W11E tire model: 26x12-12AS Tire pressure: 3.0bar</p>
<b>Electrical System</b>	The loader uses a 12 volt, automatic type, negative ground electrical system. The system includes a 51.1V400Ah lithium battery (see battery instruction manual for specific parameters), ignition switch, two headlights, amber flash, direction lights, taillights, speakers, various meters and other circuits.
<b>Quick disassembly device</b>	The attachment of the attachment is controlled by a multi-way valve for quick assembly and disassembly.
<b>Seat</b>	The seat of the loader is equipped with a seat belt and can be adjusted back and forth. The seat rating is EM8 (optional).
<b>Battery charger</b>	The loader is equipped with an integrated 220V battery charger with charging indicator. Max. loading time 6 hours
<b>Multi-function joystick</b>	The joystick is located to the right of the driver's position. As a standard, the switch on the device can control the gear position of the loader. There are 3 gear positions: forward gear, neutral gear and reverse gear, and reset button. The handle can also control two multi-way valves, so that lifting and tilting can be performed separately or in combination.
<b>Parking brake</b>	The electric driving motor is equipped with a parking brake drum. After the vehicle stops for a few seconds, the electronic control motor is powered off, and the brake is automatically locked.
<b>Pedal</b>	The accelerator pedal on the right side of the driver is connected to the controller via wires to control engine speed and thus control the speed of the loader The inching pedal on the left side of the driver is connected to the front axle brake drum via the brake hose to control the speed of the loader.

<b>Steering wheel</b>	The operation of the steering wheel is the same as usual, that is, when the steering wheel is rotated to the right, the loader turns to the right, and when the steering wheel rotates to the left, the loader turns to the left.
<b>Instrument panel</b>	Design control panel combined with the best driving comfort and efficiency.



**NOTE**

It is important that the operator adjusts the seating position and gets familiar with the controls before starting to work.



**NOTE**

The root mean square value of the vibration acceleration of the machine acting on the arm is less than 2.5m/s<sup>2</sup>.  
The root mean square value of the vibration acceleration of the machine acting on the whole body is less than 0.5m/s<sup>2</sup>.

<b>Switch</b>	
<b>Ignition switch</b>	Waterproof ignition switch for loader, including anti-restart function.
<b>Horn control switch</b>	Mounted on the underside of the instrument panel.
<b>Headlight switch</b>	Mounted on the underside of the instrument panel.
<b>Warning light switch</b>	Mounted on the underside of the instrument panel.
<b>Parking brake switch</b>	Mounted on the underside of the instrument panel.
<b>Turning signal switch</b>	Mounted on the left handle of the instrument panel.
<b>Far and near light switch</b>	Mounted on the left handle of the instrument panel.
<b>Wide light switch</b>	Mounted on the left handle of the instrument panel.



*SME Dashboard*

	Wheel loader travel speed (km/h)
	Hand brake switch. This indicator lights when the hand brake is pulled up.
	Safety seat switch. If the seat switch is not closed, the dashboard will display the seat icon. The seat switch does not pull in and the wheel loader cannot work until the seat switch is closed.
	Working hour meter (odometer).
	Steering angle showing the position of the rear wheel.
	Maintenance time prompt. Prompt the user to the maintenance time.
	Slow operation. This light is on, indicating that the vehicle is operating in the slow mode, and the speed and lifting speed are reduced.
	Accelerator pedal position (0 to 9 grids).
	Motor temperature overheat alarm.
	Battery power is indicated by 9 stripes: 9 = Fully charged 0 = Empty If the battery is completely discharged there is no stripe showed and the meter will display fault code 12. The battery must be charged when the display shows one stripe.

	<p>By pressing the E-S-H button, you can set the operating mode for your system (E-Economy, S-Middle Mode, H-High Mode)</p> <p><b>H-up mode:</b> At this time, the acceleration, deceleration rate and maximum grade of the vehicle are higher. It is suitable for transporting a large amount of cargo and climbing a steep slope in a short time, but it costs electricity, unless it is urgently needed, it usually does not work in this mode.</p> <p><b>S-mid-range mode:</b> Each indicator is slightly lower than the high-end mode.</p> <p><b>E-Economy:</b> All parameters are optimized, power saving, it is recommended to work in this mode.</p>
	<ol style="list-style-type: none"> <li>1. When the key switch is activated, press the enter button for 3 seconds to enter the adjustment and diagnosis mode.</li> <li>2. During the operation, press for 3 seconds to enter the diagnostic mode.</li> <li>3. If you press enter once in the diagnostic mode, you can exit, and the enter key is usually used as the new parameter value.</li> </ol>
	<ol style="list-style-type: none"> <li>1. Press this button to decrease the parameter value in the adjustment or diagnosis mode.</li> <li>2. In the adjustment state, the display parameter value can be reduced.</li> <li>3. Press the button for 1 second to display the mileage or weight.</li> </ol> <p>Note: The up button is the same as the down button. Some functions of the enter button and the up and down buttons are not activated.</p>

There are four LED indications on the left side of the instrument cluster. When the switch is operated, the corresponding indicator will be displayed:

	<p>Warning sign: LED shows red</p>
	<p>Light identification: LED display green</p>
	<p>The steering switch is turned on, the turn signal indicator is activated, and the LED flashes green.</p>
	<p>Brake fluid low: LED red alarm (optional)</p>

#### Instrument working process and instructions for use:

1. Turn on the key switch; the dashboard is switched on, some initial digital mode will be displayed for 3 seconds. The dashboard states the speed indication content, the power indicator, the steering angle indication, the hand brake indication, the seat switch indication, the E/S/H selection indication, the working time, and the like. These pattern data will help confirm the vehicle's working status.
2. The top of the left row of the LCD screen is the fault indication. When this indicator is on, the following three working states are displayed:
  - Display normal operation (lights when the system switch is on or off).
  - The meter is not connected to the control box (the indicator lights up after the connection stops for 3 seconds).
  - The meter is not working (the indicator is on).

When the vehicle is working normally, there is no fault code and the fault light is off.
3. When the direction indicator is turned forward and backward, the left and right turn mark lights flash, and when the headlights are turned on, the light indicator lights.

- 
4. Brake display. When the parking brake is used, the graphic [P] light is on; when the parking brake is released, the marker light is off.
- 



#### NOTE

When the power indicator only shows one dash, it must be charged to extend the battery life.

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#### Working environment:

1. The altitude does not exceed 1200 meters.
2. Working environment temperature -25 °C ~ +40 °C.
3. The maximum relative humidity is not more than 95%.

#### Precautions:

1. The dashboard is prohibited from water dripping. When the user washes the vehicle, be careful not to spray or sprinkle water onto the inside of the instrument. If water is accidentally drenched onto the surface of the instrument, immediately wipe it off with a dry cloth.
2. Do not plug or unplug the dashboard and the harness frequently to avoid loose contact.
3. It is forbidden to strongly impact and scratch the instrument.
4. If the instrument is not working properly, please contact the company in time for maintenance.

#### BEFORE DRIVING

- Be sure that all driving parts are in good working condition and fill all the fluid levels if necessary. Any defect or failure has to be repaired before use.
  - Set parking brake
  - Walk around and inspect the loader for damage or missing equipment  
Check for:
    - Pressure and the good state of the pneumatic tires
    - Look for cuts, cracks in side walls, foreign objects in treads
    - Look for loose wheel nuts - Damage to lights
    - Fire extinguishers fully loaded and in place (if have)
  - Check to see if hydraulic or lubricating oil is leaking. If leaks are detected, they must be repaired as soon as possible.
  - Check the amount of fluid in the hydraulic tank to make sure there is enough hydraulic oil. If there is a very low liquid level display, there is a serious leak in the system and it should be repaired as soon as possible.
  - Check the power cabin for loose components, loose wires or equipment leaks.
  - When all mechanical checks are completed, check that the stop lights and rear lights and dashboard lights are working properly.
  - Check the electricity meter to make sure the lithium battery power is sufficient.
  - Make sure the roll cage is raised and locked firmly.
  - Check if the driver's seat is damaged (replace the damaged one) and adjust the driver's seat according to your needs.
  - Check all operations in the work order.
- 



#### NOTE

The battery life will be damaged if the battery is undercharged. The battery should be charged after daily work to ensure that the battery is fully charged.

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## DRIVING INSTRUCTION

- Place shift lever in park.
- Adjust the driver seat and steering wheel to the comfortable location, fasten the seat belt.
- Make sure parking brake is set.
- Verify that nobody and nothing is ahead of you BEFORE starting any motion of the wheel loader.
- Turn on the main power switch located at the left side, behind the seat. Turn this for 3 seconds to the left till the green light turns on (see picture).
- Turn on the ignition switch on the side of the dashboard.
- Release the handbrake by pressing the button on the dashboard.
- Move the transmission shift lever into the required position, Forward or Reverse.
- Press the acceleration pedal slowly with your feet. The wheel loader will move to the selected direction.
- To slow the wheel loader, slowly release the accelerator pedal and press the left brake pedal. For an emergency stop, release the accelerator pedal and press brake pedal. By releasing the accelerator pedal slowly or quickly, the wheel loader can be controlled by flat or sharp braking. Press the left-pedal when emergency brakes.



## NOTE

The main power switch will turn off automatically when there is nobody on the driver seat for longer than 60 seconds.

## CHARGING THE BATTERY

The Eurotrac W11-E comes standard with a built-in 220V battery charger. With the supplied cord it is easy to connect to the machine and charge via a 220V connection. The status of the battery can be easily seen on the load indicator.

**Red** = less than 80% | **Yellow** = 80% | **Green** = 100% loaded | **Max loading time** = 6 hours



**WARNING**

The maximum duration of control for an operator should not exceed 6h per day.

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**WARNING**

Match driving speeds to loads being towed and weather conditions. Slow down when towing heavy loads and when road surface is wet or icy, especially on grades.

---

**WARNING**

When loading the goods, the speed should be lowered to 5km/h and the bucket should be raised to the transportational position (about 20cm from the ground).

---

**WARNING**

In the course of ramping on the road (uphill) for the temporary parking, drivers are not allowed to leave the driver's seat and change gear switch. Right foot should press the micro-pedal gently to remove any slipping phenomenon due to technical reasons. At the same time pull up hand brake. Downhill for the temporary parking. Drivers are not allowed to leave the driver's seat and switch to a reverse gear shift, right foot should press the micro-pedal gently and park slowly, at the same time pull up hand brake.

---

**WARNING**

Parking on the ramp is not allowed. If necessary the car should be parked on a slope (due to breakdowns), you must pull hand brakes and pad the wedge under wheels of the loader.

---

**WARNING**

Make sure the roll cage arises and fixed before driving, it can't protect the driver if the roll cage don't arise or fixed insecure.

---

**LOADING INSTRUCTION**

- Lift devices and attachments (bucket is standard) are only used for a specified purpose.
- Ensure the wheel loader is secure and is within the rated drawbar pull of the loader (See "General preventive measures").
- Ensure the rapid removal device in a locked position before filling.
- When driving with a load, the speed should be reduced to 5 km/h.

- 
- When driving with a load, the bucket should be raised to the transformational position (about 20cm from the ground).
  - When driving on the ramp, goods shall be towards the uphill direction. U-turns and parallel driving on ramps must be avoided.
  - Only operate the machine when having clear and unobstructed view.
  - When uninstalling, raise the bucket to an appropriate height, as carefully as you can accurately to drive the wheel loader to the truck or the place for goods storage; Carefully control the master control lever, uninstall, reset; Confirming that the bucket and the truck (shelf) is completely separated, the loader moves slowly back to leave the shelf.
  - When reaching the parking spot, shift it into neutral position, raise the parking brake, and turn off the ignition switch.
- 



#### NOTE

Safe and efficient loading, depends entirely on the operator. If you are an experienced driver, the following rules will refresh your memory. If you are a student, they will help you to become a professional driver.

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#### WARNING

Only qualified and licensed drivers allowed to drive.

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#### WARNING

Before starting loading, please make sure the cylinder of the quick removal device is in the locking position, set the locking tools, and cut the two-way ball valve off.

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#### WARNING

When driving on the ramp (forward or backward), goods shall be towards the uphill direction. Driving or u-turn ramping on the horizontal should be avoided.

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#### WARNING

When the goods are in a lifting state, do not leave the loader.

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#### WARNING

When the goods are in a lifting state, the loader can not turn around and can not run at high speed.

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## 2.1.1 Joystick for lifting frame

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### WARNING

Accident hazard due to wheel loader tipping! Keep the lifting frame lowered during transport.

Accident hazard due to uncontrolled lifting frame movement!

Only operate the lifting frame and attachment from the driver's seat!

Always work calmly and cautiously. Hectic and rapid operation leads to accidents.

Always lower the lifting frame during interruptions and at the end of the shift.

---

Lifting frame movements are controlled by the joystick. The joystick is located to the right of the driver's seat.

#### Lifting frame

- Move the joystick backwards: the lifting frame rises.
- Move the joystick forwards: the lifting frame lowers.
- Move the joystick 2 step forwards: the lifting frame is now in the floating position (optional extra).

#### Attachment

- Move the joystick left: the attachment tips inwards.
- Move the joystick right: the attachment tips outwards.



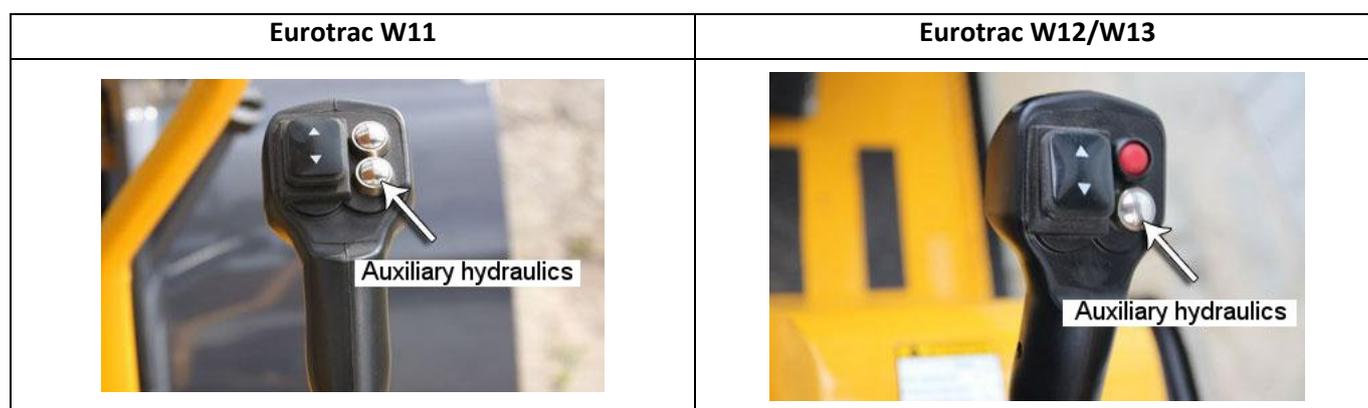
## 2.1.2 Joystick for auxiliary hydraulics



### WARNING

Hazard due to hydraulic system overheating! Ensure that the auxiliary hydraulics joystick is always in the "zero position" when the auxiliary hydraulics are not required. Lock the auxiliary hydraulics joystick when it is not required. (To do this, press the joystick down firmly until it locks into place. To unlock, you must pull the joystick back up firmly.) Avoid soiling. Ensure that the hydraulic connections are clean!

The additional hydraulics on the front arm: press the auxiliary hydraulics button and move the joystick to the left and right. The auxiliary hydraulics can be very precisely controlled. Take care to use the joystick carefully.



- Push the joystick to the left (and simultaneously press the auxiliary hydraulics button):  
The left connection is the pressure side, the right is the return.
- Push the joystick to the right (and simultaneously press the auxiliary hydraulics button):  
The right connection is the pressure side, the left is the return.

This may vary from model to model. Please always check this before using the wheel loader with optional equipment.

### Auxiliary hydraulics

This can be operated using an additional lever with switching valve. Let yourself be instructed by qualified personnel and complete this manual here.

### Replace attachment

1. Push the small handle of multi-way valve to the left to retract the locking lever.
2. Lower the working device and tilt it forward to the appropriate position.
3. Connect the hook in the attachment.
4. Hoist and tilt working device.
5. Push the small handle of the multi-way valve to the right to make the locking lever extend and insert the mounting hole under the fitting.
6. The two three-way valve rotates 90°, cut off the lock cylinder oil.

---

## Remove the attachment

The step is reversing as changing attachment step.



### WARNING

Lifting devices and tools are only used for a specified purpose. Drivers must comply with the correctly and use the lifting devices and tools. Do not enter or reach into the space between the arm and the frame.

---



### WARNING

Before the operation of hydraulic systems, check if the functions of the various hydraulic joysticks are correct.

---



### WARNING

Before disassemble the pipe of attachment, should release the rest pressure of this pipe, then disassemble the quick change connector. The detailed method of release rest pressure is: swing the first valve handle (small handle) of multi-valve left and right side several times.

---



### WARNING

Even if the engine flameout can also lower the lifting devices and tools.

---



### WARNING

If the tool is not delivered together with the loader, it can be only used after the authoritarian of stability and load capacity by the dealer of EUROTRAC.

---

## General preventive measures

- Do not operate any levers or pedals if anyone is in any position to be hurt by the machine's movement.
- Pay extra attention when working in narrow congested areas or in case of blind travel.
- Always look around in all directions BEFORE changing your direction of travel.
- Always follow all safety rules or each particular site during operation.
- Maintain a running speed which is compatible with the load and the ground conditions.

- 
- Slow down when approaching corners
  - Observe pedestrians carefully and do not follow the vehicle in front too closely.
  - Do not brake sharply and only select neutral once the loader has effectively stopped.
  - Maintain a safe distance from the edge of loading wharf.
  - When turning, pay close attention to the trajectory of the buckets.
  - Make sure that bridges and ramps are able to withstand the weight of the loader and the load being towed.
  - Before climbing or descending from vehicles (trucks, trails etc), ensure that the adequate precautions are been taken to avoid all movements including the dumping.
  - Stop, look at and listen when arriving to a rail way then to cross it in diagonal, slowly and only to the authorized points.
  - Always park at more than 2,5m of the rails.
  - Hold the wheel steering in hand during the operation.
  - When loading a larger load, more space for the overtaking of parked vehicles, objects or pedestrians should be predicted.
  - Never overtake another vehicle on crossroad or on bifurcations or when something affects the visibility for you.
  - Never drive in elevators, truck or other until you have received the order and you are sure that they can stand the combined weight of loader and the load.
  - Doesn't brake roughly.
  - Pay attention to the driving speed and be careful to the pedestrians approaching and other vehicles and to the passage heights.
  - Slow down on wet, irregular grounds and in the turning.
  - Remove all objects in your way.
  - On the crossroad, in the passages and the corridors, slow down and horn and drive on the right side of the road.
  - Be careful to the pedestrians which can appear suddenly in the way.
  - If your trip involves crossing road bridge, ensure they are secure and are strong enough to withstand the combined weight of the loader and load.
  - When approaching the destination, reduce the speed to ensure a smoothly slow stop in the far enough distance. A sudden halt could cause the load displacement.
  - In the event of an emergency, first place the load on the ground before you proceed with further action.
  - Report any mechanical or electrical irregularities immediately.
  - Always be alert; Watch out for pedestrians and never drive too close to the vehicles in front.
  - Travel at a speed consistent with load and road conditions.
  - Never operate the loader with any part of your body outside of the operator's compartment.
  - DO NOT leave the driver's cab with the loader running.
  - ALWAYS properly shut down the loader before leaving the loader.
  - ALWAYS park the loader on solid, level ground.

#### On severe slopes

- ALWAYS park the loader perpendicular to the steepest slope to prevent accidental movement.
- Use proper flags, warning marks or barriers when parking in areas of traffic.
- Do not park your vehicle in the access points where obstruct the fire brigade.
- During parking, use the parking brake and put the key on the STOP position.
- If the tractor must leave with nobody watching it, remove the ignition key.
- Never park your vehicle on a slope.
- If it is necessary to park tractor on a slope (break down etc), use the wedge under the wheels of loader.
- Do not drive while the rear cover is open.
- Don't make dangerous modifications to lithium batteries.



## WARNING

If problems or equipment malfunctions occur while operating the loader, it must be properly to shut down and correct the problem.

Continuing to use malfunctioning equipment can not only be unsafe for the operator and other personnel, but can lead to further damage to the loader as well.



## WARNING

In case of an accident, report to your superior immediately. Never neglect an injury even if it appears insignificant, go immediately to the doctor, which could avoid complications.

AREA	RISK	SAFETY STEPS
CAUSES OF FAILURE	WHAT CAN HAPPEN IF PRECAUTIONS AND SAFEGUARDS ARE NOT OBEYED	HOW TO PREVENT THE FAILURE
ENTIRE MACHINE	A moving wheel loader can run over or crush body parts between tractor and other object and cause irreparable injury or death.	Keep away all people from around tractor and always switch off the engine before leaving the driver's cab.
DRIVING STATION	Personnel injuries may happen if parts of the body or members (hands, legs, etc.) are outside of the driver's cab.	Keep head, arms, hands, legs and feet inside the operator's compartment all the time.
UNDERNEATH DURING SERVICE	Unit lifted for service could fall and injure or kill personnel around.	If loader must be lifted for service, it must be securely blocked so that all 4 (four) wheels may safely turn.
MOTOR	Hot (motors) will cause severe burns and cause serious injuries if persons are struck by moving parts or caught in belts.	DURING SERVICE: Turn off the main power. If maintenance operation requires starting motor, personnel should avoid contact with rotating equipment. Disconnect the lithium battery power supply to prevent accidental startup. Be careful to avoid hot surfaces.
LITHIUM BATTERIES	Lithium batteries can explode when dangerous operations such as welding and drilling. Contact with a battery socket or all unprotected electronic parts (or when removed) can result in an electrical shock.	Lithium batteries should be well ventilated before use, especially when welding near them. When operating a lithium battery, wear protective clothing, protective gloves and protective glasses. Avoid removing plastics and avoid contact with electrical parts.
ROLLING OR ROLLING OVER OF VEHICLE	When a vehicle rolls or rolls over, do not jump off, as the loader is installed with a safety roll cage. Jumping of may lead to the drivers death.	At this point your hands should hold the steering wheel, and feet hold the mounting brackets.
TIRE	Welding near the tire may damage the tire or lead the lead an explosion and bring damages or dangers for people.	If welding has to be done on the wheel or near the wheel, remove the tire first.

- 
- To avoid loaders accidental movement, put some wedge blocks under tires when provide services and maintenance vehicles.
  - Always stop the engine when working after the wheels.
  - Don't try to repair the machine by yourself if you haven't been approved by EUROTRAC.
  - Don't carry out any modification that is not showed in the section 3. "MAINTENANCE PARTS" of this manual.
  - EUROTRAC is not responsible in case of any modification, addition or combination with equipment from another origin, which maybe cause danger.
  - Don't change the structure and performance of vehicle when EUROTRAC is not informed.

### **Electrical equipment**

- Do not change the electronic- or hydraulic factory settings to prevent short circuit when working in the electrical system disconnecting the battery; similarly, it also can to prevent unexpected start-up when the engine is working.
- Do not check battery status near open fires, especially when lithium batteries are recharged.
- Do not smoke in the lithium battery charging area.
- No unauthorized disassembly by non-professional personnel.
- Do not tamper with the battery.
- Do not use wires to directly short circuit the outlet of the battery pack.
- The charging and discharging shall not exceed the maximum current specified in the technical parameters.
- Keep the battery away from the hot heat source.
- Avoid charging in direct sunlight.
- Do not keep the battery in a damp place or in water.
- Do not force the battery or make it fall from high altitude.

### **Welding**

Before any arc welding operation on the loader, the operation is as follows:

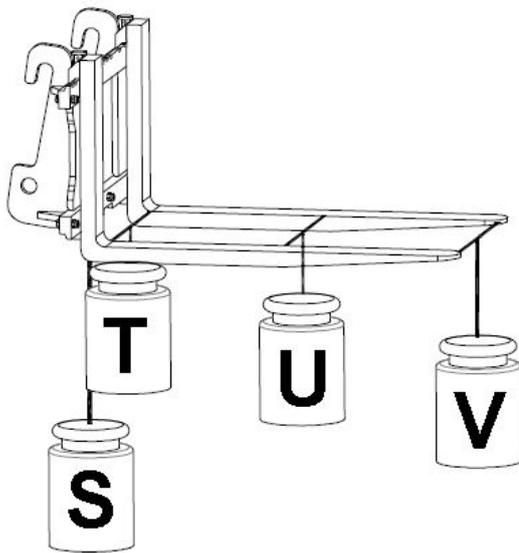
1. Disconnect the battery.
2. Disconnect electronic control system and electrical equipment.
3. Place the ground clamp where the soldering is done as close to the ground as possible.

## 2.2 Specifications and performance

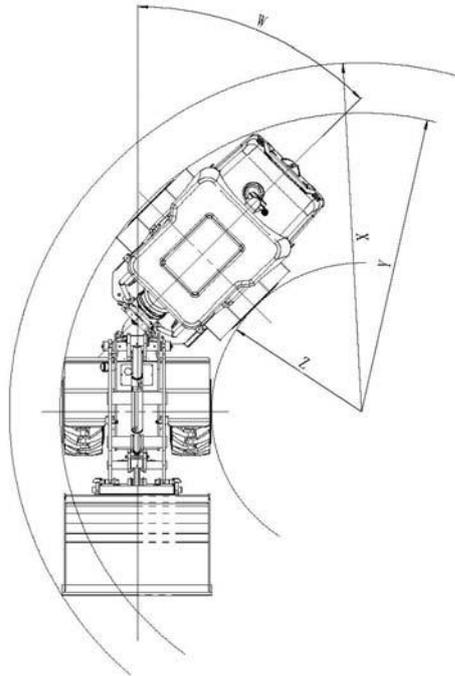
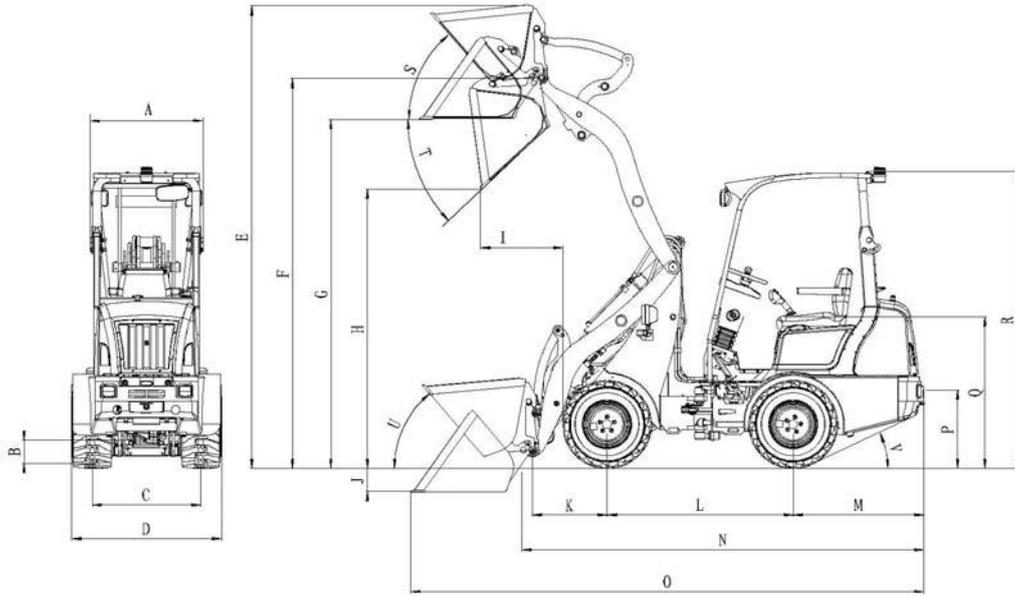
TECHNICAL PERFORMANCE PARAMETER		
Type of loader		W11E
Motor parameters		
Manufacturers		
Motor model		
Maximum power		11Kw- 48V
Electrical systems		SME Controller
Operating voltage		12V
Battery capacity		60V/400Ah (19.2KwH)
Battery type		Dry Lithium
Self-weight (with standard bucket)		2300
Rated load (0.2m <sup>3</sup> bucket) (kg)		650
Maximum lifting force (DaN)		1100
Cargo bucket overturning Load (ginseng ISO8313)		
Vehicle Straight line (kg)		1250
Vehicle articulated (kg)		900
Vehicle parameters		
Walking speed (km/h)		0-14
Hydraulic Oil (L)		30
Hydraulic system		
Hydraulic working elements		
Working pressure (BAR)		170
Dimensions (mm)		
A	Protection device width	950
B	Off-ground clearance	178
C	Tire Center Width	803
D	Total width	1104
E	Maximum operating height	3480
F	Maximum height of bucket fulcrum	2900
G	Bucket horizontal height	2649
H	Tipping height	2228
I	Tilting working distance (tilting state)	690
J	Shovel depth	120
K	To the center of the lifting pin of the bucket	550
L	Axle distance	1476
M	Rear overhang	923
N	Without bucket overall length	2950
O	With bucket overall length	3815
Q	Seat height	1208

TECHNICAL PERFORMANCE PARAMETER		
R	To protect device top height	2268
S	Angle of max lifting height	48°
T	Max tilting angle	45°
U	Turning corner of level position surface	48°
V	Departure angle	23°
W	Turning corner	45°
X	Maximum turning radius	2530
Y	Out edge radius	2220
Z	Inner turn radius	1110

Load center distance = 400, load capacity of W11E cargo fork:



	W11E
S	860kg
T	800kg
U	600kg
V	480kg



---

## 2.3 Transport procedures

### Hiking up

In the position marked with the lifting mark, use a reliable cable lifting loader.

### Lithium battery

Switch off the connector of lithium battery.  
Leave the lithium battery in battery box.

### Check

Make sure the main power switch is disconnected.

### Fixing

Tighten the front and rear frame with a locking plate.  
Use a strong rope at the vehicle bundling point and take care not to damage the paint surface.  
Tighten the front and rear wheels with wedge blocks.

## 2.4 Trailer procedure

When the loader needs rescue, only the short haul of the loader is allowed, but the following steps should be followed before dragging the loader.



### WARNING

Draught loaders are no longer capable of braking and steering.

---

### Trailer steps

- Place the shim (wedge) at the slip side behind the wheel.
- Discharge cargo and equipments.
- Start the tractor
- The tractor (which has sufficient traction and braking force) is connected to the towing pin (which must be strong and fixed reliably) at the counterweight at the rear of the loader through a rigid traction bar.

### After the trailer

Wedge a block against the sliding edge of the wheel.

**The brake function of the loader should be checked after maintenance.**



### NOTE

The towing point when being towed is at the rear counterweight. The maximum force allowed for these points is 20KN.

---



## NOTE

This machine can be used for short-distance dragging unpowered trailers:

1. The traction device is located at the trailing part of the rear of the counterweight.
2. The maximum traction of the W11E is about 7.5KN.
3. Maximum traction speed  $\leq 5$ km / h.
4. Only allowed to be pulled by rigid drawbar.
5. Not for long distance traction.

## 2.5 Stored procedures

	Once a month	Indefinite duration
<b>Travel motor</b>	No special attention is required.	Remove the motor and cover it with protection.
<b>Drive axle</b>	No special attention is required.	By removing the drain plug under the differential housing to drain the drive shaft, the plug is reloaded after it is finished.
<b>Tire</b>	The loader must be raised or the axles are padded to prevent the tires from coming into contact with the ground. The tire pressure must be reduced to 15PSI.	The loader must be raised and the axle is padded to prevent the tire from contacting the ground. The tire pressure must be reduced to 15PSI and sprayed with rubber preservatives.
<b>Lubricating oil</b>	Make sure all the points are lubricated with special oil.	Make sure all the points are lubricated with special oil.
<b>Liquid</b>	All levels must be checked and filled if necessary.	Drain all the liquid.
<b>Wheel bearing</b>	Wheel bearings must be repackaged.	Wheel bearings must be repackaged.
<b>Lithium battery</b>	Disconnect the lithium battery terminal.	Lithium batteries must be removed and stored separately. Lithium batteries must be stored in a cool, dry place and must not be exposed to direct sunlight. If a lithium battery is stored in an open area, it must be covered to protect it from contaminants and moisture. Lithium-ion batteries must be recharged slowly every one or two months.

### Note:

1. The ambient temperature range of this loader is  $-30^{\circ}\text{C}$ - $50^{\circ}\text{C}$
2. Long-term storage may damage the gaskets in the hydraulic system.

---

## 3. MAINTENANCE PARTS

### 3.1 General description

By definition, preventive maintenance, including regular maintenance and inspection operations, is to prevent failures. Preventive maintenance operations allow the operator to detect wear or deterioration on the equipment early.

### 3.2 General cleaning instructions

When thoroughly cleaning the loader, use normal methods (do not use high pressure cleaning) to avoid wearing electrical equipment, safety equipment, trademarks and labels. When cleaning electrical components, it is recommended to blow dry air with a maximum pressure of 29 PSI. When cleaning mechanical parts, first clean the oil with a degreasing product and then dry it with dry air. Lithium batteries must be protected from chemical reactions and severe damage to current branches.



#### WARNING

Solutions may affect the skin, eyes and respiratory tract. Use only in well ventilated areas. Avoid breathing under water vapor for a long time. Keep away from sparks and flames. To avoid possible personal injury, do not perform cleaning and drying steps with more than 30 PSI air pressure. Use eye protection and defense and approve air hose nozzles.



#### WARNING

Before removing the hydraulic hose, the filler cap must be loosened and the residual pressure in the tank must be released.



#### CAUTION

Do not immerse electronic components, packaging, or rubber, plastic, or plastic parts in a cleaning solvent. Wipe the parts with a clean cloth. Cleaning solvents can affect materials and cause serious damage or damage to parts.

- 
- Wash parts in a tank that specializes in cleaning parts or spray the cleaning agent on the surface of the part.
  - Rinse or spray to clean the parts. If necessary, brush with a non-metallic brush.
  - Except the bearings, dry the parts with compressed air after cleaning.
  - Do not use metal scrapers, wire brushes, grinding wheels, or abrasive compounds when cleaning parts unless there are special requirements for maintenance procedures.
  - Clean electronic parts such as relays or switches with a cloth dampened with cleaning solvent.
  - Clean the heat exchanger with a steam cleaner or a pressure washer and soap. Do not use the aluminum or copper cleaner that will affect it.
  - Clean the outer surface of the battery with a weak solution of soda and water.

- Use a non-metallic brush to remove corrosion from the lithium battery cable terminals.
- Use 1/4 pound of soap to add a gallon of water to clean the painted surface of the vehicle.
- Clean with clean water and dry with linen or air.

#### First maintenance program

- First time maintenance must be performed between 10 and 125 hours of operation.
- For motor maintenance, see the motor operating manual (this unit comes with the motor operating manual).
- Check for oil leaks and correct if necessary.
- Check hoses and connections and check the wires.
- Check the rim nut torque after 10 hours of operation, also for more than 50 hours and check the rim nut torque after each wheel change.

## 3.3 Service

### 3.3.1 Preparation for use

<b>Lithium battery</b>	Connect the lithium battery cable. If it is disconnected, connect the positive pole first. Make sure the lithium battery is fully charged.
<b>Brake system</b>	Check if the brake fluid leaks. Slowly start the vehicle, release the throttle, and step on the jog pedal to check the brake effect.
<b>Travel motor</b>	Check that the travel motor is operating normally. Check the line connection.
<b>Rear axle and reducer</b>	Check the axle oil level and refuel if necessary.
<b>Tire Air Refill</b>	Check the tire air pressure and inflate if necessary. After removing the wheel, it is recommended to tighten the nut: 2 hours, 50 hours, every 200 hours. Recommended wheel nut tightening: 372N.m Recommended wheel pressure W11E: 3.0Bar
<b>Hydraulic oil</b>	Check the hydraulic tank level and the lowest level is indicated on the filter at the filler.



#### WARNING

Due to pressure in the hydraulic tank, loosen the filler cap and slowly release the pressure before opening.

#### Grease points

Add in each grease point

1. All joint bearings
2. All hinges
3. All bushings

### 3.3.2 Regular maintenance form

The loader must be maintained according to the following table

	Daily inspection	Weekly or every 50 hours	Monthly or every 200 hours	Every two months or every 400 hours	Every six months or every 1200 hours	Every year or every 2400 hours
Lithium battery capacity	x					
- 3.0/5.2BAR tire pressure	x					
Tire tread, check Remove foreign objects such as stones in gaps	x					
Adjust headlights, aim correctly	x					
Work light, tail light, double jump light, work light and turn signal operation	x					
Cab sign lights, heaters, wiper operation and cab lights (if installed)	x					
Horn	x					
Hydraulic oil level		x				
372N.M (*) Wheel nut fastening		x				
Drive axle fixing bolts, tighten when needed		x				
Tighten the cylinder head bolts and all nuts and bolts. Adjust the specific torque to the specific requirements if necessary.		x				
Drive axle oil level		x				
Replace the axle oil (replace the oil after 50 hours for the first time; then replace it once a year)		x				
Hydraulic oil		x				
Hydraulic suction oil filter			x			
Parking brake			x			
Handbrake on the engine has to be adjusted when the power is off.			x			
Hydraulic oil			x			
Driver seat adjuster			x			
Pedal point			x			
Oil all greasing points			x			
Cab door lock (if installed)			x			
Check motor idle speed and speed, adjust if necessary				x		
Replace the brake pads of the parking brake				x		
The hydraulic oil in the hydraulic system drains out, cleans the system and refills the new hydraulic oil.						x
Drive axle gear oil replacement.						x

(\*): The tire nut must be re-adjusted to the position: 372N.M. After each replacement of the wheel, and at any time the nut has been loose, and maintenance is required at this specified time interval.

---

Proper regular maintenance will allow the operator to avoid any mechanical failure. Pay attention to the frequency of the lubricating oil.

### **Lithium battery inspection and replacement**

Use and maintain the battery according to the Lithium Ion Power Battery Installation Operation and Maintenance Manual provided by the lithium battery manufacturer.

#### **Replace the lithium battery**

1. Place the loader in a safe and open horizontal position.
2. Disconnect the main power switch.
3. Use a wooden wedge on the front and rear wheels to prevent the vehicle from moving when replacing the battery.
4. Remove the rear bonnet, rear frame cover, traction seat assembly, battery fixing plate, remove the lithium battery lever and disconnect all the connectors with the lithium battery and affect the lithium battery replacement circuit.
5. Use a forklift and a special guide to command the forklift to operate. Use the shovel foot from the rear of the loader to gently shovel from under the battery, slowly raise the shovel foot until the battery leaves the base and pour the fork backwards. The lithium battery can be completely removed.
6. Barbaric operations are strictly prohibited during operation.
7. The replaced lithium battery should not be discarded at will, and it should be recycled by the lithium battery manufacturer.
8. The above operation is reversed when installing a lithium battery and when restoring the loader.

#### **Tire replacement**

---



#### **CAUTION**

1. Never enter the loader after the loader has been jacked up by the jack.
  2. Torque tighten the hub nut, 372N.M.
  3. Adjust tire pressure after tire replacement, W11E: 3.0Bar.
  4. Do not increase the air pressure beyond the specified range.
- 

#### **Front wheel**

1. Place the loader in a horizontal position.
2. Use a parking brake and insert a jack under the body.
3. Use a jack to lift the body until the tire is almost off the ground and loosen the hub nut.
4. Use a jack to jack up the body so that the tire is off the ground and remove the hub nut and wheel.
5. After repairing and replacing the tires, repeat the reverse process to install the wheels. Tighten the hub nut evenly in the diagonal direction in order.
6. Check and adjust the tire air pressure after the wheel is installed.

---

## Hydraulic oil replacement

---



### WARNING

The front working unit should be lowered completely before draining the hydraulic fluid.

---

1. Drive the loader to the trench.
  2. Lower the front working device completely.
  3. Place a container on the bottom of the loader.
  4. Open the rear cover.
  5. Unscrew the hydraulic oil filler port.
  6. Unscrew the suction filter.
  7. Remove the drain plug of the hydraulic tank.
  8. Fully drain the hydraulic oil.
  9. Wipe the area near the drain plug.
  10. Reinstall the drain plug.
  11. Make sure the replaced oil filter is filled with oil to avoid damages.
  12. Tighten the filler cap.
  13. Fill the oil filter port with the hydraulic oil until it is full.
  14. Tighten the oil filter cover back.
  15. Start the engine, run for a while in the idle state, repeatedly turn the steering wheel to the left and right to the maximum corner several times, let the car slowly drive for dozens of meters and lift down several times, and check the oil level again.
- 



### CAUTION

Discarded oil should be disposed of in accordance with relevant regulations. Avoid skin contact with oil. Also don't let the oil flow into the sewer or flow to the ground.

---

### 3.3.3 Oil & Lubricant

Hydraulic system	
Model Specification	Caltex HDZ-46
W11E	66L
Drive axle	
Model Specification	Gear Oil L-CKC 220
W11E	2L

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### CAUTION

The oil mentioned above is used under normal weather conditions. For a coldest or hottest country, please contact EUROTRAC or dealer.

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**NOTE**

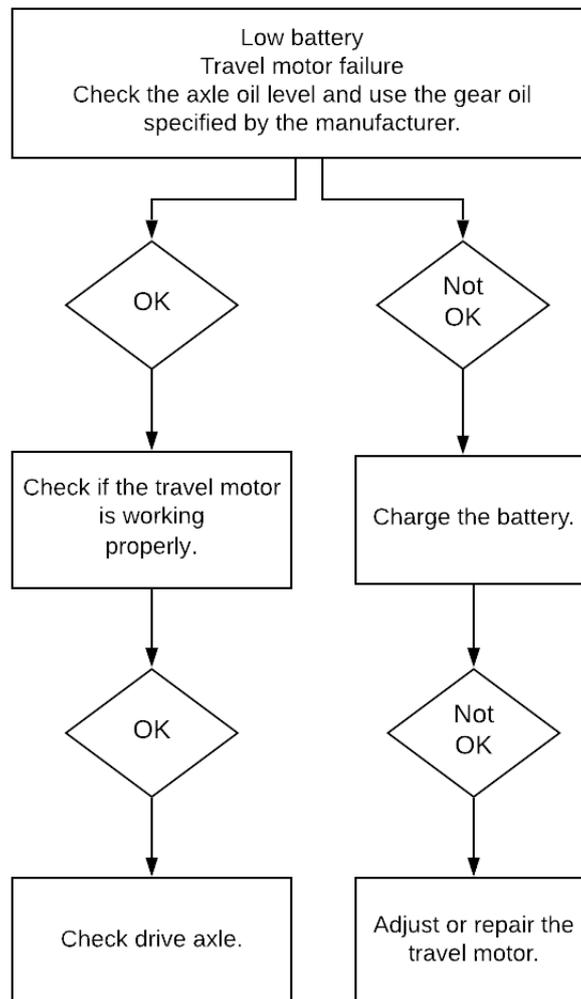
1. When replacing hydraulic components, in order to avoid component deterioration, it is essential to filter and inspect hydraulic fluid before use.
  2. Do not mix two oils.
- 

Drive axle	
Type	NLGI grade No. 3 lithium grease
Rod end joint bearing	
Type	Lithium base grease every 500 hours.

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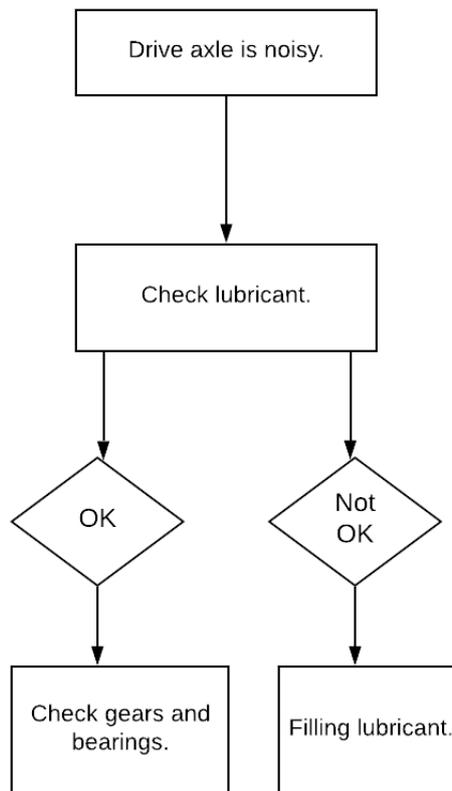
## 3.4 Troubleshooting

### 3.4.1 Kinetic energy reduction

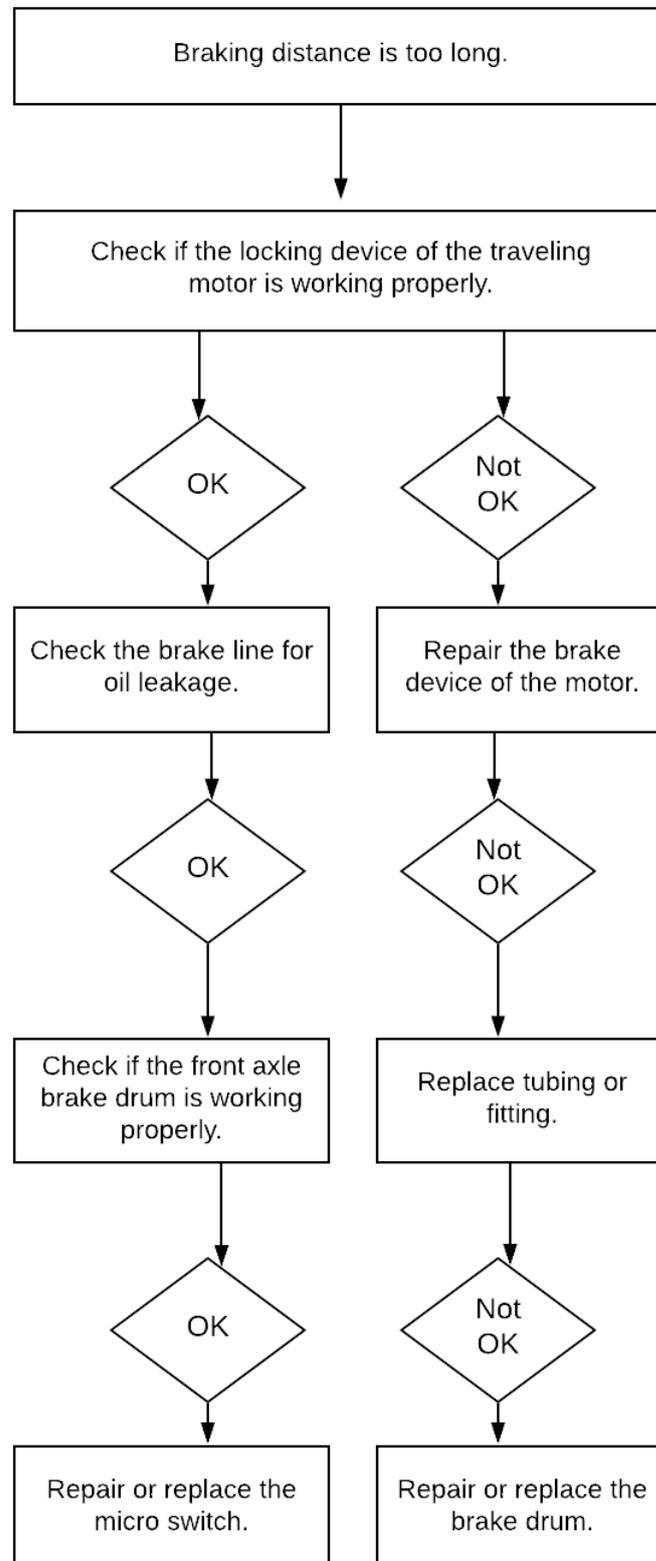


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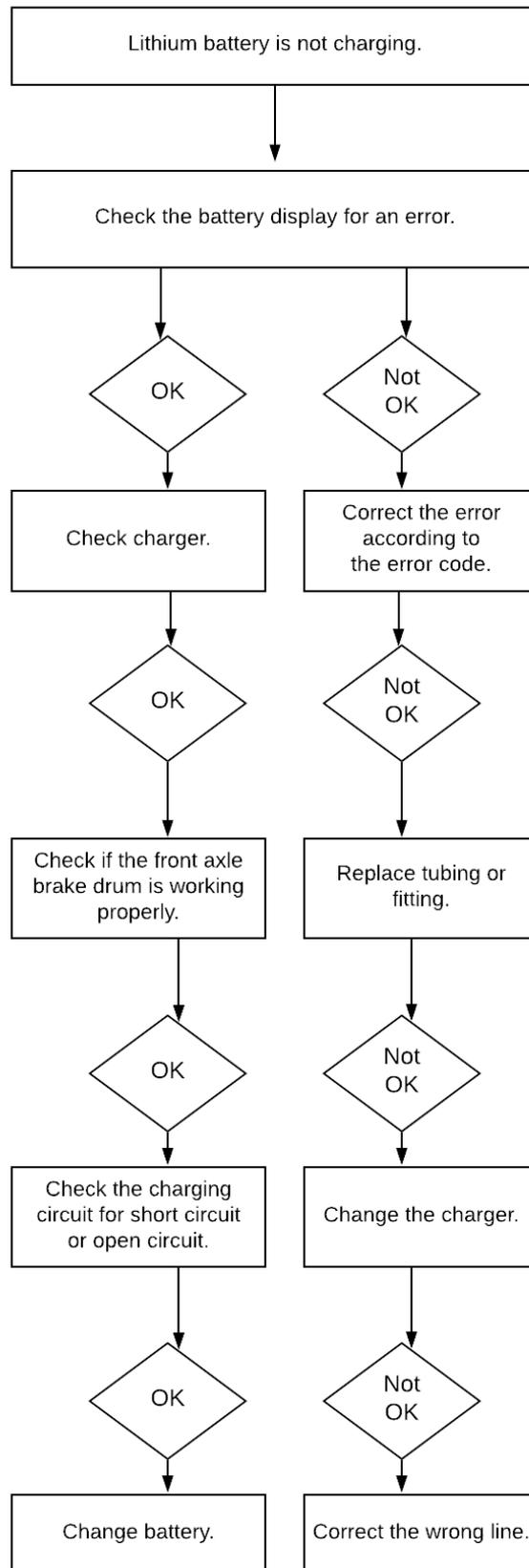
### 3.4.2 Drive axle



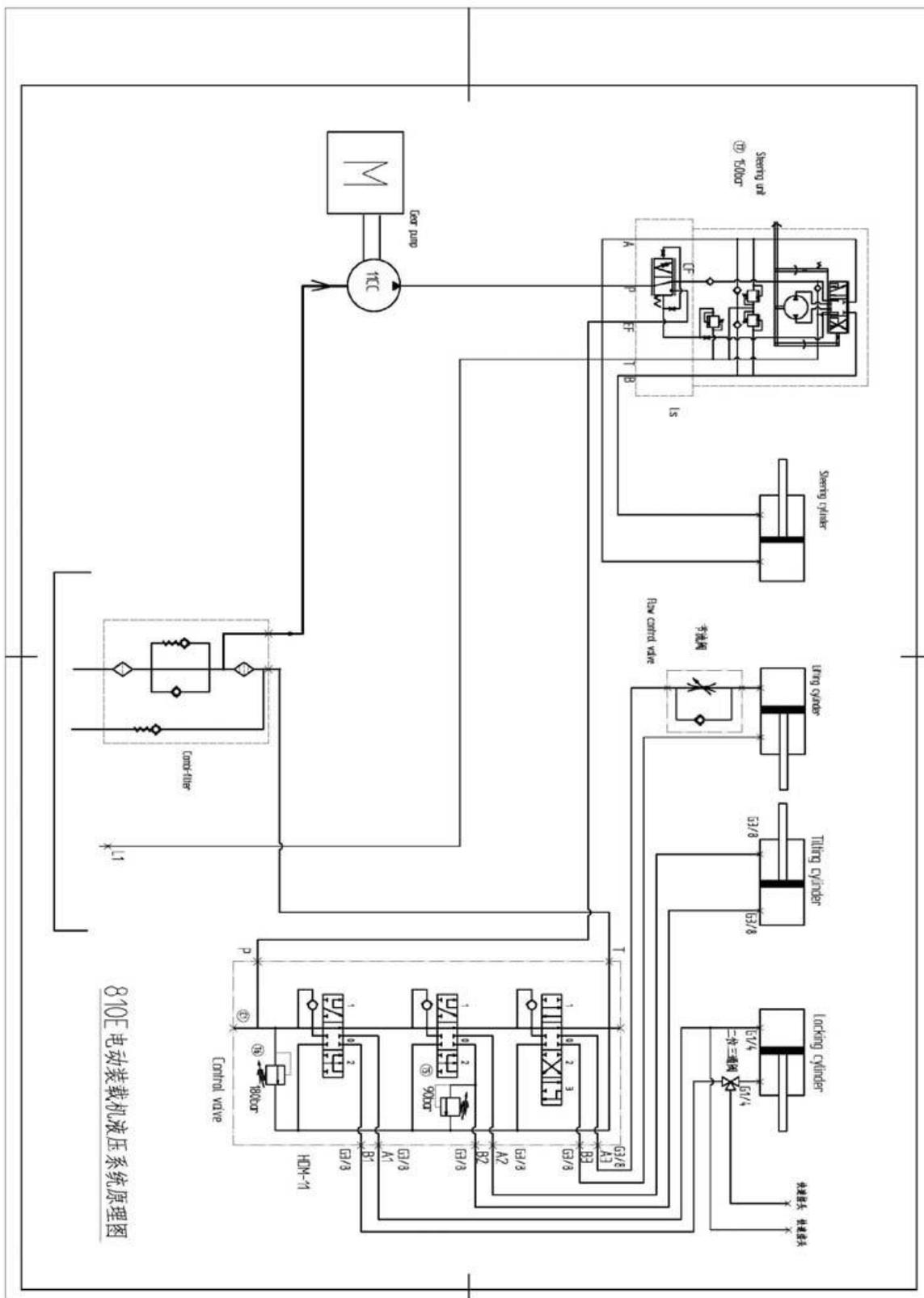
### 3.4.3 Brake system



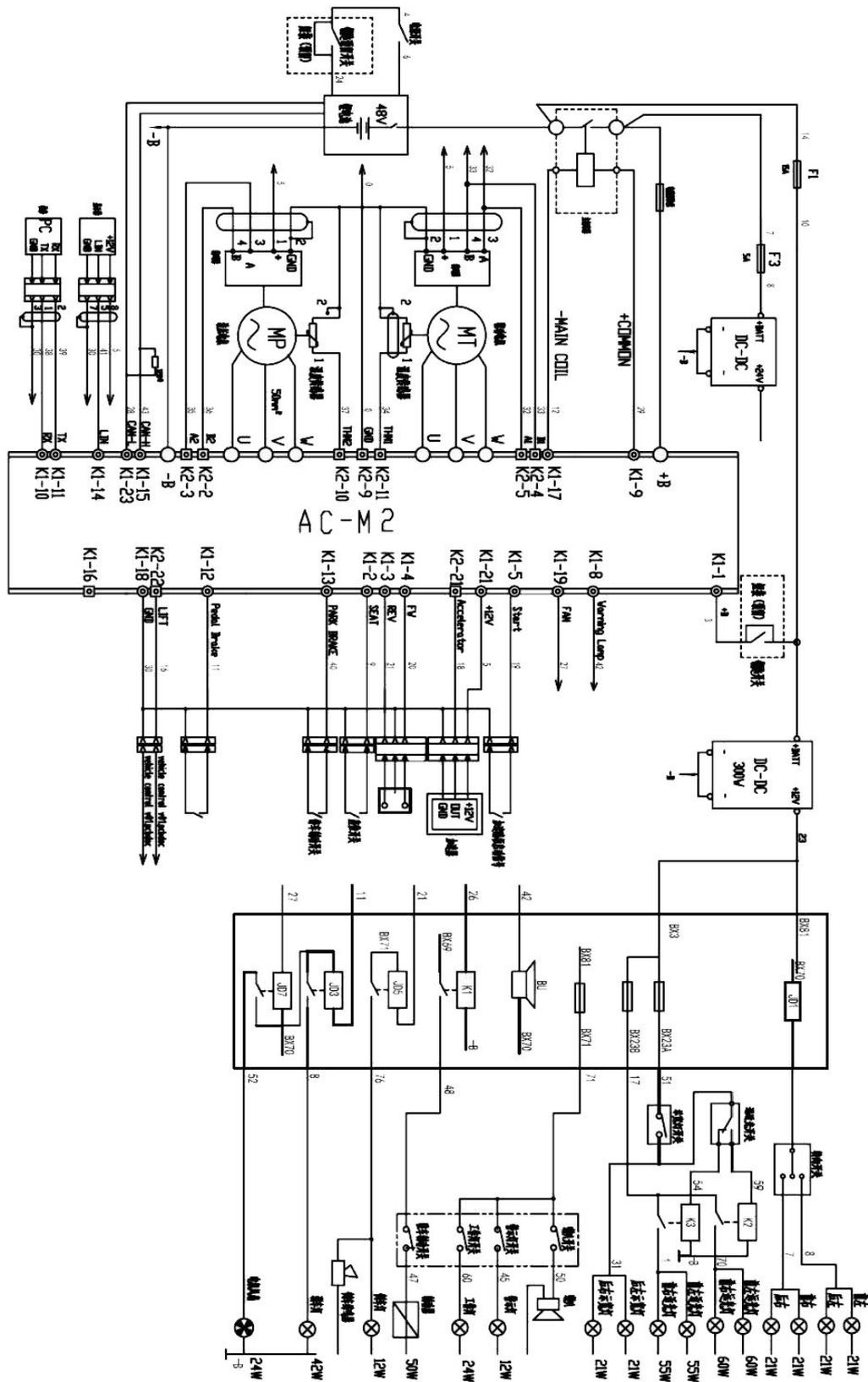
### 3.4.4 Lithium battery



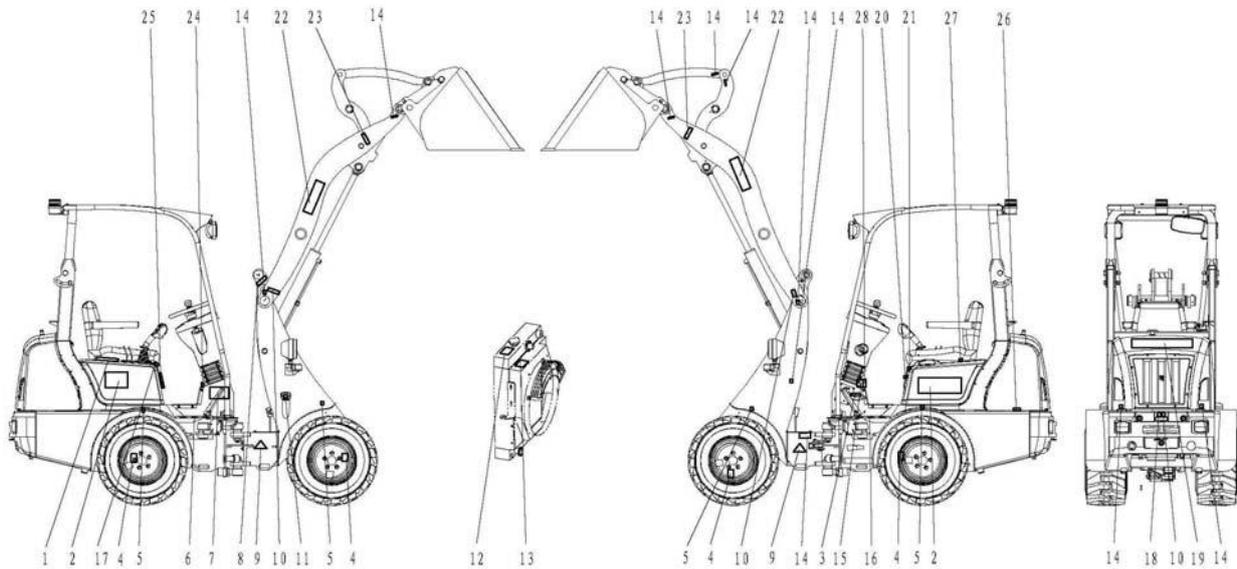
**FIGURE 1: W11E HYDRAULIC SCHEMATIC**



# FIGURE 2: ELECTRICAL SCHEMATIC



## FIGURE 3: BODY LOGO LAYOUT



1.	Hydraulic control tips	19.	Brandname sticker
2.	Model trademark	20.	Read instructions for use
3.	Parking brake sign (English)	21.	Read the maintenance manual warning
4.	Tire label	22.	Make a trademark sticker
5.	Tire pressure label	23.	Lifting capacity sticker
6.	Anti-slip mat	24.	Anti-tip sticker
7.	Vehicle nameplate	25.	Vehicle nameplate - cab
8.	Lifting label	26.	Hydraulic oil label
9.	Anti-sticker label	27.	Seat belt label
10.	Danger of crushing hand sticker	28.	Anti-label
11.	Fuel label		
12.	Water tank anti-scald label		
13.	Anti-cutting label		
14.	Greasing point indication		
15.	Noise statement label		
16.	Anti-slip mat		
17.	Reset button label		
18.	Transport fixed point label		

---

# DAILY EQUIPMENT INSPECTION

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## WARNING

In the event of a problem, the operator should not attempt to repair and is responsible for immediately reporting to the superior. Repairs must be performed by a professional.

---

Daily Equipment Inspection – W11E Loader		
Car Number S/N:	Date:	
Operator:		
<input type="checkbox"/> Well	<input type="checkbox"/> [A] Commissioning completed	<input type="checkbox"/> [N] need to repair
<input type="checkbox"/>	Ensure that the travel motor and hydraulic motor are good.	
<input type="checkbox"/>	Open the hydraulic tank cover and check the fluid level. Make sure the liquid level is within the operating range and then close the lid.	
<input type="checkbox"/>	Check the inflation pressure of each pneumatic tire. Wheel requirements 3.0BAR. Adjust tire pressure as required.	
<input type="checkbox"/>	Check for tread damage or wear. Remove the stone from the tread and report any damage, side tread damage, or unusual wear.	
<input type="checkbox"/>	Make sure the headlights are working properly.	
<input type="checkbox"/>	Check other lights, including rear, tail stop lights and directional lights, if the vehicle is equipped with these lights.	
<input type="checkbox"/>	Make sure that the heater, wiper and cab ceiling lights in the cab work properly (if installed).	
<input type="checkbox"/>	Operate the horn, it can be clearly heard under noisy sound.	
<input type="checkbox"/>	Make sure all controls are good. Report any fault control and do not use the device until it is fully repaired.	
<input type="checkbox"/>	Correct the driver's seat position and adjust it to suit your requirements.	

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## 4. SME ELECTRONIC CONTROL SYSTEM

### 4.1 About warning, caution and information notices

Special attention must be paid to the information presented in Warning, Caution and other kinds of information notices when they appear in this manual. Failure to follow those recommendations may result in dangerous situations or in damages to the components, for which SME will not respond.

	<b>Warnings:</b> A Warning informs the user of a hazard or a potential hazard which could result in serious or fatal injury if the precautions or instructions given in the warning notice are not observed.
	<b>Cautions:</b> A caution informs the reader of a hazard or a potential hazard which could result in a serious damage to the appliance.
	<b>Information Notices:</b> An information notice contains additional, not essential pieces of information to complete or to clarify the meaning of the paragraph they are placed into.
	<b>User Manual Reference:</b> A User Manual Reference informs the user to look up specified user manual for more details.
	<b>Interactive Documentation Tips:</b> An advice about where to find the related section in the Interactive Documentation

## 4.2 Troubleshooting and fault codes

### 4.2.1 Fault levels

PRIORITY	LEVEL	ACTIONS
1 (HIGHEST)	Blocking	Main contactor opened
		Motors disabled
		Outputs disabled
2	Stopping	Main contactor closed
		Motors stopped
		Outputs enabled
3	Limiting	Main contactor closed
		Motors limited
		Outputs enabled
4 (LOWEST)	Warning	Main contactor closed
		Motors enabled
		Outputs enabled

### 4.2.1 Fault list

Code	Fault	Level	Family	Possible Causes	Set Condition	Clear Condition
1	Over Voltage	Blocking	All	<ul style="list-style-type: none"> <li>Battery resistance too high while regenerating.</li> <li>Battery disconnected while regenerating.</li> </ul>	Key-switch voltage or capacitors voltage is above the maximum level allowed for the controller.	Bring key-switch voltage below over-voltage limit and then cycle key switch.
2	Under Voltage	Blocking	All	<ul style="list-style-type: none"> <li>Battery seriously damaged or exhausted.</li> <li>Battery resistance too high.</li> <li>Battery disconnected while driving.</li> <li>Blown key-switch fuse.</li> <li>External load drains power from battery.</li> </ul>	Key-switch voltage is below the minimum level allowed for the controller.	Bring key-switch voltage above under-voltage limit and then cycle key switch.
3	User Over Voltage	Blocking	TAU System	<ul style="list-style-type: none"> <li>Battery resistance too high while regenerating.</li> <li>Battery disconnected while regenerating.</li> <li>Too low voltage level defined by the user</li> </ul>	Key-switch voltage is above the maximum level defined by the user.	Bring key-switch voltage below user over voltage limit and then cycle key switch.
4	User Under Voltage	Blocking	TAU System	<ul style="list-style-type: none"> <li>Battery serious damaged or exhausted.</li> <li>Battery resistance too high.</li> <li>Battery disconnected while driving.</li> <li>Blown key-switch fuse.</li> <li>External load drains power from battery.</li> <li>Too high voltage level defined by the user.</li> </ul>	Key-switch voltage is below the minimum level defined by the user.	Bring key-switch voltage above user under voltage limit and then cycle key switch.
5	Inverter 1 Over Current	Blocking	All	<ul style="list-style-type: none"> <li>External or internal short-circuit between U1, V1 or W1 AC motor's phases.</li> <li>Incorrect motor 1 parameter/s.</li> <li>Inverter 1 power module damaged.</li> </ul>	Inverter 1 phase current exceeded its current limit.	Cycle key switch.
6	Inverter 2 Over Current	Blocking	All	<ul style="list-style-type: none"> <li>External or internal short-circuit between U2, V2 or W2 AC motor's phases.</li> <li>Incorrect motor2 parameter/s.</li> <li>Inverter 2 power module damaged.</li> </ul>	Inverter 2 phase current exceeded its current limit.	Cycle key switch.
7	-	-	All	-	-	-

Code	Fault	Level	Family	Possible Causes	Set Condition	Clear Condition
8	Inverter 1 Over Temperature	Blocking	All	<ul style="list-style-type: none"> <li>• Operation in high temp environment.</li> <li>• Operation with high load.</li> <li>• Wrong mounting of the controller heat sink.</li> <li>• Wrong working of controller cooling system.</li> </ul>	Inverter 1 power module temperature above +100°C.	Bring power module temperature of inverter1 below 100°C and cycle key switch.
9	Inverter 2 Over Temperature	Blocking	All	<ul style="list-style-type: none"> <li>• Operation in high temp environment.</li> <li>• Operation with high load.</li> <li>• Wrong mounting of the controller heat sink.</li> <li>• Wrong working of controller cooling system.</li> </ul>	Inverter 2 power module temperature above +100°C.	Bring power module temperature of inverter2 below 100°C and cycle key switch.
10	Inverter 1 High Temperature	Limiting	All	<ul style="list-style-type: none"> <li>• Operation in high temp environment.</li> <li>• Operation with high load.</li> <li>• Wrong mounting of the controller heat sink.</li> <li>• Wrong working of controller cooling system.</li> </ul>	Inverter 1 power module temperature above +80°C.	Bring power module temperature of inverter1 below 80°C.
11	Inverter 2 High Temperature	Limiting	All	<ul style="list-style-type: none"> <li>• Operation in high temp environment.</li> <li>• Operation with high load.</li> <li>• Wrong mounting of the controller heat sink.</li> <li>• Wrong working of controller cooling system.</li> </ul>	Inverter 2 power module temperature above +80°C.	Bring power module temperature of inverter2 below 80°C.
12	Inverter 1 Under Temperature	Blocking	All	Operation in low temp environment.	Inverter 1 power module temperature below -40°C.	Bring inverter 1 power module temperature above -40°C and cycle key switch.
13	Inverter 2 Under Temperature	Blocking	All	Operation in low temp environment.	Inverter 2 power module temperature below -40°C.	Bring inverter 2 power module temperature above -40°C and cycle key switch.
14	Inverter 1 Current Sensor Fault	Blocking	All	<ul style="list-style-type: none"> <li>• Leakage current due to motor 1 stator short-circuit.</li> <li>• Controller's sensor faulty.</li> </ul>	Current sensor of inverter 1 has an invalid offset reading at key on.	Cycle key switch.
15	Inverter 2 Current Sensor Fault	Blocking	All	<ul style="list-style-type: none"> <li>• Leakage current due to motor 2 stator short.</li> <li>• Controller's sensor faulty.</li> </ul>	Current sensors of inverter 2 have an invalid offset reading at key on.	Cycle key switch.
16	-	-	All	-	-	-
17	Inverter 1 Temp Sensor Fault	Stopping	All	Inverter 1 internal temperature sensor not connected or shorted.	Difference between inverter 1 and microprocessor temp greater than 70 °C.	Cycle key switch.
18	Inverter 2 Temp Sensor Fault	Stopping	All	Inverter 2 internal temperature sensor not connected or shorted.	Difference between inverter 2 and microprocessor temp greater than 70 °C.	Cycle key switch.
19	Motor 1 Over Temperature	Stopping	All	<ul style="list-style-type: none"> <li>• Motor 1 temperature is too high.</li> <li>• Wrong Motor 1 thermal probe type or input.</li> <li>• Motor 1 thermal probe not connected or shorted input.</li> </ul>	Motor 1 temperature is above the motor over temperature parameter setting.	Bring motor 1 temperature below over temperature limit and cycle the key switch.
20	Motor 2 Over Temperature	Stopping	All	<ul style="list-style-type: none"> <li>• Motor 2 temperature is too high.</li> <li>• Wrong Motor 2 thermal probe type or input.</li> <li>• Motor 2 thermal probe not connected or shorted input.</li> </ul>	Motor 2 temperature is above the motor over temperature parameter setting.	Bring motor 2 temperature below over temperature limit and cycle the key switch.
21	Motor 1 High Temperature	Limiting	All	<ul style="list-style-type: none"> <li>• Motor 1 temperature is too high.</li> <li>• Wrong Motor 1 thermal probe type or input.</li> <li>• Motor 1 thermal probe not connected or shorted input.</li> </ul>	Motor 1 temperature is above the motor start cutback temperature parameter setting.	Bring motor 1 temperature below start cutback temperature and cycle the key switch.

Code	Fault	Level	Family	Possible Causes	Set Condition	Clear Condition
22	Motor 2 High Temperature	Limiting	All	<ul style="list-style-type: none"> <li>Motor 2 temperature is too high.</li> <li>Wrong Motor 2 thermal probe type or input.</li> <li>Motor 2 thermal probe not connected or shorted input.</li> </ul>	Motor 2 temperature is above the motor start cutback temperature parameter setting.	Bring motor 2 temperature below start cutback temperature and cycle the key switch.
23	Motor 1 Temp Sensor Fault	Limiting	All	Motor 1 temperature sensor reads a not permitted value.	Motor 1 temperature sensor value is out of permitted range.	Check motor 1 temperature sensor and cycle the key switch.
24	Motor 2 Temp Sensor Fault	Limiting	All	Motor 2 temperature sensor reads a not permitted value.	Motor 2 temperature sensor value is out of permitted range.	Check motor 2 temperature sensor and cycle the key switch.
25	-	-	All	-	-	-
26	-	-	All	-	-	-
27	Microprocessor Over Temperature	Stopping	All	<ul style="list-style-type: none"> <li>Microprocessor faulty.</li> <li>Microprocessor temperature sensor faulty.</li> </ul>	Microprocessor temperature is above 125°C.	Cycle key switch.
28	+5V Supply Failure	Blocking	All	External load impedance on +5V output is too low.	+5V supply is outside the +5V±10% range.	Remove all external load, bring +5V supply inside range and cycle the key switch.
29	+12V Supply Failure	Blocking	All	External load impedance on +12V output is too low.	+12V supply is outside the +12V±10% range.	Remove all external load, bring +12V supply inside and cycle the key switch.
30	Encoder 1 Fault	Blocking	All	<ul style="list-style-type: none"> <li>Motor 1 encoder failure.</li> <li>Motor 1 encoder faulty wirings.</li> <li>Motor 1 speed changes too quickly.</li> <li>Electromagnetic noise on the Motor 1 sensor bearing.</li> </ul>	The difference of speed evaluated between two consecutive readings of the encoder is above the fixed limit	Cycle key switch.
31	Encoder 2 Fault	Blocking	All	<ul style="list-style-type: none"> <li>Motor 2 encoder failure.</li> <li>Motor 2 encoder faulty wirings.</li> <li>Motor 2 speed change very fast.</li> <li>Electromagnetic noise on the Motor 2 sensor bearing.</li> </ul>	The difference of speed evaluated between two consecutive readings of the encoder is above the fixed limit.	Cycle key switch.
32	Driver Output 1 Open/Short	Blocking	All	<ul style="list-style-type: none"> <li>Open or short-circuit of driver output 1 load.</li> <li>Driver output 1 damaged.</li> </ul>	Driver output 1 is either opened or shorted.	Correct open or short in driver output 1 load and cycle key switch. If fault condition is present without load connected replace the controller.
33	Driver Output 2 Open/Short	Blocking	All	<ul style="list-style-type: none"> <li>Open or short-circuit of driver output 2 load.</li> <li>Driver output 2 damaged.</li> </ul>	Driver output 2 is either opened or shorted.	Correct open or short in driver output 2 load and cycle key switch. If fault condition is present without load connected replace the controller.
34	Driver Output 3 Open/Short	Blocking	All	<ul style="list-style-type: none"> <li>Open or short-circuit of driver output 3 load.</li> <li>Driver output 3 damaged.</li> </ul>	Driver output 3 is either opened or shorted.	Correct open or short in driver output 3 load and cycle key switch. If fault condition is present without load connected replace the controller.
35	Digital Output 1 Open/Short	Blocking	All	<ul style="list-style-type: none"> <li>Open or short-circuit of digital output 1 load.</li> <li>Digital output 1 damaged.</li> </ul>	Digital output 1 is either opened or shorted.	Correct open or short in digital output 1 load and cycle key switch. If fault condition is present without load connected replace the controller.
36	Digital Output 2 Open/Short	Blocking	All	<ul style="list-style-type: none"> <li>Open or short-circuit of digital output 2 load.</li> <li>Digital output 2 damaged.</li> </ul>	Digital output 2 is either opened or shorted.	Correct open or short in digital output 2 load and cycle key switch. If fault condition is present without load connected replace the controller.

Code	Fault	Level	Family	Possible Causes	Set Condition	Clear Condition
37	EEPROM Failure	Blocking	All	Failure to read/write EEPROM memory.	Error during read/write operation in EEPROM memory.	Cycle key switch.
38	EEPROM Corrupted	Blocking	All	Wrong firmware version or parameters.	Memory CRC doesn't match.	Download correct firmware or restore default parameters.
39	Driver Output 4 Open/Short	Blocking	All	<ul style="list-style-type: none"> <li>Open or short-circuit of driver output 4 load.</li> <li>Driver output 4 damaged.</li> </ul>	Driver output 4 is either opened or shorted.	Correct open or short in driver output 4 load and cycle key switch. If fault condition is present without load connected replace the controller.
40	Precharge Circuit Fault	Blocking	All	<ul style="list-style-type: none"> <li>Pre-charge circuit faulty.</li> <li>Short on capacitors between +B and -B</li> <li>Power module short-circuit.</li> </ul>	Pre-charge is too fast or capacitors voltage is fixed to zero during precharge.	Cycle key switch.
41	Precharge Failed	Blocking	All	<ul style="list-style-type: none"> <li>External load on capacitors.</li> <li>Pre-charge circuit faulty.</li> </ul>	Pre-charge phase fails to charge capacitors till the key switch voltage.	Cycle key switch.
42	Main Contactor Welded	Blocking	All	<ul style="list-style-type: none"> <li>Line contactor contacts are welded closed.</li> <li>Motor phases are not connected.</li> <li>An external wiring is providing voltage to capacitors.</li> </ul>	Before closing main contactor capacitors are loaded for a short time and voltage don't discharge.	Cycle key switch.
43	Main Contactor Did Not Close	Blocking	All	<ul style="list-style-type: none"> <li>Main contactor did not close after contactor's coil has been powered</li> <li>Main contactor coils are not connected.</li> <li>+B fuse is blown.</li> </ul>	The difference between key switch and capacitors voltage id too high after the contactor has been powered.	Cycle key switch.
44	Interlock Disabled	Stopping	TAU System	Interlock input is not active.	Interlock input is not active and line contactor is open.	Activate interlock input.
45	Static Return To Off Traction	Warning	TAU System	Traction throttle or direction selector are active at key on, after the Emergency Reverse or a controlled stop procedure.	One or more traction inputs are active at key on, after an EMR or a controlled stop procedure.	De-select all traction inputs.
46	Static Return To Off Hydraulic	Warning	TAU System	Hydraulic throttle or Auxiliary input are active at key on or after a controlled stop procedure.	One or more hydraulic inputs are active at key on or after a controlled stop procedure.	De-select all hydraulic inputs.
47	Traction Throttle Fault	Stopping	TAU System	Traction throttle wiring/s (analog/digital) are not connected.	A fault condition of traction throttle is detected. See throttle type documentation.	Cycle key switch.
48	Hydraulic Throttle Fault	Stopping	TAU System	Hydraulic throttle wiring/s (analog/digital) are not connected.	A fault condition of hydraulic throttle is detected. See throttle type documentation.	Cycle key switch.
49	Brake Throttle Fault	Stopping	TAU System	Brake throttle wiring/s (analog/digital) are not connected.	A fault condition of brake throttle is detected. See throttle type documentation.	Cycle key switch.
50	Service Time Expired	Warning	TAU System	Service interval time has expired.	Service timer has expired.	Reset service timer.
51	Low Battery State Of Charge	Limiting	TAU System	Battery state of charge drops below the setting parameters.	Battery state of charge estimated is lower than minimum setting.	Bring battery state of charge above reset parameter setting and cycle key switch.

Code	Fault	Level	Family	Possible Causes	Set Condition	Clear Condition
52	Wrong Parameter	Blocking	All	Wrong value of a parameter setting is entered.	Parameter setting is out of permitted range.	Bring wrong parameter within correct range and cycle key switch.
53	Restart Required	Warning	All	A parameter setting is changed and you need to restart the controller to become it effective.	Changed a parameter setting.	Cycle key switch.
54	CAN Bus Off	Stopping	All	<ul style="list-style-type: none"> <li>• Short between L, H channels or H channel and GND of CAN driver.</li> <li>• Wrong cable wirings.</li> <li>• Wrong baud rate configuration of one node.</li> </ul>	Bus off condition detected.	Cycle key switch.
55	CAN Open Circuit	Stopping	All	<ul style="list-style-type: none"> <li>• H or/and L channel not connected.</li> <li>• Wrong cable wirings.</li> <li>• All other nodes of the net not powered up.</li> </ul>	Messages not longer received.	Cycle key switch.
56	CAN Bad Wiring or Short Circuit	Blocking	All	<ul style="list-style-type: none"> <li>• Wrong cable wirings.</li> <li>• Swap of L channel and GND of CAN driver.</li> </ul>	CAN bus synchronization phase failed.	Cycle key switch.
57	-	-	All	-	-	-
58	-	-	All	-	-	-
59	-	-	All	-	-	-
60	-	-	All	-	-	-
61	-	-	All	-	-	-
62	Net Heartbeat Timeout	Stopping	All	Temporary loss of communication.	Heartbeat hasn't been received for the timeout established by the user through the CAN configuration settings.	Cycle key switch.
63	Net RPDO Timeout	Stopping	All	Temporary loss of communication.	At least one PDO hasn't been received for the timeout established by the user through the CAN configuration settings (for standard application and for electric steering application).	Cycle key switch.
64	Mains Contactor Close Command Timeout	Blocking	TAU Generic Slave	5 sec after pre-charge is ended up, the power line is not ready (for master).	Pre-charge timer has expired before the master sends the power ready request.	Cycle key switch.
65	Blocking Request From Master	Blocking	TAU Generic Slave	Master has requested a fault condition.	Fault request is received from master.	Cycle key switch.
66	-	-	All	-	-	-
67	Net Startup Timeout	Blocking	All	Net synchronization failure at startup.	The Node hasn't been able to synchronize itself to the network.	If needed, correct net startup parameter and cycle key switch.
68	Net External Failure	Stopping	All	Net synchronization lost.	At least one Node has become not operational.	Cycle key switch.
69	Net	Blocking	TAU	A TAU Node, Helper or Follower for the main contactor management, signals that the powering sequence made by the Manager is wrong.	The main contactor Manager has executed a wrong powering sequence.	Cycle key switch.
70	Net Mains Manager Precharge Too Slow	Blocking	TAU System	A TAU Node, Helper for the main contactor management, signals that the precharge phase has been too slow.	DC Bus voltage will not increase after discharging phase.	Cycle key switch.

Code	Fault	Level	Family	Possible Causes	Set Condition	Clear Condition
71	Net Mains Manager Closing Too Slow	Blocking	TAU System	A TAU Node, Helper for the main contactor management, signals that the main closing phase has been too slow.	The main contactor doesn't close.	Check the cable which command the contactor and cycle the key switch.
72	Net Mains Manager Powering Alarm	Blocking	TAU System	A TAU Node, Helper or Follower for the main contactor management, signals that the main Manager has the powering state machine alarmed.	At least one fault has occurred on main contactor Manager controller.	Cycle key switch.
73	CO Synchro Failed	Blocking	All	Net never synchronized	At least one node of the net could be wrong configured or switched off.	Check that all nodes are switched on and have right net configuration before cycle key switch.
74	CO Synchro Lost	Stopping	All	Net synchronization lost	At least one node of the net could be wrong configured or switched off during operation.	Check that all nodes are correctly supplied and have right net configuration before cycle key switch.
75	Stopped For System Fault	Stopping	TAU System	Node stopped for system fault	Node is stopped because another node has a stopping/blocking fault condition.	Reset system fault stopping condition or verify system faults remapping configuration.  Cycle key switch.
76	Blocked For System Fault	Blocking	TAU System	Node blocked for system fault	Node is blocked because another node has a stopping/blocking fault condition.	Reset system fault stopping condition or verify system faults remapping configuration.  Cycle key switch.
77	BMS Wall Charge	Blocking	TAU System	The BMS is recharging the battery.	The TAU Node sets a blocking fault.	Cycle key switch.
78	BMS Stop	Stopping	TAU System	The BMS requires a system stop.	The TAU Node sets a	Cycle key switch.
79	BMS Fault	Blocking	TAU System	The BMS signals its faulty state.	The TAU Node sets a blocking fault.	Cycle key switch.
80	BMS Limiting	Limiting	TAU System	The BMS requires a current limit.	The TAU Node limits its current to the required value.	Cycle key switch.
81	Steering Sensor Fault	Limiting	TAU System	Steering sensor wiring/s (analog/digital) are not connected.	A fault condition of steering sensor is detected. See steering sensor type documentation.	Cycle key switch.
82	Digital Inputs Overvoltage	Blocking	TAU System	Digital Input Supply has reached dangerous value	Bad Wiring	Verify the wiring.
83	Programming Required	Blocking	TAU System	A blocking fault is voluntary forced during the programming to disconnect the power from the Controller.	Firmware Programming	-
84	-	-	All	-	-	-
85	-	-	All	-	-	-
86	-	-	All	-	-	-
87	-	-	All	-	-	-
88	-	-	All	-	-	-
89	-	-	All	-	-	-
90	-	-	All	-	-	-
91	-	-	All	-	-	-
92	-	-	All	-	-	-
93	-	-	All	-	-	-
94	-	-	All	-	-	-

Code	Fault	Level	Family	Possible Causes	Set Condition	Clear Condition
95	-	-	All	-	-	-
96	-	-	All	-	-	-
97	-	-	All	-	-	-
98	-	-	All	-	-	-
99	-	-	All	-	-	-
100	Internal Software Fault 1	Blocking	All	Internal software error(s)	Internal error.	Restore Eeprom default and cycle key switch.
101	Internal Software Fault 2	Warning	All	Internal software error(s)	Internal error.	Restore Eeprom default and cycle key switch.
102	Internal Software Fault 3	Warning	All	Internal software error(s)	Internal error.	Restore Eeprom default and cycle key switch.
103	Internal Hardware Fault 1	Blocking	All	Internal hardware error(s)	Internal error.	Cycle key switch.
104	Internal Hardware Fault 2	Blocking	All	Internal hardware error(s)	Internal error.	Cycle key switch.
105	Internal Hardware Fault 3	Blocking	All	Internal hardware error(s)	Internal error.	Cycle key switch.
106	Internal Hardware Fault 4	Blocking	All	Internal hardware error(s)	Internal error.	Cycle key switch.
107	Internal Software Fault 4	Warning	All	Internal software error(s)	Internal error.	Restore Eeprom default and cycle key switch.

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## 5. AC SMARTMOTION AC-M2 OVERVIEW



AC-M2

### 5.1 Product description

The AC-M2 Controller is designed for lift trucks, handling machines and electrical vehicles using dual AC motors up to 50kW.

Being based on high reliable DCB technology and exceptionally stable ITC Control Algorithm, AC-M2 Controller ensures the best performance without use of mechanical differential.

AC-M2 Controller is suitable to control:

- 1 AC Traction motor + 1 AC Pump motor
- 2 AC Traction motor

The product is suitable for the following range of applications: Counterbalanced Lift Trucks, Reach Trucks, Order Picking Trucks, Very narrow aisle Trucks, Cleaning Machines, Aerial Lifts, Tractors, Utility Vehicles.

### 5.1.1 Product Indication Label

The product label shows important data regarding the specific product.



The meaning of each field is described in the table below.

Field	Description
<b>Model</b>	Product description.
<b>Type Code</b>	SME code for the specific product.
<b>Rating Data</b>	It contains the indication of the input voltages and the output currents supplied by the product.
<b>Batch Number</b>	Production batch number (the same value as in barcode below).
<b>Lot</b>	Production Month and Year

## 5.2 General Specifications

<b>Motor Type</b>	AC Asynchronous 3-Phase
<b>Braking</b>	Regenerative
<b>Modulation</b>	PWM (Pulse Width Modulation)
<b>Switching Frequency</b>	9kHz
<b>Low R<sub>DS,on</sub> MOSFET</b>	
<b>16 bits DSP controlling 1 AC motor</b>	
<b>Integrated Hall Effect Current Sensors</b>	

## 5.3 Electrical Specifications

### 5.3.1 Input and Output Ratings

Model Chart for 36/48V version			
Model Name	AC Inverter 1 Max Arms (2')	AC Inverter 2 Max Arms(2')	Max Power (2') at 48V
AC-M2 36/48V 500A+500A	500 Arms	500 Arms	27.7 kVA + 27.7 kVA

### 5.3.2 Signal: Inputs and Outputs

Digital Inputs	17
Analog Inputs	6
Digital Outputs (ON/OFF)	2
Driver Outputs (PWM)	3
Motor Speed Sensor Inputs	4 (A+B Channels)

Refer to following tables for a complete AC-M2 controller K1 and K2 connectors pin-out.

K1 connector pin-out for AC-M2 SPECIFICATIONS				
Pin	Name	I/O	Specification	Typical Function
1	KEY SWITCH IN	Supply Input	Rated battery +25/-30%, 6Amax	Positive supply of the control section of the AC-M2
2	DIGITAL IN 1	Digital Input	4mA pull-up, VL<=1V, VH>=3,5V	TO BE ASSIGNED
3	DIGITAL IN 2	Digital Input	4mA pull-up, VL<=1V, VH>=3,5V	TO BE ASSIGNED
4	DIGITAL IN 3	Digital Input	4mA pull-up, VL<=1V, VH>=3,5V	TO BE ASSIGNED
5	DIGITAL IN 4	Digital Input	4mA pull-up, VL<=1V, VH>=3,5V	TO BE ASSIGNED
6	DIGITAL IN 5	Digital Input	4mA pull-up, VL<=1V, VH>=3,5V	TO BE ASSIGNED
7	DIGITAL IN 6	Digital Input	4mA pull-up, VL<=1V, VH>=3,5V	TO BE ASSIGNED
8	DIGITAL OUT 1	Digital Output	Low side 0,5A	TO BE ASSIGNED
9	COIL RETURN	Supply Output	High side 5A max	Positive common
10	RS-232 RX	Com Input	-	Serial port
11	RS-232 TX	Com Output	-	Serial port
12	DIGITAL IN 7	Digital Input	4mA pull-up, VL<=1V, VH>=3,5V	TO BE ASSIGNED
13	DIGITAL IN 8	Digital Input	4mA pull-up, VL<=1V, VH>=3,5V	TO BE ASSIGNED
14	LIN IN/OUT	Com Input/Output	12mA pull-up	LIN display connection
15	CAN-H	Com Input/Output	CAN-bus	CAN H (No internal termination resistor)
16	DRIVER OUT 1	PWM Output	Low side 2A	TO BE ASSIGNED
17	DRIVER OUT 2	PWM Output	Low side 1,5A	TO BE ASSIGNED
18	I/O GROUND	-	-	Negative logic supply
19	DIGITAL OUT 2	Digital Output	Low side 1,5A	TO BE ASSIGNED
20	DRIVER OUT 3	PWM Output	Low side 1,5A (*)	TO BE ASSIGNED
21	+12V OUT	Supply Output	12V 250mAmax	12V supply

K1 connector pin-out for AC-M2 SPECIFICATIONS				
Pin	Name	I/O	Specification	Typical Function
22	CAN GROUND	-	-	CAN- bus negative supply
23	CAN-L	Com Input/Output	CAN-bus	CAN L (No internal termination resistor)

K1 connector pin-out for AC-M2 SPECIFICATIONS				
Pin	Name	I/O	Specification	Typical Function
1	+5V OUT	Supply Output	5V+/-5%, 200mAmax	5V supply
2	ENCODER 2 B	Peripheral Input	20mA pull-up, VL<=1V, VH>=3,5V	Quad encoder 2 channel B
3	ENCODER 2 A	Peripheral Input	20mA pull-up, VL<=1V, VH>=3,5V	Quad encoder 2 channel A
4	ENCODER 1 B	Peripheral Input	20mA pull-up, VL<=1V, VH>=3,5V	Quad encoder 1 channel B
5	ENCODER 1 A	Peripheral Input	20mA pull-up, VL<=1V, VH>=3,5V	Quad encoder 1 channel A
6	DIGITAL IN 9	Digital Input	4mA pull-up, VL<=1V, VH>=3,5V	TO BE ASSIGNED
7	DIGITAL IN 10	Digital Input	4mA pull-up, VL<=1V, VH>=3,5V	TO BE ASSIGNED
8	DIGITAL IN 11	Digital Input	4mA pull-up, VL<=1V, VH>=3,5V	TO BE ASSIGNED
9	I/O GROUND	-	-	Negative logic supply
10	MOTOR THERMAL PROBE 1	Analog Input	Pull-up	Motor 1 temperature probe
11	MOTOR THERMAL PROBE 2	Analog Input	Pull-up	Motor 2 temperature probe
12	ANALOG IN 1	Analog Input	0/12V pull-down	TO BE ASSIGNED
13	ANALOG IN 2	Analog Input	0/12V pull-down	TO BE ASSIGNED
14	DIGITAL IN 12	Digital Input	4mA pull-up, VL<=1V, VH>=3,5V	TO BE ASSIGNED
15	DIGITAL IN 13	Digital Input	4mA pull-up, VL<=1V, VH>=3,5V	TO BE ASSIGNED
16	DIGITAL IN 14	Digital Input	4mA pull-up, VL<=1V, VH>=3,5V	TO BE ASSIGNED
17	DIGITAL IN 15	Digital Input	4mA pull-up, VL<=1V, VH>=3,5V	TO BE ASSIGNED
18	DIGITAL IN 16	Digital Input	4mA pull-up, VL<=1V, VH>=3,5V	TO BE ASSIGNED
19	ANALOG IN 3	Analog Input	0/12V pull-down	TO BE ASSIGNED
20	ANALOG IN 4	Analog Input	0/12V pull-down	TO BE ASSIGNED
21	ANALOG IN 5	Analog Input	0/12V pull-down	TO BE ASSIGNED
22	ANALOG IN 6	Analog Input	0/12V pull-down	TO BE ASSIGNED
23	DIGITAL IN 17	Digital Input	4mA pull-up, VL<=1V, VH>=3,5V	TO BE ASSIGNED

---

### 5.3.3 Interfaces

- Serial Communication: RS-232
- CAN:
  - Protocol: CAN Open
  - Physical layer: ISO11898-2
  - Baud rates: 1Mbps, 800kbps, 500kbps, 250kbps, 125kbps, 50kbps
- Lin Bus

### 5.3.4 EMC

EN12895 (Industrial Trucks – Electromagnetic Compatibility)

### 5.3.5 Safety

EN1175-1 (Safety of Industrial Trucks – Electrical Requirements)



#### NOTE

The vehicle OEM takes full responsibility of the regulatory compliance of the vehicle system with the controller installed.

---

## 5.4 Operating Environment Specifications

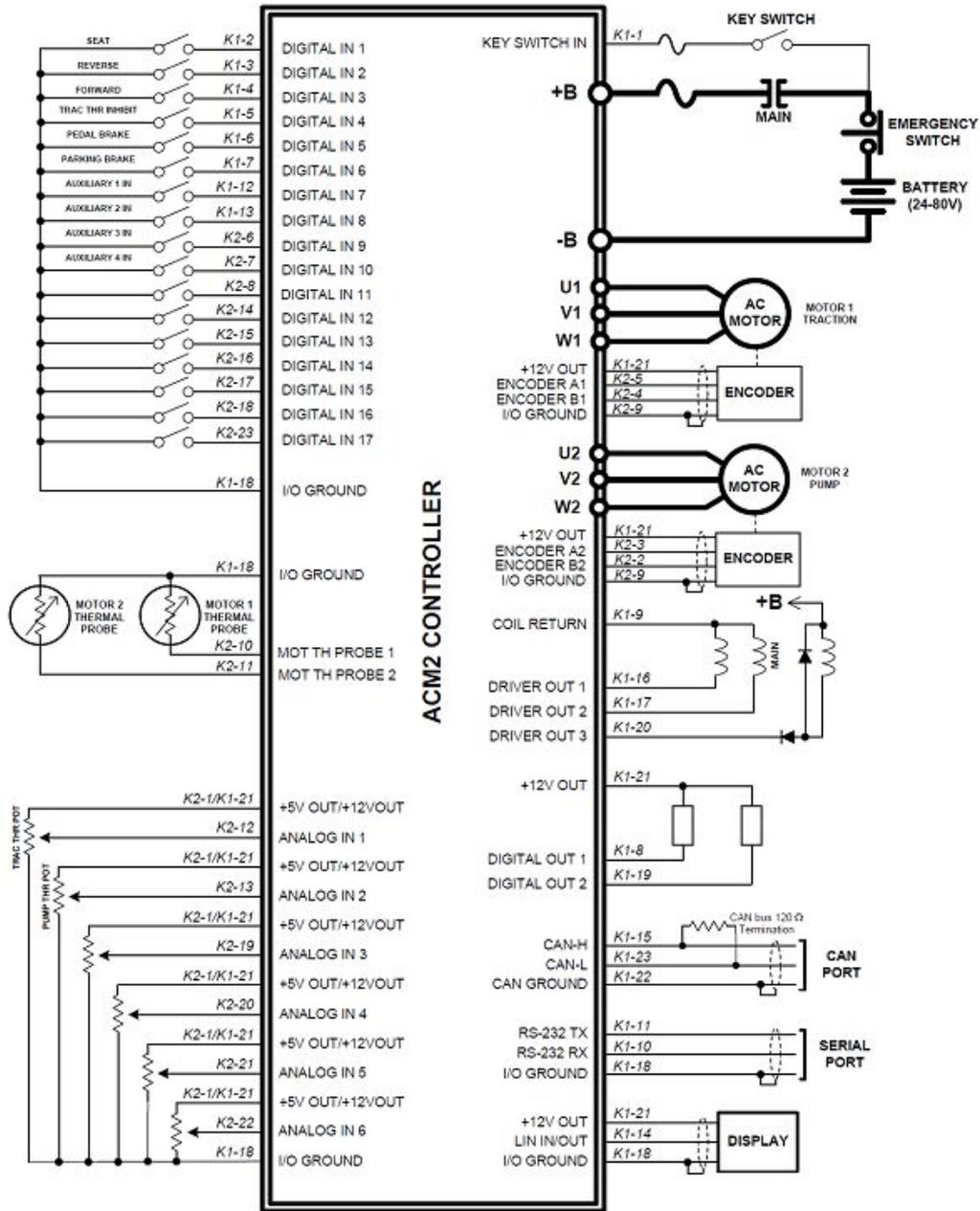
<b>Storage ambient temperature range</b>	-40°C ÷ +70°C
<b>Operating ambient temperature range</b>	-40°C ÷ +55°C
<b>Heatsink operating temperature range</b> - With linear derating	-40°C ÷ +95°C +80°C ÷ +95°C
<b>Protection Level</b>	IP65
<b>Vibration</b>	Tested under conditions suggested by EN60068-2-6 [5g, 10÷500Hz, 3 axes]
<b>Shock &amp; Bump</b>	Tested under conditions suggested by EN60068-2-27
<b>Cold &amp; Heat</b>	Tested under conditions suggested by EN60068-2-1
<b>Mechanical size</b>	210 x 145 x 91 [mm]
<b>Weight</b>	3 kg

# 6. INSTALLATION AND WIRING



## INTERACTIVE DOCUMENTATION

For specific application, refer to the About Controllers Area of the Interactive Documentation.



AC-M2 Wiring Diagram

---

## 6.1 Controller

---



### CAUTION

The Controller contains ESD-sensitive components. Use appropriate precautions in connecting, disconnecting, and handling it.

---



### WARNING

Working on electrical systems is potentially dangerous; you should protect yourself against:

**Uncontrolled operation:** some conditions could cause the motor to run out of control: disconnect the motor or jack up the vehicle and get the drive wheels off the ground before attempting any work on the motor control circuitry.

**Voltage hazard and high current arcs:** batteries can supply high voltage and very high power, and arcs can occur if they are short circuited. Always disconnect the battery circuit before working on the motor control circuit. Wear safety glasses and use properly insulated tools to prevent shorts. Never energize the system if the terminals –B and +B are not tightly connected.

**Lead acid batteries:** charging or discharging generates hydrogen gas, which can build up and go around the batteries. Follow the battery manufacturer's safety recommendations and wear safety glasses.

---

### Mechanical Drawing

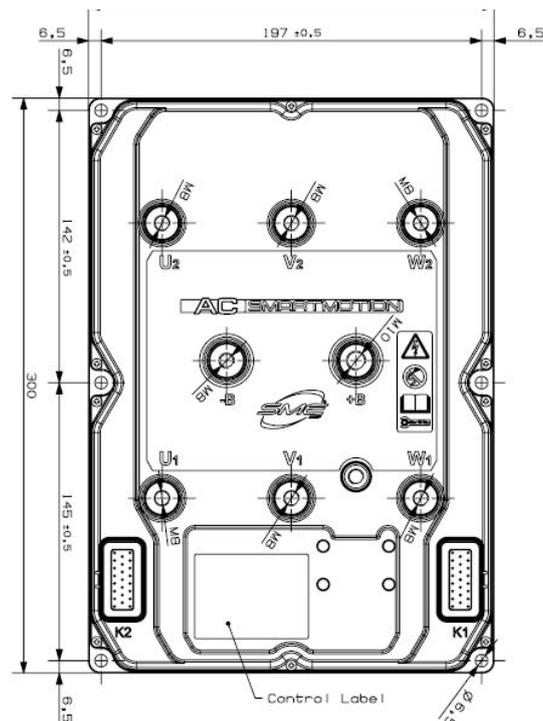
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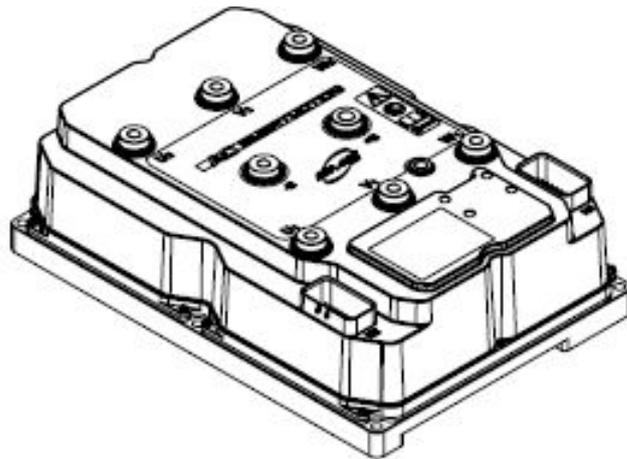
### INTERACTIVE DOCUMENTATION

For high resolution diagram, refer to the About Controllers Area of the Interactive Documentation.

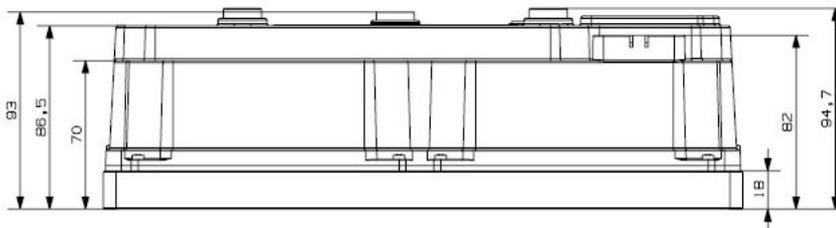
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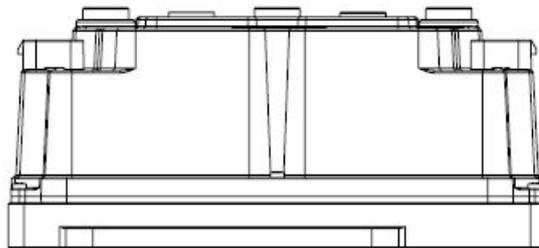
AC – M2 Top View



*AC – M2 General View*



*AC – M2 Side View*



*AC – M2 Back View*

### **Mounting and Replacement**

The Controller meets IP65 environmental protection rating against dust and water.

The mounting location should be carefully chosen in order to be clean and dry, to minimize shock, vibration, temperature changes and exposure to water & contaminants. If this kind of location can't be ensured, then a cover should be used to shield the controller. Cables must be routed to prevent liquids flowing into the connections. The mounting location should also allow access to all connections.

The replacement of the Controller must be done with the hand brake engaged, the drive wheels off the ground, the key switch in off position, battery plug disconnected and the capacitors of the inverter completely discharged. The capacitors in the inverter can be discharged by connecting a load across the inverter's +B and -B terminals.



### **CAUTION**

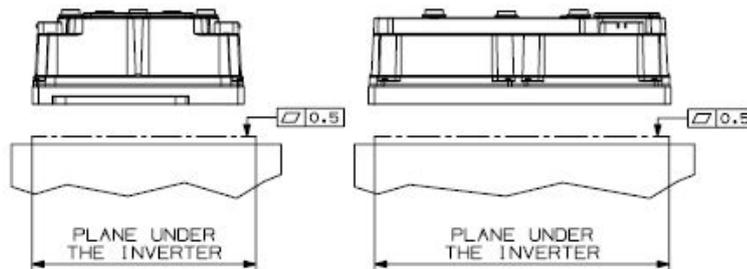
Avoid to swap K1 and K2 connectors. This operation can seriously damage the Controller.

---

## Cooling

It is recommended that the Controller is assembled to a flat, free of paint surface preferably lightly coated with a thermal transfer compound using the 4 holes provided. Ideally, this surface will provide maximum heat dissipation and ensure full rated power output. When designing a cooling system, please refer to the following steps:

1. Apply thermal grease to the Controller before mounting for better cooling effect.
2. The Controller is cooled by the surface contact to the vehicle body, so it is important to pay much attention to the flatness and the roughness of the surface of the vehicle frame where it is mounted. The roughness Rz should be between 1.6  $\mu\text{m}$  and 3.2 $\mu\text{m}$ , while the planarity of the surface should be under 0.5mm, as shown in the following image:



*Planarity specifications for the AC-M2 with aluminium baseplate.*

3. Any airflow around the controller will further enhance the thermal performance.
4. Additional heatsink could be necessary to meet the desired continuous ratings. The heat sink material and system should be sized on the performance requirement of the machine. We recommend ambient temperature air to be directed over the heatsink fins to maintain heatsink temperature below 75 °C.
5. In systems where either ventilation is poor, or heat exchange is difficult, forced air ventilation should be used.

## Clearances

For all AC-M2 models 50 mm clearances in front of and behind the AC-M2 are required for airflow; 50 mm clearance above the AC-M2 is required for installation/removal of interface connectors and wiring.

## 6.2 Power Terminals

### Wiring

The Controller has eight Power Terminals, which are clearly marked on Controller's body as B+, B-, U1, V1, W1, U2, V2 and W2 (See "AC – M2 General View").

Power Terminals on Controller	
Terminal	Meaning
B+	Positive Battery coming from the Main Contactor
B-	Negative Battery
U1	U1 Motor Phase
V1	V1 Motor Phase
W1	W1 Motor Phase
U2	U2 Motor Phase
V2	V2 Motor Phase
W2	W2 Motor Phase

The recommended screw torque for fixing the Power Terminals is 6.4 Nm. This value is reported on the label placed on the cover, exceeding the recommended value may cause damages.

## Sizing

The environment conditions strongly affect the current carrying capacity of a single wire. Temperature and wire length can decrease the cable performance and other factors such as Controller duty cycles and airflow should also be taken into consideration when sizing the power cables.

The following formula gives an advice on the cable size needed in welding cable, not grouped with other cables:

$$\text{Minimum Wire Section suggested}[\text{mm}^2] = \frac{\text{Average Current}}{\text{Suggested Current Density}}$$

Ambient Temperature	25°C
Maximum Temperature rise on the cable surface	60°C
Suggested Current Density [A <sub>rms</sub> /mm <sup>2</sup> ]	5 A <sub>rms</sub> /mm <sup>2</sup>

The following table shows you the most common cases:

Average Current [A <sub>rms</sub> ]	Minimum Wire Section Suggested [mm <sup>2</sup> ]	Wire Size	
		Mm <sup>2</sup>	AWG
100	20	21.1	4
150	30	33.6	2
200	40	42.4	1
250	50	53.5	0
300	60	67.4	2/0
350	70	85	3/0

## 6.3 Main contactor

The Controller must be connected to one Main contactor for two basically reasons:

- **Capacitors Pre-Charge:** The Controller handles all this phase internally by discharging/charging its DC-Bus through the Key Input. As soon as a certain voltage value is reached by the DC-Bus, the Controller can close the Main contactor connecting it to the Battery. In this way dangerous shocks on Controller's capacitors are avoided.
- **Safety:** In case of dangerous situations, the Main contactor must be opened disconnecting the Battery from Controller. If the main contactor coil is not connected to the controller, the system will not meet EEC safety requirements.

## Sizing

In order to select the Main Contactor, it must be considered the Controller Ratings, the Duty Cycle of the System and several other working conditions. The following empirical formula can be useful to quickly find the **Main contactor minimum rating I<sub>MC</sub>**:

$$I_{MC} = \frac{\text{Max Power } 2'[\text{kVA}] \times 1000 \times 0.6}{V_{\text{Battery}}}$$

with 0.6 = Factor between Maximum (S2 2') and Continuous Power (S2 60').

## 6.4 Fuse

A fuse protects the Controller and the entire system against shorts circuit in the power section and it can be mounted in the Controller between the +B and the related terminal.

Anyway, consider that the fuse doesn't be used to avoid overloads on the Controller or on the AC Motor. The firmware inside the Controller already manages them so they don't usually cause the fuse to blow.

### Sizing

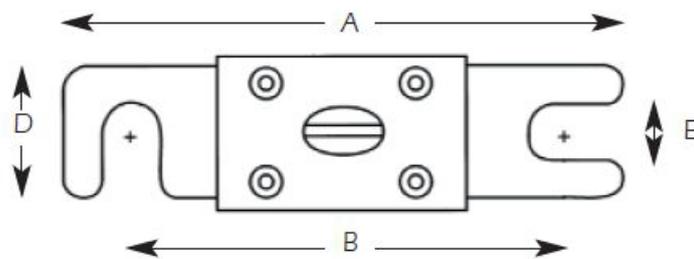
In order to select the Fuse Rating, refer to the following formula:

$$I_{FUSE} = \frac{Max\ Power\ 2'[kVA] \times 1000 \times \overline{\cos(\varphi)}}{V_{Battery} \times \mu_C}$$

with  $\mu_C$  = Minimum Controller Efficiency = 0.95 and  $\overline{\cos(\varphi)}$  = Medium Power Factor.

You must choose a fuse with specific rating and time delay characteristics. It must carry  $I_{FUSE}$  indefinitely, but blow within maximum 3 seconds for  $2 \times I_{FUSE}$ .

The following diagram shows common dimensions for fuse on Controller.



Dimensions (mm)	
A	82
B	60
D	20
E	11

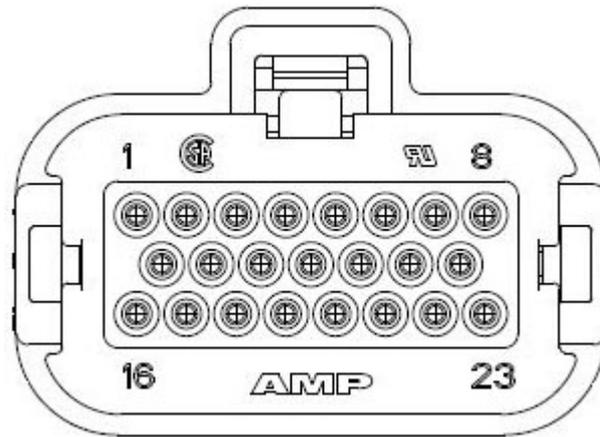
*Fuse Dimensions*

Suggested Manufacturers are FERRAZ, BUSSMAN, LITTELFUSE and others which satisfy the time delay and dimensions required.

---

## 6.5 Signal

The Controller uses two Ampseal connectors:



*Ampseal Connector*

Refer to the following specifications for these connectors:

Number of Positions	23
Mounting Style	Wire
Termination Style	Crimp
Contact Type	Plug
Current Rating	17 A
Housing Material	Thermoplastic
Material	Plastic
Number of Rows	3
Packaging	Bulk
Type	Female
Wire Gauge Range	20 AWG - 16 AWG

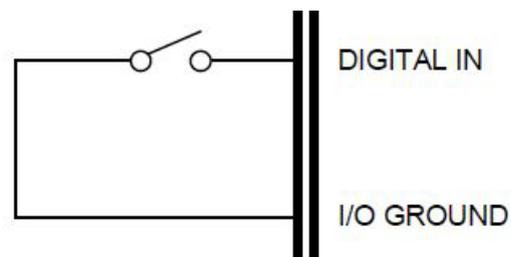
For detailed product information, please refer to the **AMPSEAL Connectors: Product Specification 108-1329**. In order to ensure a fine wiring, please refer to the **AMPSEAL Automotive Plug Connector and Header Assembly: Application Specification 114-16016**.

## 6.5.1 Digital Inputs

Digital Inputs on Controller			
Pin	Meaning	Pin	Meaning
K1 - 2	Digital Input 1	K2 - 6	Digital Input 9
K1 - 3	Digital Input 2	K2 - 7	Digital Input 10
K1 - 4	Digital Input 3	K2 - 8	Digital Input 11
K1 - 5	Digital Input 4	K2 - 14	Digital Input 12
K1 - 6	Digital Input 5	K2 - 15	Digital Input 13
K1 - 7	Digital Input 6	K2 - 16	Digital Input 14
K1 - 12	Digital Input 7	K2 - 17	Digital Input 15
K1 - 13	Digital Input 8	K2 - 18	Digital Input 16
K1 - 18	I/O Ground	K2 - 23	Digital Input 17

### Wiring

All Digital Inputs are 4mA pull-up. All of them have  $V_L \leq 1V$  and  $V_H \geq 3,5V$ .



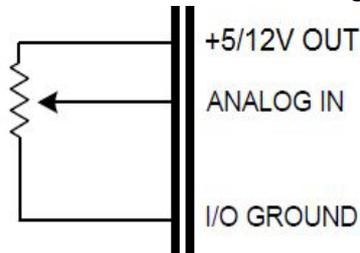
*Negative Logic for Digital Input*

## 6.5.2 Analog Inputs

Analog Inputs on Controller			
Pin	Meaning	Pin	Meaning
K1 - 18	I/O Ground	K2 - 1	+5V Out
K1 - 21	+12V Out	K2 - 12	Analog Input 1
		K2 - 13	Analog Input 2
		K2 - 19	Analog Input 3
		K2 - 20	Analog Input 4
		K2 - 21	Analog Input 5
		K2 - 22	Analog Input 6

### Wiring

All Analog Inputs are +5/12V pull down, the recommend resistance range of external potentiometer is 5÷10kΩ.



*Potentiometer connected to Analog Input*

### 6.5.3 Driver Outputs (PWM)

Driver Outputs on Controller			
Pin	Meaning	Pin	Meaning
K1 - 9	Coil Return	K2 - 1	+5V OUT
K1 - 16	Driver Output 1 (Max 2A)		
K1 - 17	Driver Output 2 (Max 1.5A)		
K1 - 20	Driver Output 3 (Max 1.5A)		
K1 - 21	+12V Out		

#### Wiring

The Driver Output (low side output) is the negative reference applied to the load. The positive reference is given by the other pin connected:

Driver Outputs Wiring on Controller		
Positive Reference	How to wire	
	Driver Output 1 – Driver Output 2	Driver Output 3
Controller +5/12V		
Battery Voltage		
External Supply from a DC/DC converter	Not allowed	

## 6.5.4 Digital Outputs (ON/OFF)

Digital Outputs on Controller			
Pin	Meaning	Pin	Meaning
K1 - 8	Digital Output 1 (Max 0.5A)	K2 - 1	+5V OUT
K1 - 9	Coil Return		
K1 - 19	Digital Output 2 (Max 1.5A)		
K1 - 21	+12V OUT		

### Wiring

The Digital Output (low side output) is the negative reference applied to the load. The positive reference is given by the other pin connected:

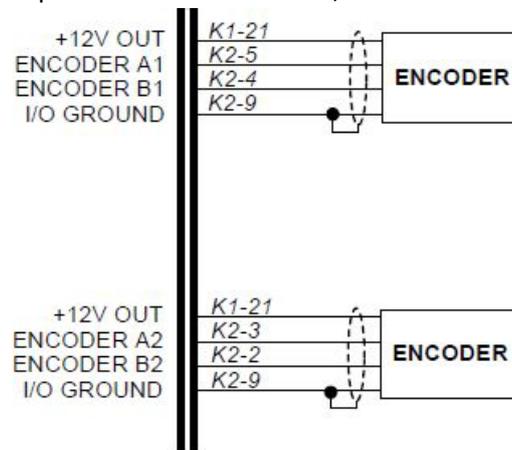
Digital Outputs Wiring on Controller	
Positive Reference	How to wire
Controller +5/12V	
Battery Voltage	
External Supply from a DC/DC converter	

## 6.5.5 Speed Sensor Inputs

Speed Sensor Inputs on Controller			
Pin	Meaning	Pin	Meaning
K1 - 21	+12V OUT	K2 - 1	+5V OUT
		K2 - 2	Quad Encoder Channel B2
		K2 - 3	Quad Encoder Channel A2
		K2 - 4	Quad Encoder Channel B1
		K2 - 5	Quad Encoder Channel A1
		K2 - 9	Negative Logic Supply

### Wiring

The Encoder Channels are 20mA Pull-up with  $V_L \leq 1V$  and  $V_H \geq 3,5V$ .



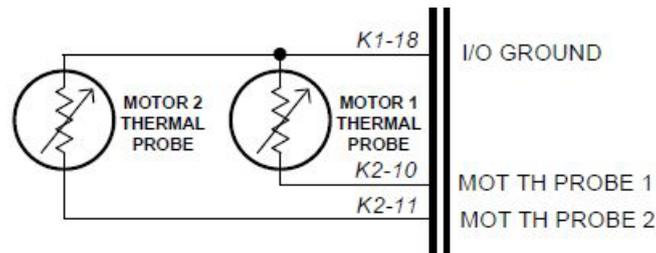
*Encoders Wiring*

## 6.5.6 Thermal Probe

Speed Sensor Inputs on Controller			
Pin	Meaning	Pin	Meaning
K1 - 18	Negative Logic Supply	K2 – 10	Motor Temperature Probe 1
		K2 – 11	Motor Temperature Probe 2

### Wiring

The Controller can acquire the Motor Temperature through the Thermal Sensor:



*Thermal Probe Wiring*

The following sensors are supported:

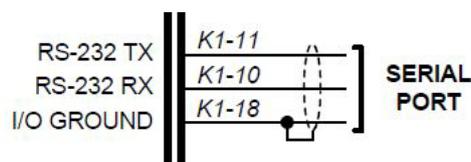
Thermal Probe supported on Controller	
Code	Meaning
DKF103N3	NTC – Negative Temperature Coefficient
KTY84-130/150	PTC – Positive Temperature Coefficient
KTY83-121/122	PTC – Positive Temperature Coefficient
PT 1000	PTC – Positive Temperature Coefficient
SWITCH - (NO)	Normally Open Switch
SWITCH - (NC)	Normally Closed Switch

## 6.5.7 Serial

Serial Pins on Controller	
Pin	Meaning
K1 – 11	RS-232 TX
K1 – 10	RS-232 RX
K1 – 18	Negative Logic Supply

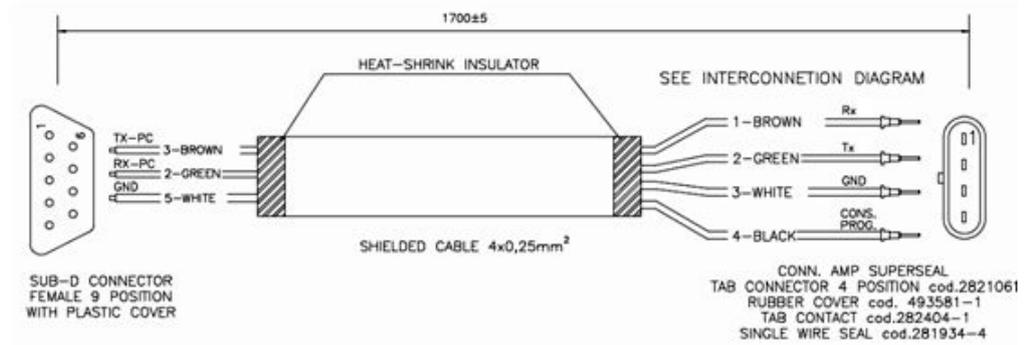
### Wiring

The Controller communicates with the PC through the serial RS-232 with a speed of 38.4Kbps.



*Serial Wiring*

The following picture represents the schematic of interconnection cable from the Controller to the Sub-D connector.



*Interconnection*

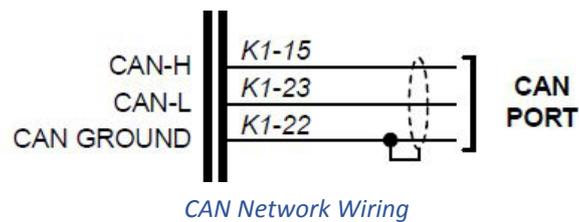
You can communicate with the controller through:

- RS-232 serial port, using an interconnection cable.
- USB port, using a serial-to-USB converter:
  - Supported: Prolific chip
  - Recommended: FTDI chip

### 6.5.8 CAN Network

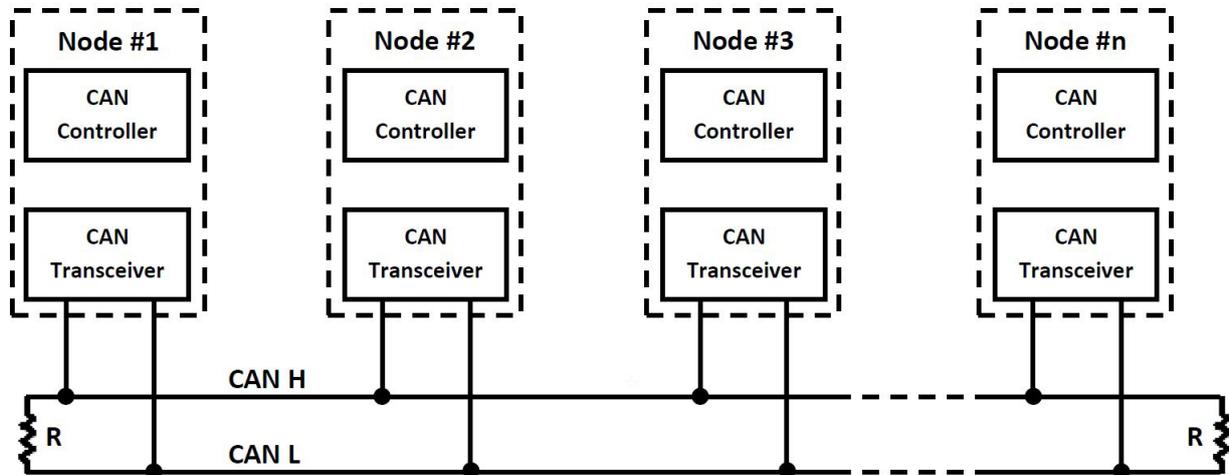
CAN Network Pins on Controller	
Pin	Meaning
K1 – 15	CAN - H
K1 – 23	CAN - L
K1 - 22	CAN Ground

#### Wiring



*CAN Network Wiring*

The High-Speed ISO 11898 Standard specifications are given for a maximum signaling rate of 1 Mbps with a bus length of 40m and a maximum of 30 nodes. It also recommends a **maximum unterminated stub length of 0.3m**. The cable is specified to be a shielded twisted-pair with a 120Ω characteristics impedance ( $Z_0$ ). The Standard defines a single line of twisted-pair cable with the network topology as shown in the following picture:



It's terminated at both ends with 120Ω resistors in order to adapt the lines to a fixed impedance, avoiding reflections or other problems that can occur at high frequency of CAN (from 125KBaud to 1Mb). Placing these resistors on a node should be avoided since the bus line loses termination if the node is disconnected from the bus.

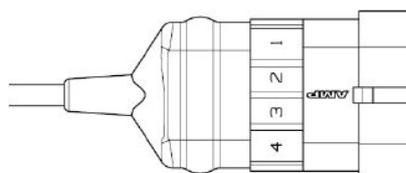
## 6.6 SME external devices description

The Controller can be connected to SME external devices described below.

### 6.6.1 Encoder

The encoder can detect the rotating motion of the toothed wheel fixed to the motor shaft and it generates two electrical signals (square wave and open collector type), usual for kind of encoders. The two output signals, named channel A and channel B, are shifted by 90 electrical degrees. Their frequency is proportional to the rotational speed of the motor shaft. Since the toothed wheel has 64 teeth, each channel generates 64 pulses every complete turn of the shaft.

SME Encoder			
Electrical Data		Mechanical Data	
Pulses/Rev	64	Protection Level	IP67
Max. Speed	10000rpm	Weight	64g



Pin	Wiring
1	Vcc
2	Gnd
3	Channel A
4	Channel B

---

## 6.6.2 Displays

SME displays (Compact or Mini) are optional devices which show overall information about your system. They have to be connected to controller through LIN interface.



*Display Compact*

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## 7. GRAPHICAL INTERFACE

The Controller has a number of parameters that can be calibrated using SME PC Graphical User Interface (GUI) which is user friendly and intuitive.

These programmable parameters allow the vehicle functions and performances to be customized to fit the needs of different applications. They are grouped into main categories (i.e. system, motor & control, traction / pump), and into additional subgroups, each with its own programming menu. Most of Controller default settings are fixed by SME software developers; even if user opt to leave most of the parameters at their default values, each parameter can be calibrated inside an allowable range.

Operator is easily guided through the process of parameter set-up and can communicate with the controller during working operations and can analyze real-time main system variables.

**Do not drive the vehicle until initial set-up has been completed.**

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### INTERACTIVE DOCUMENTATION

For deep and exhaustive information about programmable parameters and calibration procedure refer to the Interactive Documentation.

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#### Minimum requirements

- 350MHz Pentium class or higher microprocessor
- 128MB or greater of RAM
- Serial port/USB port
- Graphic card 1MB
- Windows XP/Vista/7/8/8.1
- 1024x768 resolution video adapter

#### Recommended requirements

- 1GHz Pentium class or higher microprocessor
- 512MB of RAM
- Serial port/USB port
- Graphic card 2MB
- Windows XP/Vista/7/8/8.1
- 1024x768 resolution video adapter