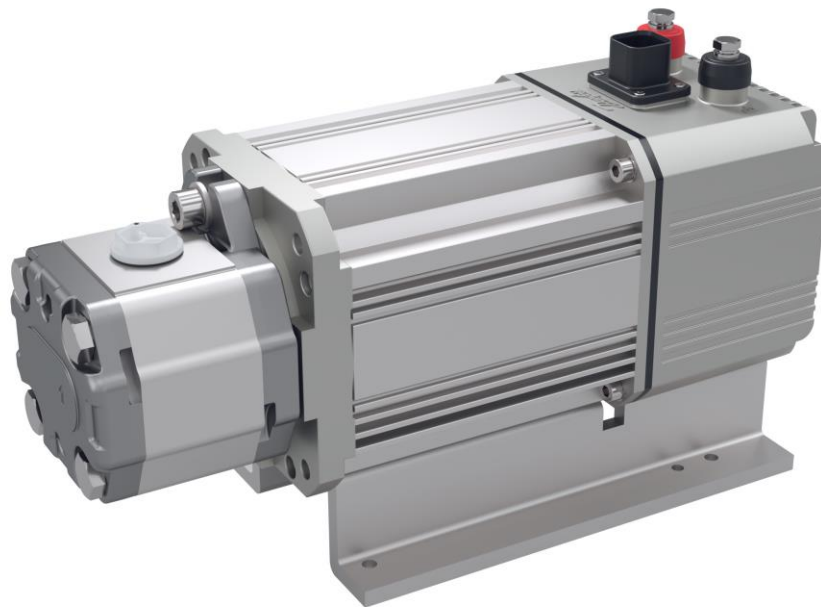


Technical Information

ePowerpack ED-EP130



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Technical Information
ePowerpack ED-EP130

Revision History

Revision Table

| Date | Change | Version |
|-------------|---------------------|----------------|
| July. 2022 | Version 1 | 0101 |
| Feb. 2024 | Update Product Code | 0102 |

Technical Information

ePowerpack ED-EP130

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Overview

The Danfoss ED-EP130 ePowerpack is designed with optimized structure, allowing for achieving maximum system efficiency while ensuring compact overall dimensions. The ED-EP130 is equipped with high-performance built-in permanent magnet synchronous motor and controller. Gear pumps with different displacement are available via parameter adjustment. This servo hydraulic system is the optimal choice for mobile elevated work platforms (MEWP) and off-highway applications, providing flow for the whole vehicle hydraulic system.

Benefits

As the power drive unit of the system, the permanent magnet synchronous motor has the following benefits:

- The magnetic field is generated by permanent magnets, avoiding generating a magnetic field through excitation current, with increased power density and reduced excitation loss (copper loss);
- Low starting current and high torque;
- The maximum efficiency is > 95%, with high efficiency and wide working areas, and the proportion of efficient areas is > 85%;
- Wide range of operating speeds;
- Low torque ripple with smooth operation;
- Built-in structure with reliable and stable operation;
- Maintenance-free system with no need to replace carbon brushes;

ED-EP130 Features

Product

- ED-EP130 Compact Size, Easy to Install;
- Simply need to connect the power cord and CAN/throttle control cable;
- Integrated controller and built-in permanent magnet synchronous motor, with up to 93% maximum efficiency;
- IP67 protection grade, meeting the requirements of severe work conditions;
- Standard SAE A flange and 9-tooth splines, with quick installation adapting to standard gear pumps;
- Meet flow demands by poleless control of the motor speed through the CAN-bus or throttle signal;
- Commissioning parameters and power curves can be freely configured;
- Controller + motor + gear pump assembly test, ensuring efficient system assembly;
- Supporting handheld device, facilitating on-site commissioning;

Application Scenario

- Scissor forklift work platform
- Boom aerial work vehicle
- Electro hydraulic actuator (EHA)
- DC power frequency conversion hydraulic power pack
- Engineering mechanical electric assisted steering

Technical Information
ePowerpack ED-EP130

Profile

Product code definition

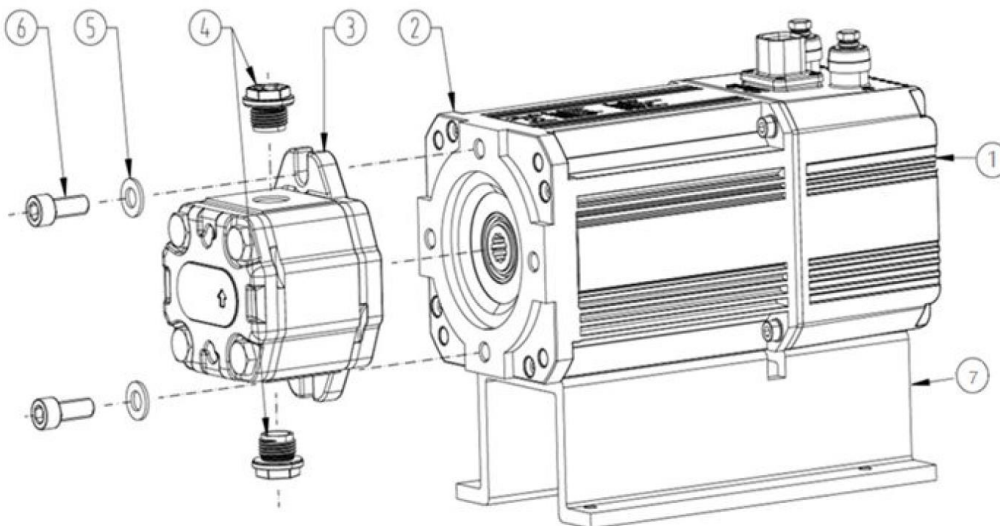
| Product code | Definition |
|-----------------------|--|
| ED-EP130-T22-24V-4000 | ED - Electric sub-system/system products |
| | EP130 - ePowerpack with 130 mm stator diameter |
| | T22 - Continuous torque |
| | 24V - 24VDC operating voltage |
| | 4000 - Max speed |

Profile
Other parts definition

| Optional Parts | Codes | Description |
|-------------------------------------|-------|------------------------------|
| Maximum busbar operating current | 200 | 200A |
| Flange and shaft extension of motor | SA | SAE Aφ82.55/SAE A J498-9T |
| Connector | A | AMP 776276-1 |
| Cable connection mode | 1 | Cable built-out |
| Displacement of gear pump | 39 | 3.9cc/r |
| | 49 | 4.9cc/r |
| Steering of gear pump | L | Left Rotation |
| | R | Right Rotation |
| Installation direction of gear pump | D | Oil outlet facing downwards |
| | U | Oil outlet facing upwards |
| | L | Oil outlet facing leftwards |
| | R | Oil outlet facing rightwards |
| Packaging format | S | Single |
| | P | Pallet |

Function

Composition of main components



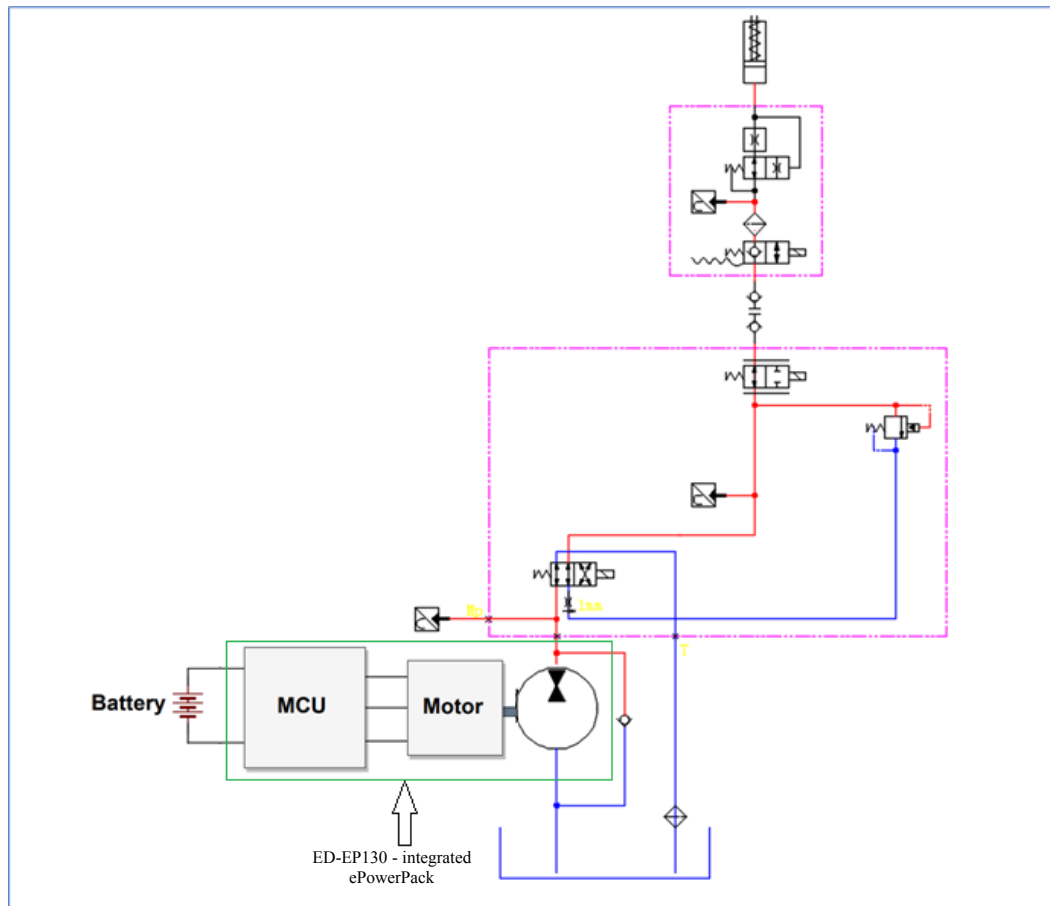
List of main components

| Serial Number | Name of Component |
|---------------|-------------------|
| 1. | Motor controller |
| 2. | Motor |
| 3. | Gear pump |
| 4. | Plastic plug |
| 5. | Washer |
| 6. | Bolt |
| 7. | Footing |

Function

ED-EP130 - scissor forklift integrated ePowerpack

Whole vehicle functional principles



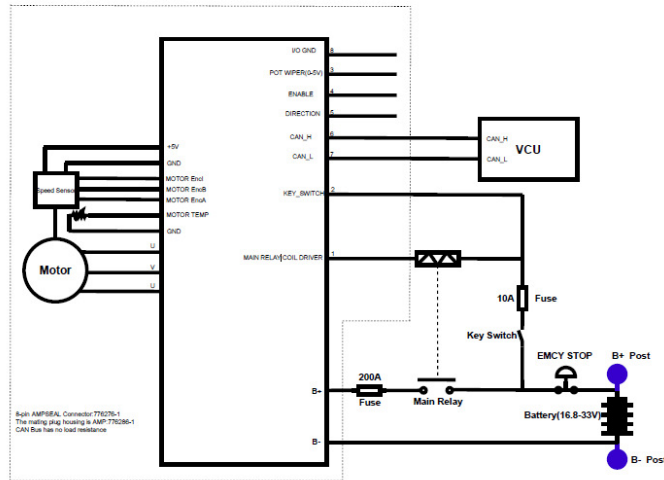
The ED-EP130 ePowerpack provides power for the whole vehicle. This product converts the DC power (batteries in the vehicle) to three-phase AC and output it to the permanent magnet synchronous motor to drive the gear pump and generate oil pressure, thus driving the lifting or walking of the scissor forklift work platform.

ED-EP130 - Power System Control Wiring Diagram

There are two typical wiring modes for the ED-EP130 ePowerpack, which refer to the typical CAN wiring diagram and the typical analog throttle control wiring diagram, as shown below:

Function

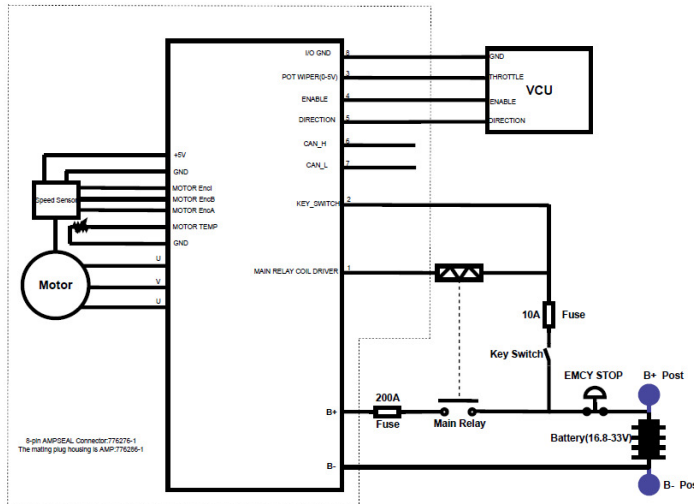
Power Pack Typical Wiring Diagram By CAN



**Inside the Virtual Frame is the PowerPack

Typical CAN Wiring Diagram

Power Pack Typical Wiring Diagram By Throttle

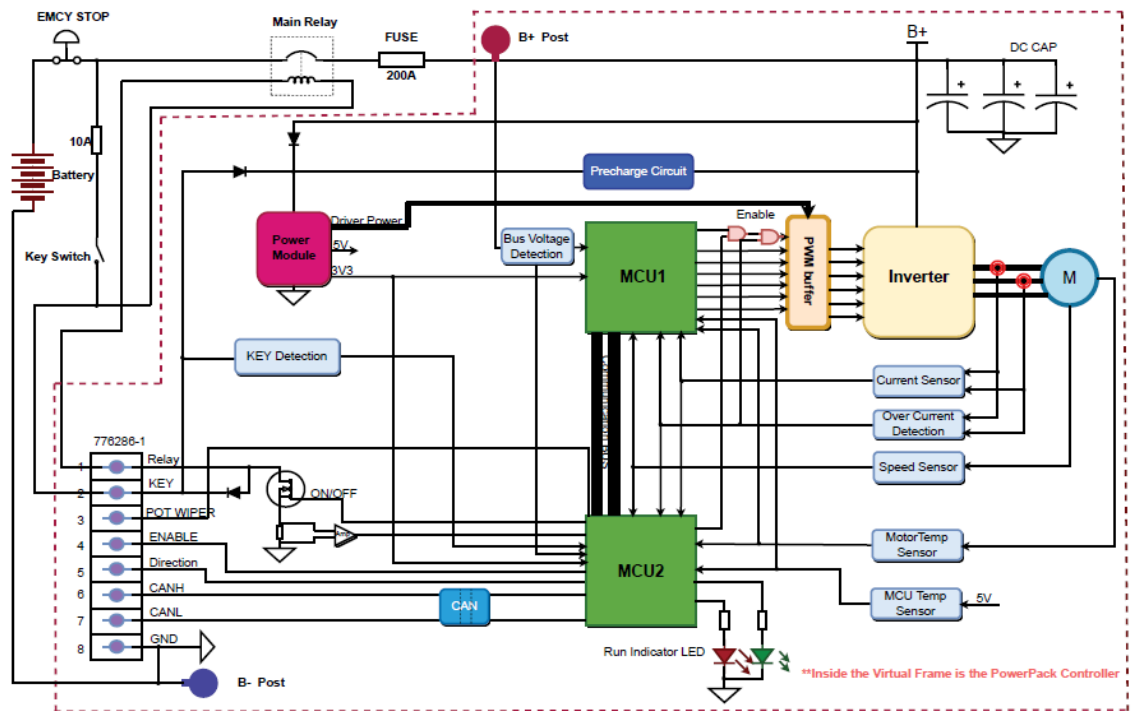


**Inside the Virtual Frame is the PowerPack

Typical Analog Throttle Control Wiring Diagram

Controller Block Diagram

E-scissor PowerPack Project Control Block Diagram



Recommended wiring for external electrical system

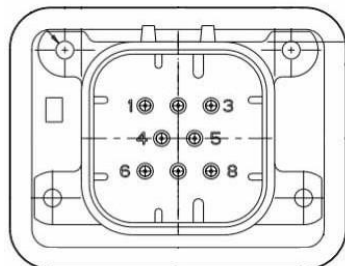
The controller is equipped with two high current power interface terminal posts and one signal connector. The power interface terminal posts are used to provide busbar voltage to the controller, which is the power source for the entire power system. The signal connector is used for low-voltage signal transmission such as key switch power supply and CAN communication command, etc.

Power interface terminal post:

- B+ battery power positive end.
- B- battery power negative end.
- B+, B- recommended wire diameter 35 mm², M6 bolt torque: 7 - 8 Nm;

Signal interface:

- 8Pin AMP 776286-1 connector (see Figure 2 for pin numbers)
- See the Pin Information Configuration Table for the pin definition



Function

Pin diagram

Pin definition

| Pin count | Type | Name | Description |
|-----------|-------|------------------------|---|
| 1 | Input | Main Relay Coil Driver | Main relay drive (connected to the negative end of the relay drive) |
| 2 | Input | Key Switch | Key input switch |
| 3 | Input | Pot Wiper | Analog throttle signal input (0 - 5 V) |
| 4 | Input | ENABLE | Enable signal input |
| 5 | Input | DIRECTION | Direction signal input |
| 6 | / | CAN_H | CAN communication bus high end |
| 7 | / | CAN_L | CAN communication bus low end |
| 8 | Input | I/O GND | I/O ground reference signal |

I/O signal cable

For a low-voltage signal input cable, it is recommended to use the 0.5 mm² cable.

It is recommended to keep the low-voltage signal cable away from the power cable as far as possible, and ensure a spacing of 100 mm between the two types of cables.

To avoid signal interference, it is recommended not to connect any signal ground wire onto the vehicle frame (even if it is allowed in EN1175-1 that the ground wire of the signal cable can be connected to the vehicle frame in a 24 V system)

When the controller is working, there is a large amount of current flowing through the busbar of the motor controller. Even selecting a power cable with a reasonable wire diameter can lead to a significant voltage drop between the battery negative end and the controller negative end, which means that there may be a voltage difference between the GND reference grounds of different units in the entire control system. Therefore, it is strongly recommended to connect all input/output pins of the sensors provided by the motor controller directly onto the corresponding input/output pins of the controller. Do not connect the signal cable at will, which may cause instability of the entire system.

To avoid electromagnetic interference on the CAN bus, it is recommended to use twisted pair cables as the CAN connection line, and to keep the CAN wiring away from the power cable. When necessary, cross it at right angles, without parallel wiring.

Power cable

Tightly connect the controller and batteries together using high quality copper wiring terminals and well-insulated copper wires in accordance with the recommended torque value.

To achieve optimal anti-electromagnetic interference performance, do not cross the battery cable (B+, B-) through the central part of the controller as much as possible.

In case that there are multiple high current electricity consuming units in the system, please connect the negative end of the electricity consuming unit to the negative end of the battery in a star connection mode.

Technical Information ePowerpack ED-EP130

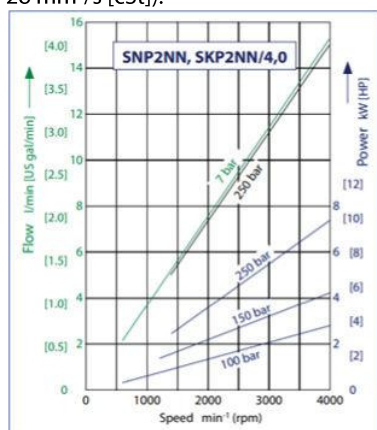
Technical parameters

Technical parameters of gear pump

The technical parameters of the gear pump as follows are the result of typical measurements. For the hydraulic system, the mineral hydraulic oil with a viscosity of 21 mm²/s (102 SUS) and a temperature of 50 °C (122 °F) is used.

| Parameter name | Unit | Value | |
|--|----------------------|-------|------|
| Displacement | cm ³ /rev | 3.9 | 4.9 |
| Theoretical flow at maximum speed | L/min | 15.6 | 19.6 |
| Rated pressure | bar | 250 | 250 |
| Peak pressure | bar | 280 | 280 |
| Minimum speed (pressure 0 - 100 bar) | rpm | 600 | 600 |
| Minimum speed (pressure 100 - 180 bar) | rpm | 1200 | 1200 |
| Minimum speed (pressure 180 - 250 bar) | rpm | 1400 | 1400 |
| Maximum speed | rpm | 4000 | 4000 |
| Weight | Kg | 2.3 | 2.35 |

The following figure shows the typical output flow and input power of the gear pump (3.9 cc) under different working pressures, and the data is obtained using ISO VG46 petroleum/mineral based fluid at 50 °C (a viscosity of 28 mm²/s [cSt]).



Motor technical parameters

This unit adopts the permanent magnet synchronous motor as the drive motor. Compared to a asynchronous motor, the permanent magnet synchronous motor has higher power density and torque density. At the same mass and volume, the permanent magnet synchronous motors can provide maximum power output and acceleration for the lifting of a scissor forklift, which is also the main development direction in the field of aerial work vehicles with extremely high requirements for space and battery range. Under the same work conditions, the powerpack unit adopting the permanent magnet synchronous motors has higher efficiency and longer range, thereby reducing the charging frequency of aerial work vehicle batteries. The specific parameters are as follows:

Rated power: 3.5 kW

Rated speed: 3,000 r/min

Maximum speed: 4,000 r/min

Rated torque: 9.6N.m

Maximum torque: 21N.m

Number of poles of the motor: 10 poles

Technical Information

ePowerpack ED-EP130

Cooling mode: Natural air cooling: Type Y

Technical parameters

Protection grade: IP67

Insulation grade: Grade F

Model of the motor temperature sensor: KTY84-150

Parameters of the motor controller

The controller adopts a dual MCU main control chip control system, with MCU 1 used for motor control and MCU 2 used for functional safety testing and whole vehicle information exchange, which has improved the real time performance of the motor control and the safety of the system. The control system is configured with two strategies: overcurrent hardware protection and software protection, which has higher timeliness than the conventional single software protection strategy, thus reducing the failure rate of electronic control of the motor. An isolated CAN circuit is adopted to reduce the impact of external interference on the controller system. The important parameters are as follows:

Rated voltage: 24VDC

Voltage range: 16.8 - 33 VDC

Persistent current: 110 Arms (S2 - 60 min)

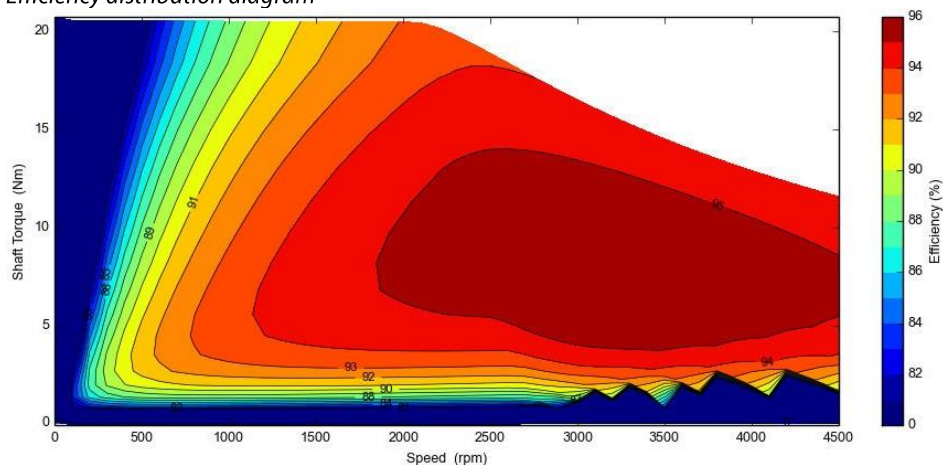
Peak current: 200 Arms (S2 - 30S)

Communication mode: CANopen

Connector model: AMP 776276-1

ED-EP130 ePowerpack Efficiency Distribution

Efficiency distribution diagram



Technical Information
ePowerpack ED-EP130

Software parameters

| Functional module | Parameter name | Range |
|------------------------|--|--------------|
| Control mode selection | Control mode | 0-1 |
| Fast speed mode | Fast speed mode Kp | 0-100% |
| | Fast speed mode Ki | 5-100% |
| | Forward acceleration rate | 0.1~30.0s |
| | Forward deceleration rate | 0.1~30.0s |
| | Forward braking rate | 0.1~30.0s |
| | Reverse acceleration rate | 0.1~30.0s |
| | Reverse deceleration rate | 0.1~30.0s |
| | Reverse braking rate | 0.1~30.0s |
| Speed mode | Forward, high speed, full throttle acceleration rate | 0.1~30.0s |
| | Forward, low speed, full throttle acceleration rate | 0.1~30.0s |
| | Forward, low throttle acceleration rate | 0.1~30.0s |
| | Forward, high speed, full brake deceleration rate | 0.1~30.0s |
| | Forward, low speed, full brake deceleration rate | 0.1~30.0s |
| | Forward, low brake deceleration rate | 0.1~30.0s |
| | Reverse, high speed, full throttle acceleration rate | 0.1~30.0s |
| | Reverse, low speed, full throttle acceleration rate | 0.1~30.0s |
| | Reverse, low throttle acceleration rate | 0.1~30.0s |
| | Reverse, high speed, full brake deceleration rate | 0.1~30.0s |
| | Reverse, low speed, full brake deceleration rate | 0.1~30.0s |
| | Reverse, low brake deceleration rate | 0.1~30.0s |
| | Neutral, high speed deceleration rate | 0.1~30.0s |
| | Neutral, low speed deceleration rate | 0.1~30.0s |
| | Low throttle deceleration rate | 0.1~30.0s |
| | Typical maximum speed | 500~10000rpm |
| | Controller relative high speed | 0~100% |
| | Controller relative low speed | 0~100% |
| Reverse soften control | 0~100% | |
| Motion limit | Maximum Forward Speed | 0-10000rpm |
| | Maximum Reverse Speed | 0-10000rpm |

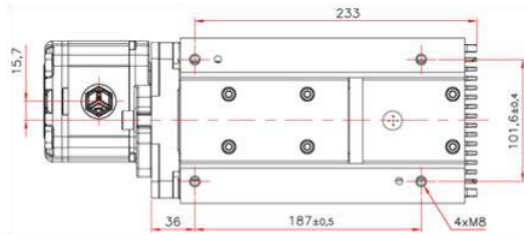
Software parameters

| | | |
|---|---|------------------|
| Current limit | PL Nominal Speed | 100-5000rpm |
| | Delta Speed | 50-1000rpm |
| | Drive current limit | 0~100.0% |
| | 1,000 rpm maximum drive current percentage | 0-100% |
| | 1,200 rpm maximum drive current percentage | 0-100% |
| | 1,400 rpm maximum drive current percentage | 0-100% |
| | 1,800 rpm maximum drive current percentage | 0-100% |
| | 2,600 rpm maximum drive current percentage | 0-100% |
| | 3,400 rpm maximum drive current percentage | 0-100% |
| | 4,200 rpm maximum drive current percentage | 0-100% |
| | Regenerative brake current limit | 0~100% |
| | 1,000 rpm regenerative braking current percentage | 0~100% |
| | 1,200 rpm regenerative braking current percentage | 0~100% |
| | 1,400 rpm regenerative braking current percentage | 0~100% |
| | 1,800 rpm regenerative braking current percentage | 0~100% |
| | 2,600 rpm regenerative braking current percentage | 0~100% |
| 3,400 rpm regenerative braking current percentage | 0~100% | |
| 4,200 rpm regenerative braking current percentage | 0~100% | |
| Drive parameters | Main relay enables | 0-1 |
| | Pull-in voltage | 0~30.0V |
| | Holding voltage | 0~30.0V |
| | Master contactor DNC fault voltage threshold | 0~30.0V |
| Battery parameters | Overvoltage | 100-150% |
| | Undervoltage | 5-100% |
| | Maximum output current limit of the battery | 0-300.0A |
| | Maximum allowable motor temperature | 0-150.0°C |
| | Motor encoder electrical angle offset | 0-1.000 |
| CAN interface | User PDO sending type | 0-10 |
| | User PDO receiving type | 0-10 |
| | CAN node 1 ID | 0x0-0x7F |
| | Baud rate (Kbps) | 125/250/500 kbps |
| Monitoring parameters | Throttle command | 0~100% |
| | Throttle voltage signal | 0~25.0V |
| | Key switch voltage | 0~48.0V |
| | Current command (RMS) | -300~300A |
| | Phase current (RMS) | -500~500A |
| | Motor speed | -32768-32767rpm |
| | Motor output torque | -3276.8-3276.7nm |
| | Battery voltage | 0-3276.7V |
| | Battery current | -3276.8-3276.7A |
| | Motor temperature | -3276.8-3276.7°C |
| | Controller temperature | -3276.8-3276.7°C |
| | Controller maximum temperature | 0-200.0°C |

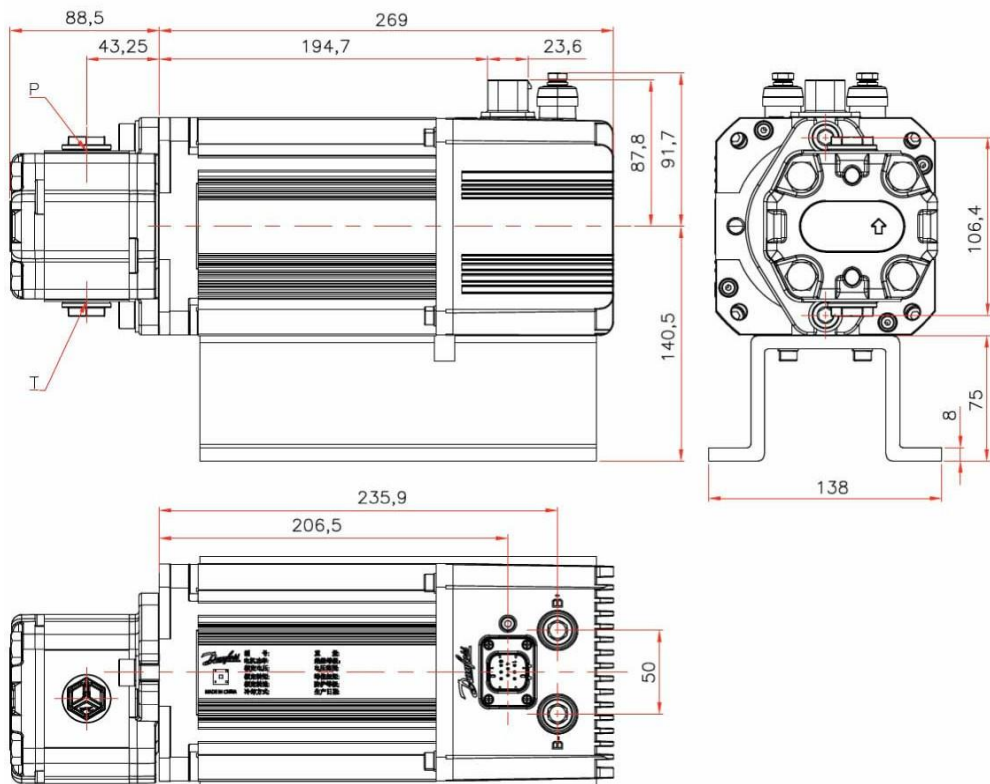
Technical Information
ePowerpack ED-EP130
Dimensions

High mounting feet

Mounting hole pattern



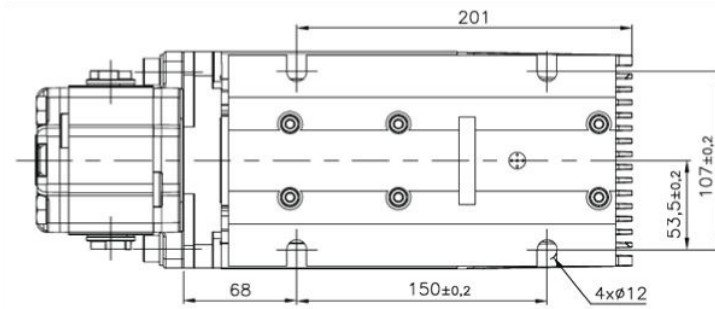
Overall dimensions of the product



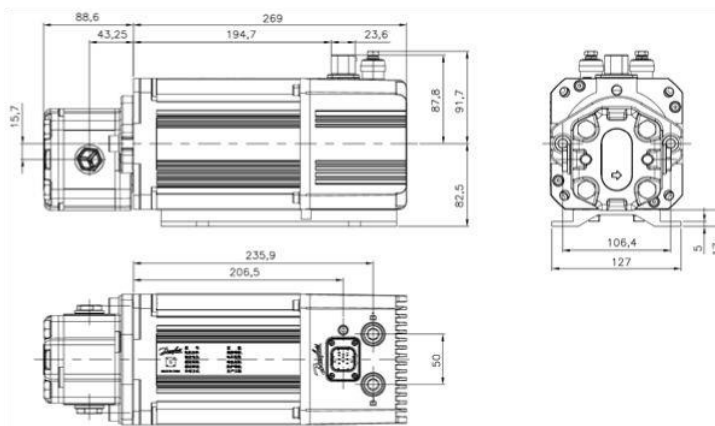
Dimensions

Low mounting feet

Mounting hole pattern



Overall dimensions of the product



Fault description;
Commissioning description;

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Local address:

Danfoss Power Solutions (US) Company
2800 East 13th Street
Ames, IA 50010, USA
Phone: +1 515 239 6000

Danfoss Power Solutions GmbH & Co. OHG
Krokamp 35
D-24539 Neumünster, Germany
Phone: +49 4321 871 0

Danfoss Power Solutions ApS
Nordborgvej 81
DK-6430 Nordborg, Denmark
Phone: +45 7488 2222

Danfoss Power Solutions Trading (Shanghai) Co., Ltd.
Building #22, No. 1000 Jin Hai Rd
Jin Qiao, Pudong New District
Shanghai, China 201206
Phone: +86 21 2080 6201

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