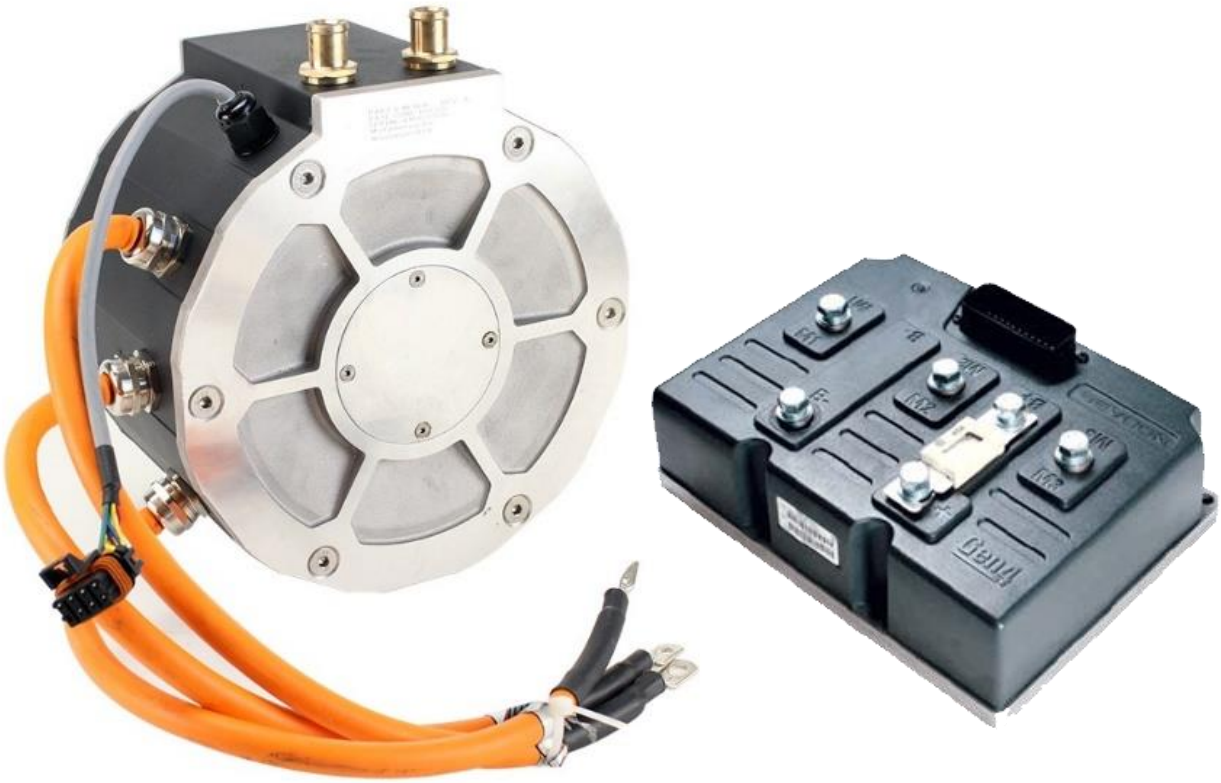
ELECTRIC DRIVE ENGINEERING



# Installation & Operating Manual

*48kW EDE Electric Drive Kit*

# Contents



## Contact Information

Electric Drive Engineering

10/52 Kent St, Cannington, Western Australia 6107

support@electricdriveengineering.com.au

www.electricdriveengineering.com.au


# Safety Disclaimer

Electric motors and inverters are high powered devices which involve potentially lethal voltages and currents. Proper precautions and electrical safety procedures should always be observed.

Never touch or work on this equipment live.

Please read this manual carefully before using this equipment to ensure correct installation and operation. If you are unsure of anything, please contact us before proceeding.

## User Responsibility

We have endeavoured to make a safe and reliable product however since Electric Drive Engineering has no control over the integration of its products, we can assume no responsibility for the safety or functionality of the completed vehicle/machine. It is up to the end user to determine the suitability of the products for the purpose employed, and the end user assumes all risks associated.

## Qualified Personnel Only

This product should only be installed by suitably qualified and experienced persons and should always be used in a safe and lawful manner. Please check your state or territories electrical regulations to ensure you are suitably qualified to install/use this product.

## Technical Support and Warranty

This product is covered by a 12-month warranty against manufacturing faults or failures under normal operating conditions. The warranty does not cover misuse of the product, including but not limited to:

- Modifications made to the harness (e.g. cutting the harness)
- Modification made to the DCF
- Excessive voltage or reversed polarity on input terminals
- Short circuits on output terminals
- Excessive voltages applied to control wiring
- Opening of housing and/or modification of internals
- Severe impact damage
- Exposure to water

We have taken great care to design a safe and reliable product, but faults can happen. If you believe this product has a fault, please contact us via our website to discuss.

If you have any questions not covered by this manual, please contact us at support@electricdriveengineering.com.au

# Introduction

Thank you for your purchase of an Electric Drive Engineering *48kW EDE Electric Drive Kit*. Please notify us immediately if any damage has occurred during shipping.

## About This Guide

This installation guide provides instructions and guidelines for assembling, mounting, starting, and operating your *48kW EDE Electric Drive Kit*.

This guide is intended to be used in conjunction with the following:

- *Sevcon Gen4 Applications Reference Manual*
- *Sevcon Clearview Display Reference Manual*

# Packing List

The standard packaging for the *48kW EDE Electric Drive Kit* consists of two parcels with a combined weight of 33kg.

## Package 1

Weight: 26kg

Dimensions: 370mm x 370mm x 320mm

| Item # | Description | Quantity | Purpose |
|---|---|---|---|
| 1a | Motenergy ME1616 | 1 | Traction motor |
| 1b | Phase cables | 3 | Cable between motor and controller |
| 1c | Mounting Bolts and washers | 4 | Secure motor |

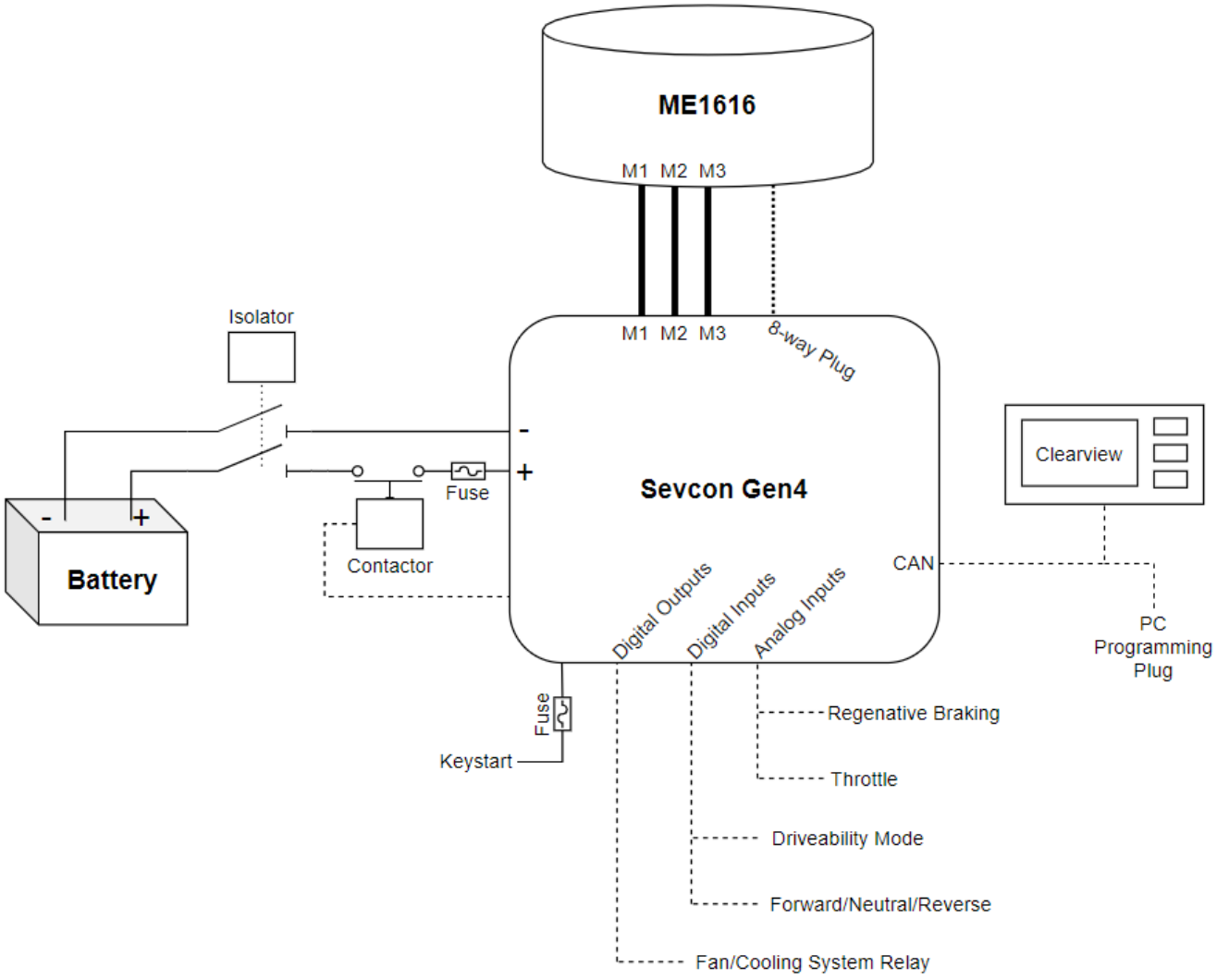
## Package 2

Weight: 8kg

Dimensions: 390mm x 290mm x 120mm

| Item # | Description | Quantity | Purpose |
|---|---|---|---|
| 2a | Sevcon Gen4 Size 6 Controller | 1 | Inverter/Controller |
| 2b | Multi leaf Connector | 1 | Connect B+ and Contactor |
| 2c | 500A Fuse (attached to controller) | 1 | Battery fuse |
| 2d | Gigavac GV200PA | 1 | Contactor to switch ON/OFF battery power |
| 2e | Wire Harness | 1 | Control/Aux Power/CAN |
| 2f | Throttle | 1 | Control |
| 2g | Sevcon Clearview | 1 | Dashboard, Modify driveability parameters |
| 2h | Battery Cable | 2 | Connect battery to controller (via contactor and fuse) |
| 2i | Coolant Pump | 1 | Circulate coolant through motor |

# System Overview



# Components

## Sevcon Gen4 Size 6

The SEVCON Gen4 Size 6 motor controller is designed to control 3-phase Permanent Magnet Alternating Current (PMAC) motors for traction and pump applications. A diagram of the unit is shown in Figure 1. There four mounting holes, one in each corner of the metal heatsink. In the top left-hand corner is a LED indicator. To the left side of the unit is a female connector for a 35-way AMPSeal plug which is a commercially available automotive plug developed by TE Connectivity. This plug is used to attach input/output(I/O), communications, and control power. In the centre of the unit are three terminals labelled M1, M2 and M3. These terminals are for connecting each phase to the motor. At the bottom of the unit are three terminals for connecting traction power. The left most terminal, labelled B- is for connecting battery negative. The terminal labelled + is a dummy terminal and is used to support a fuse between the line contactor and the B+ terminal which is the right-most terminal.

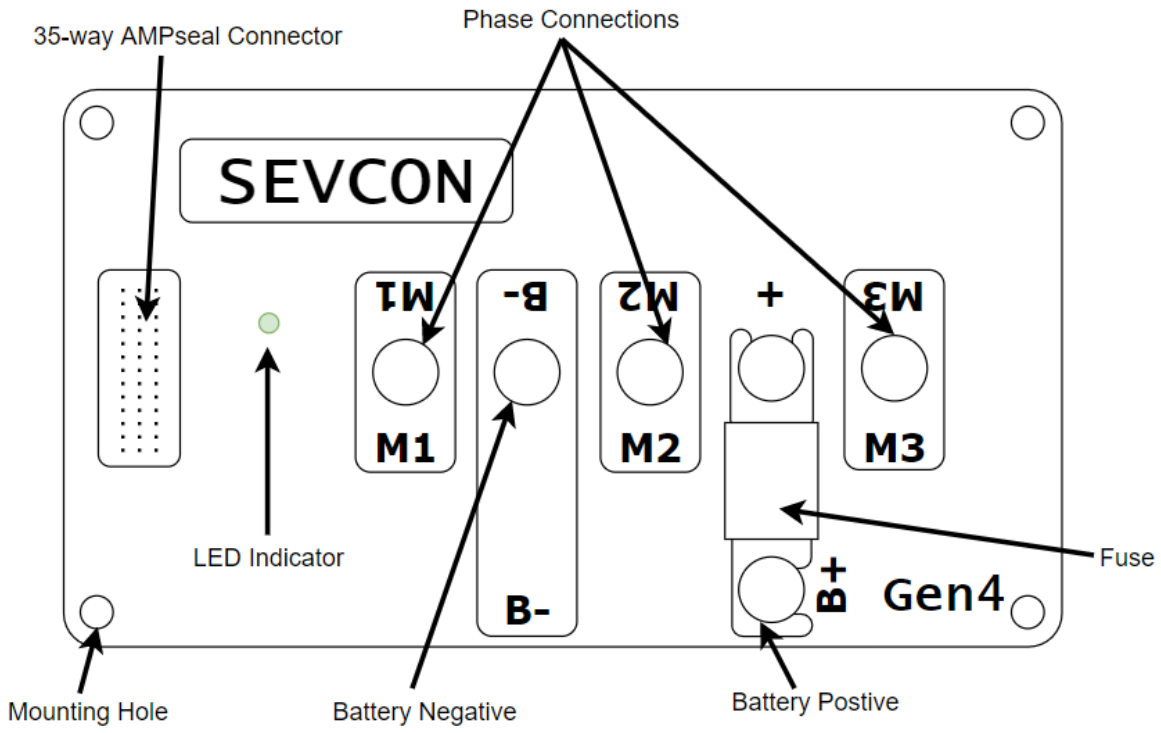



Figure 1 Sevcon Gen 4 Size 6 Features

*Ensure battery positive is connected to the Gen4 through the surface mounted fuse.*

## Motenergy ME1616

The Motenergy ME1616 is a water-cooled permanent magnet synchronous motor. A diagram of the unit is shown in Figure 2. The ME1616 comes with the phase cables and 8-way plug already attached. The 8-way plug passes rotor position and temperature data to the Sevcon controller.

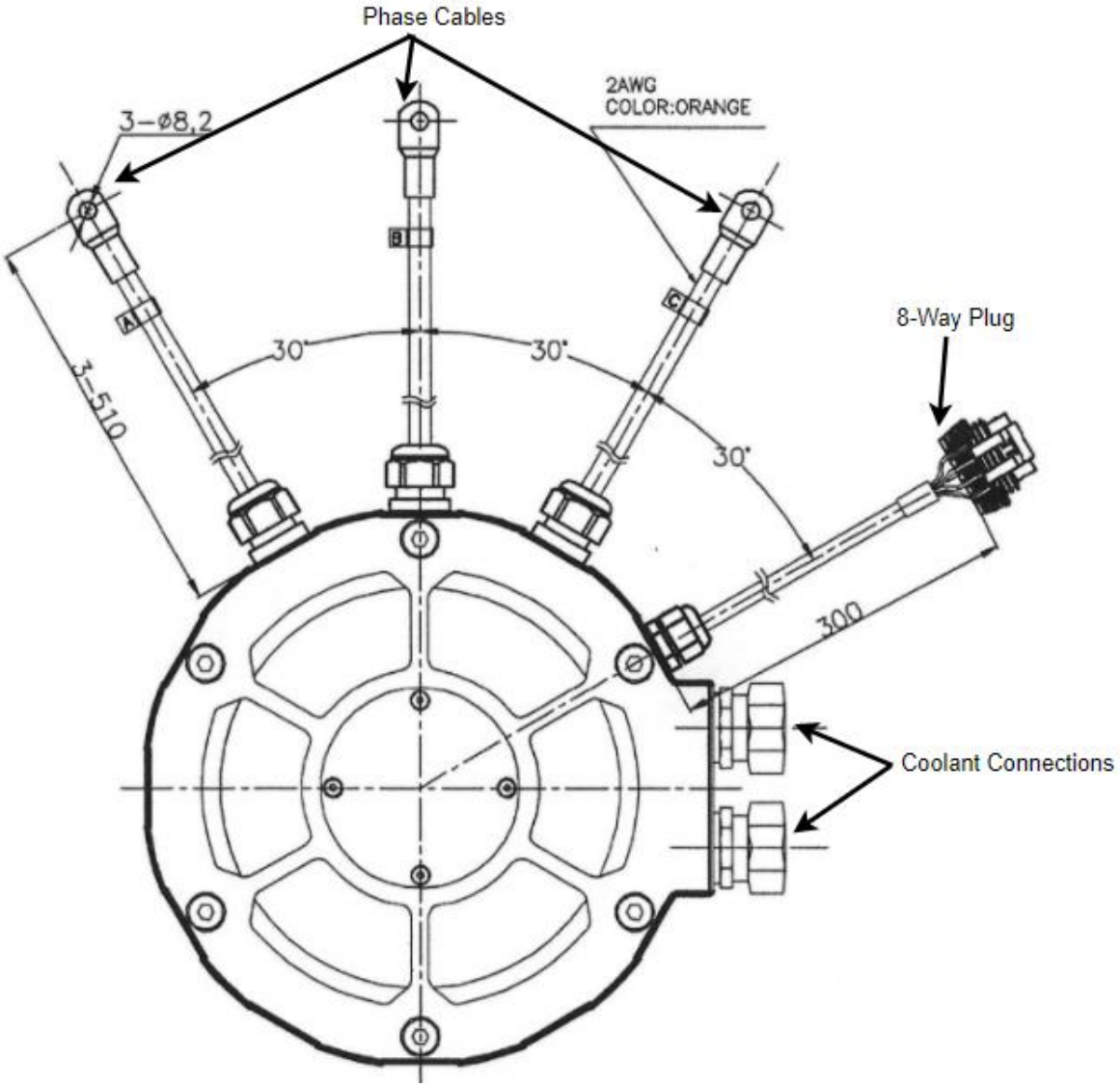



Figure 2 Motenergy ME 1616 Features

The ME1616 is designed to operate with circulating coolant passing through it. A coolant pump is supplied.

*The motor must be adequately secured before being turned on.*

## Gigavac GV-200PA

The Gigavac GV-200PA is a hermetic sealed DC relay that allows the Sevcon Gen4 controller to switch ON and OFF high-current battery power. A relay is required so that the controller can remove power to itself as well as pre-charge.

## What is Pre-charge?

Motor controllers contain large capacitors which bring about two problems. Firstly, when in a discharged state they temporarily behave as a short circuit, drawing large inrush currents until fully charged. These inrush current can be many times greater than the rated capacity of internal components and can cause serious damage. Secondly, when power is removed the capacitors maintain stored energy that takes time to discharge. This leaves a short time window where the unit is OFF but still contains dangerous voltages.

Although inrush currents only last a short time their sheer magnitude can cause permanent damage to components. Pre-charging is one method of reducing this effect. Pre-charging works by applying battery voltage to the capacitors through a large resistor. Once the capacitors have reached an appropriate level of battery voltage (usually 90%), the battery can be directly applied.

## Harness

The harness is made up of several components as shown in Figure 3 and Figure 4.

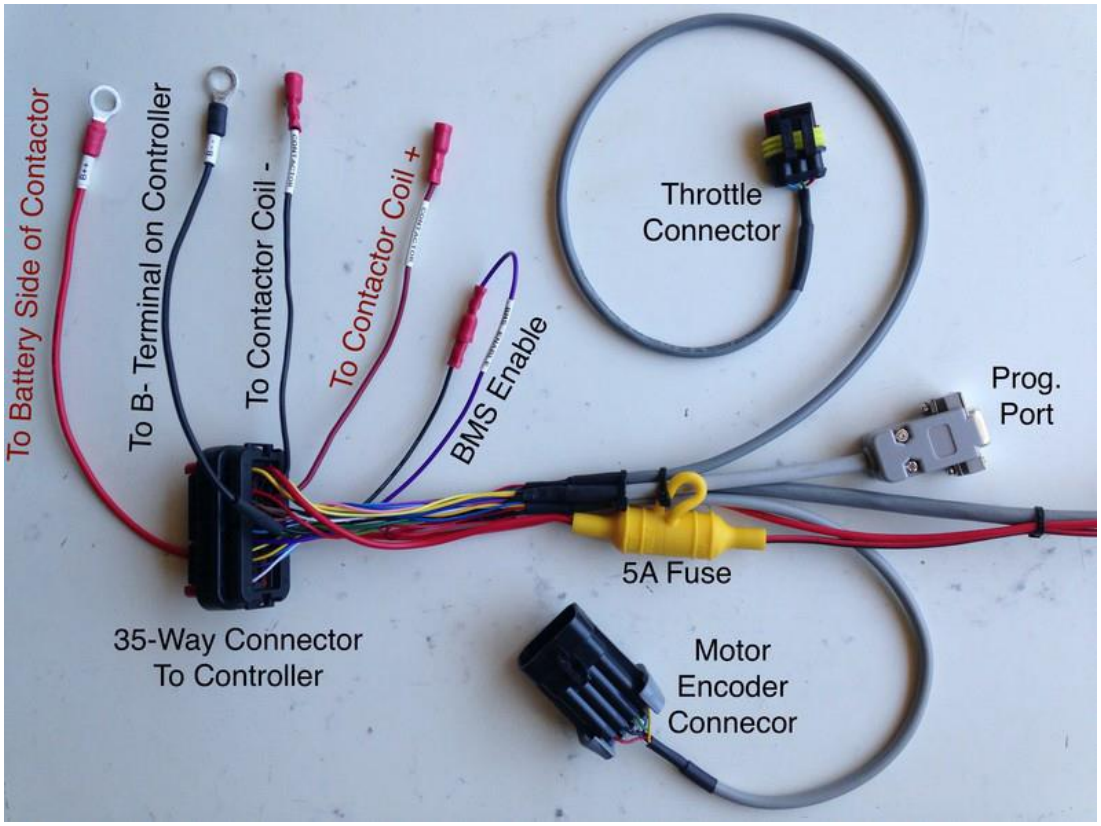



Figure 3 Harness components A

*Keep the harness wires separate from the phase and power cables as much as practical to minimise electromagnetic interference (EMI).*

| # | Component | Purpose |
|---|---|---|
| A | Auxiliary Power Supply Wires | Provide auxiliary power supply for controller |
| B | Contactor Coil Wires | Allows the controller to apply power to the relay coil to OPEN and CLOSE the battery positive cable. |
| C | BMS Enable Wires | (Optional) Allows connection to battery management system (BMS). This must be connected if not used. |

| | | |
|---|---|---|
| D | Throttle Connector | Allow connection to throttle of choice (5 types available) |
| E | 5A Fuse | Short circuit protection |
| F | Motor Connector | Passes position and temperature data to the controller |
| G | Programming Port | Allows connection to PC (IXXAT USB-CAN interface, Sevcon DVT software and licence required for use) |
| H | 35-Way Connector | Connects harness to Sevcon Gen 4 controller |

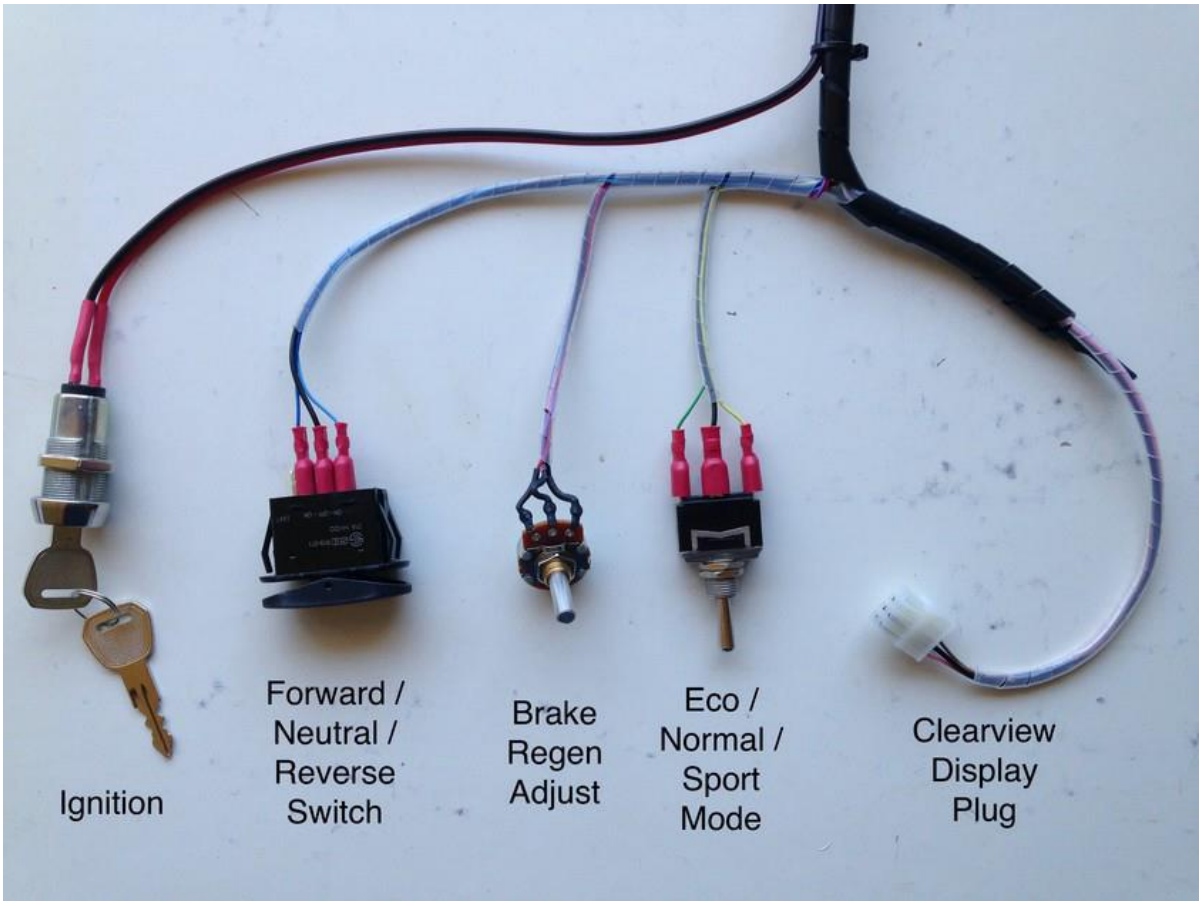



Figure 4 Harness components B

| # | Component | Purpose |
|---|---|---|
| I | Ignition | Turn system ON and OFF |
| J | Forward/Neutral/Reverse Switch | Change direction of motor rotation |
| K | Brake Regen Adjust | Control the level of regenerative braking |

| | | |
|---|---|---|
| L | Drive Select | Switch between Drive Mode 1 and Drive Mode 2 |
| M | Clearview Display Plug | Connect to Sevcon Clearview Display |

*Modifying/cutting the harness will void the warranty of the harness component of this system.*

## How does regenerative braking work?

Regenerative braking is used to recover kinetic energy which is converted into electrical energy for storage in the battery. When an electric vehicle is moving it has kinetic energy. The faster it is going and the heavier it is the more kinetic energy it has. When you brake on a traditional vehicle, that energy is converted into heat and sound by brake pads, wheels etc. This essentially throws away all that energy and wastes it. On an electric vehicle with regenerative braking, the controller instead puts the electric motor in reverse and turns it into a generator which generates power. The vehicle slows down gradually as the kinetic energy is turned back into electrical energy and then stored in the battery for later use.

The regen dial on the harness adjust the amount of regenerative braking. It can be used as a dial or connected to a foot pedal.

### Sevcon Clearview Display

The Sevcon Clearview Display is a colour display that shows information sent from the Gen4 controller. The user can also change drivability characteristics (such as ramp rate) from the Clearview.

The Clearview Display and the Gen 4 controller pass information between each other via a CAN network. A CAN network requires both ends of the signal wires to have signal termination. Signal termination prevents signals from reflecting from each end of the cable causing interference. Both the Gen4 controller and the Clearview have internal termination.

*If the Clearview is unplugged, you may require a 120ohm resistor across the CAN high CAN low terminals.*

## Throttle

The throttle is used to send torque demands to the controller.

## Water pump

The Water Pump specifically designed for cooling EV motors and controllers.

The recommended cooling arrangement is shown in Figure 5.

*Do not run the water pump dry as this could lead to permanent damage.*

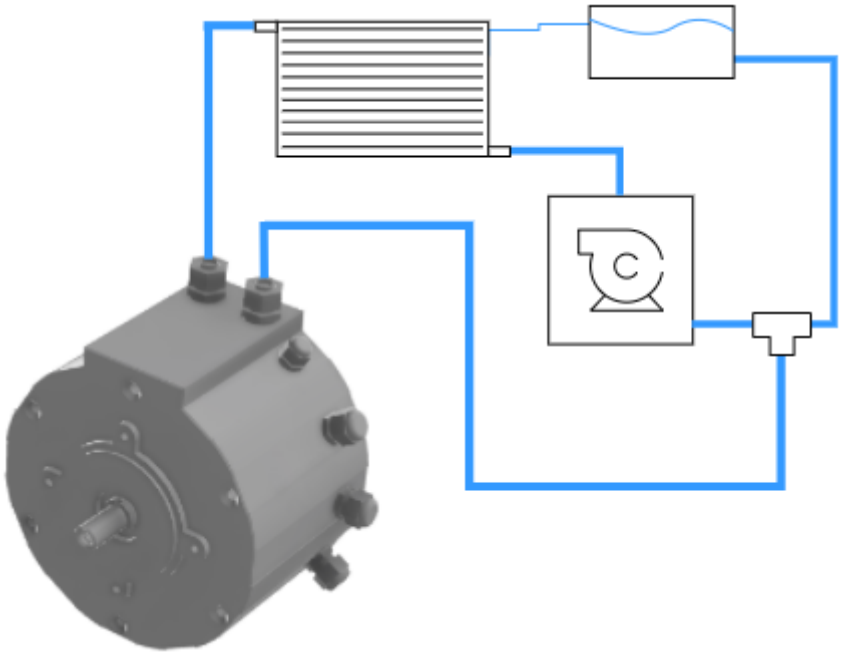


Figure 5 Recommended liquid cooling setup

The following are the recommended cooling system parameters:

- Aluminium corrosion and freezing preventing coolant (water/glycol 50/50 mix)
- Flow rate ≥6 l/min
- Inlet temperature ≤ 45°C

The chosen radiator needs to be dimensioned to dissipate the machine losses at the specified flow rate and fluid temperature – generally a small radiator from motorcycle is sufficient.

## Assembly

1. Ensure you have thoroughly read this manual and *Sevcon Gen4 Applications Reference Manual* before commencing assembly.
2. Securely mount the motor and set up coolant system. Ensure the bolts do not penetrate too deeply into the motor casing. Failure to do so could result in damage to the motor windings. Bolts should be tightened to 22Nm.
3. Mount the controller. Ensure the controller is securely mounted from a mechanical and thermal perspective. See *Sevcon Gen4 Applications Reference Manual* for more details.

*The provided bolts are suitable for a mounting plate thickness of 10mm minimum. Please make alternative arrangements if mounting plate thickness differs.*

4. Terminate the motor phase cables to the controller as per Figure 6. (11Nm ± 2Nm)

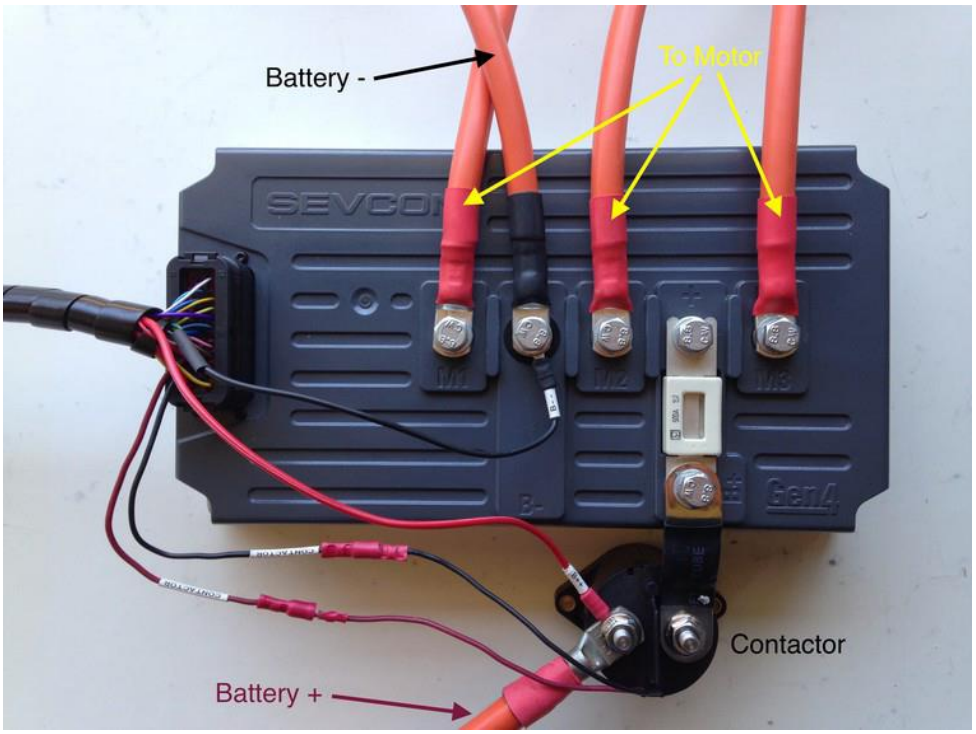



Figure 6 Correct cables and harness arrangement

5. Connect the contactor to the controller via the multi leaf connector as shown in Figure 6. Do not connect the battery side yet and ensure the relay coil wires are disconnected. (8Nm for the contactor side, 11Nm ± 2Nm for the controller side)
6. Connect the 35-way plug into the controller. Connect the Clearview display and throttle to the harness. Ensure the throttle is in the minimum position, the key switch is in the OFF position, and the forward/neutral/reverse switch is in neutral.
7. Connect the negative battery cable through an isolator (not supplied) to the B- terminal of the controller as shown in Figure 6. At the same time connect the negative auxiliary wire from the harness to the same terminal.
8. Connect the positive battery cable through an isolator (not supplied) to the contactor as shown in Figure 6. At the same time connect the positive auxiliary power wire from the harness to the same terminal.
9. Confirm the isolator is open (i.e. no battery current can flow) and double check steps 1-7 before connecting the relay coil wires to the contactor as per Figure 6.

# Operating Guide

*Incorrectly wired or configured electric drives may behave in unexpected ways. Always confirm correct operation before connecting to a vehicle or machine.*

## Pre-start Checklist

- Confirm the throttle is in the minimum position, the key switch is in the OFF position, and the forward/neutral/reverse switch is in neutral.
- Confirm battery isolator is open (i.e. no current can flow)
- Confirm all connections are tightened to specified level.
- Confirm all plugs are fully inserted.
- Confirm power wiring connections are made to the correct terminals (B+, B-, +, M1, M2 and M3).
- Confirm the controller is securely mounted (from a mechanical and thermal perspective).
- Confirm motor coolant system is operational.
- Confirm there is adequate and correctly ducted airflow for any fan cooling system.
- Check the routing of cables is safe with no risk of short circuit, overheating or cable insulation wear due to rubbing.
- Check motor drive shaft is clear of obstructions.

## Start-up Procedure

1. Confirm the throttle is in the minimum position, the key switch is in the OFF position, and the forward/neutral/reverse switch is in neutral.
2. Turn on main isolator switch to connect system to battery.
3. Turn the key switch to the ON position.

If the system is correctly installed, a loud click should be heard from the contactor and the green LED on the controller should be constantly lit. If this is not the case, the system should be powered down and the above checks repeated.

# Troubleshooting

The following section describes some of the typical issues and how to resolve them. If you have any questions not covered by this manual, please contact us via support@electricdriveengineering.com.au.

## Avoiding Electromagnetic Interference

Some precautions can reduce the level of electromagnetic emissions:

- Keep signal wires (particularly the motor encoder) separate from power cables as much as practical.
- Keep the controller and motor as close as practical to reduce power conductor length.
- Keep all the motor phase cables as close together as practical in the routing from controller to motor.
- Route DC conductors side by side.
- Always use proper grounding and shielding in the remainder of the system.