APPLICATION NOTE

Removing Propulsion Power on MagneMover LITE

Purpose

This document describes the methods that can be used to remove propulsion power on MagneMover LITE motors and the precautions that have to be implemented to avoid damaging the hardware.

Introduction

There are several methods to remove power from a MagneMover LITE system. The easiest option is to remove power on the AC side of the power supply using appropriate AC relays or switches. The advantage of this method is that the turn on/off transients are seen on the power supply input side and not on the MagneMover LITE motor input side. However, the disadvantage is that both logic and propulsion power to the motors are removed. Logic power is used to power the motor internal components and sensors, while propulsion power is used to move vehicles (pucks). Removing propulsion power only while keeping logic power has the benefit of keeping the pucks tracked within MagneMotion's control software. If logic power is removed, the tracking of the pucks is lost and they will be re-detected when the system starts up again. This may have undesirable effects like changing vehicle IDs or making manual interference with the pucks undetectable.

In order to only remove propulsion power while keeping logic power, the propulsion power must be removed on the DC side of the power supply. Logic and propulsion power are supplied to the MagneMover LITE motors via separate buses and it is therefore possible to remove propulsion power only.

Removing Propulsion Power

There are three main methods to remove propulsion power on the DC side of the MagneMover LITE power supply:

1. Using the DC propulsion power enable/disable jumper on the back of the power supply.
2. Using a solid state relay to remove propulsion power.
3. Using a mechanical relay or contactor to remove propulsion power. This option requires flyback protection.

The following sections will provide details on each method.

DC Propulsion Power Enable/Disable Jumper

The DC Propulsion Power Enable/Disable Jumper is located on the back of the MagneMover LITE Power Supply, as highlighted in orange in Figure 1 and labeled J4.

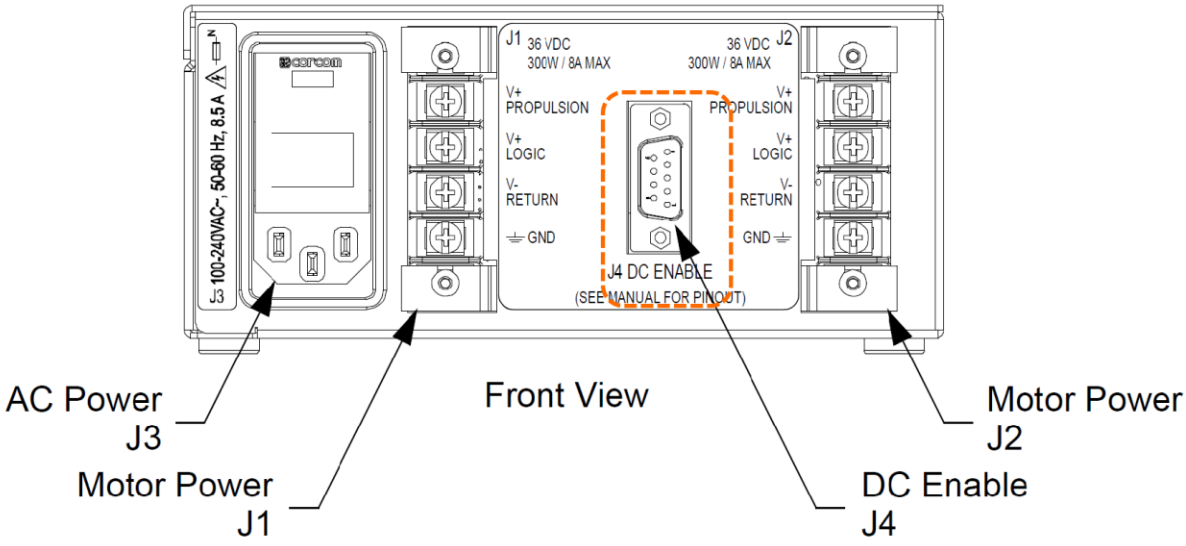

Figure 1: MagneMover LITE Power Supply Electrical Connections

A user-supplied cable can be used to provide remote DC propulsion power enable and disable functionality. The detailed instructions on how to use the jumper can be found in the MagneMover LITE Manual (990000410) in the DC Enable section of the MM LITE Power Supply electrical specifications.

MagneMotion recommends using the jumper to disable propulsion power if possible, however because it is implemented using a solid state relay, it may not be permitted to use the DC propulsion power enable/disable jumper for safety critical functionality.

Solid State Relay

A solid state relay can be used to remove propulsion power. Solid state relays have well documented advantages and disadvantages compared to mechanical relays, but for this specific application the main advantage is the absence of potential issues due to arcing between contacts and intermittent connections as well as the presence of an integral diode that prevents the flyback issues that will be discussed for mechanical relays in the next section. The main disadvantage is that using solid state relays may not be permitted in safety critical applications.

A solid state relay can be used to remove propulsion power by interrupting the power from the $V+_{propulsion}$ bus of the power supply outlet terminal to the MagneMover LITE motors. Note that there are two outlet terminals per power supply, labeled J1 and J2 in Figure 1, each delivering power to a series of motors. It is therefore possible to remove propulsion power for every bus independently if the application requires that. In order to remover propulsion power from all motors connected to one power supply, the power through both V+propulsion buses of the two terminals J1 and J2 must be interrupted.

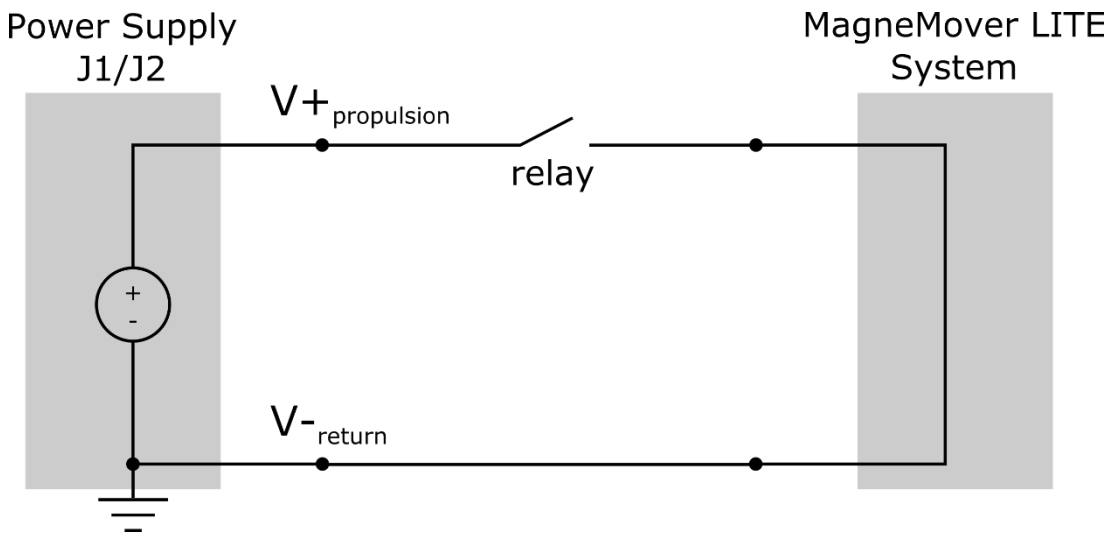

Figure 2: Basic Schematic of a Relay to Remove Propulsion Power

Mechanical Relay with Flyback Protection

An electromechanical relay or contactor can be used in the same way as a solid state relay. The main difference is that due to the slightly inductive characteristics of the load, flyback protection has to be included.

Flyback is a voltage spike across an inductive load when its supply voltage is suddenly removed. According to Lenz's Law, the energy stored in the electromagnetic field of the inductor will induce a voltage that opposes the change of current flow when the switch is opened. This will cause a large negative Voltage at the open end of the switch connected to the inductor (Figure 3).

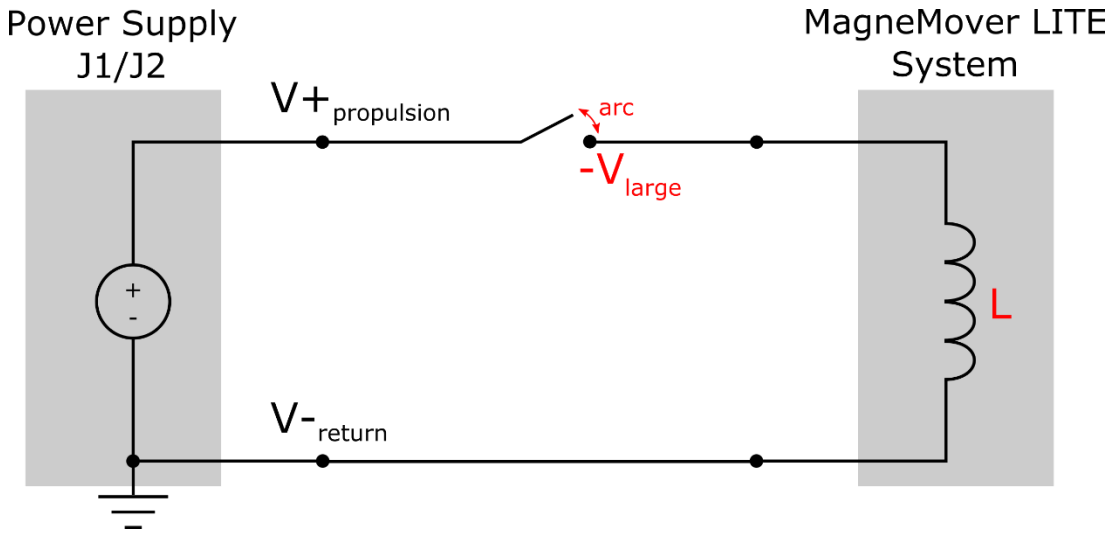

Figure 3: Large Negative Voltage Caused by Inductance [1]

This voltage spike can have negative effects on the hardware of the relay and the MagneMotion hardware. In the open switch, the large difference in potential can cause an arc across the contacts of the open switch and the heat generated in such an arc can damage the contacts of the relay. The large voltage spike can also damage the electronics in the MagneMotion motors. The flyback voltage spike must therefore be avoided. This is generally achieved by using a so-called flyback diode (also called a suppressor diode or freewheeling diode). The same is true for voltage spikes that can be caused when the mechanical switch bounces.

A flyback diode is commonly implemented anti-parallel to the load as shown in Figure 4. With this setup, the inductor can draw current from itself in a continuous loop through the forward-bias of the flyback diode (Figure 5).

[1]: Please note that in Figures 3, 4 and 5 the MagneMover LITE hardware is simplified to only depict the inductive properties relevant to this Application Note.

The stored magnetic energy is dissipated through losses in the circuit and the voltage spike is limited to the forward-bias of the diode. In normal operation, when the switch is closed, the flyback diode is reverse-biased against the power supply and doesn't impact the circuit for practical purposes.

Selecting a flyback diode for this application is generally not critical, but Schottky diodes are often used for their low forward drop and ability to quickly respond to reverse-bias.

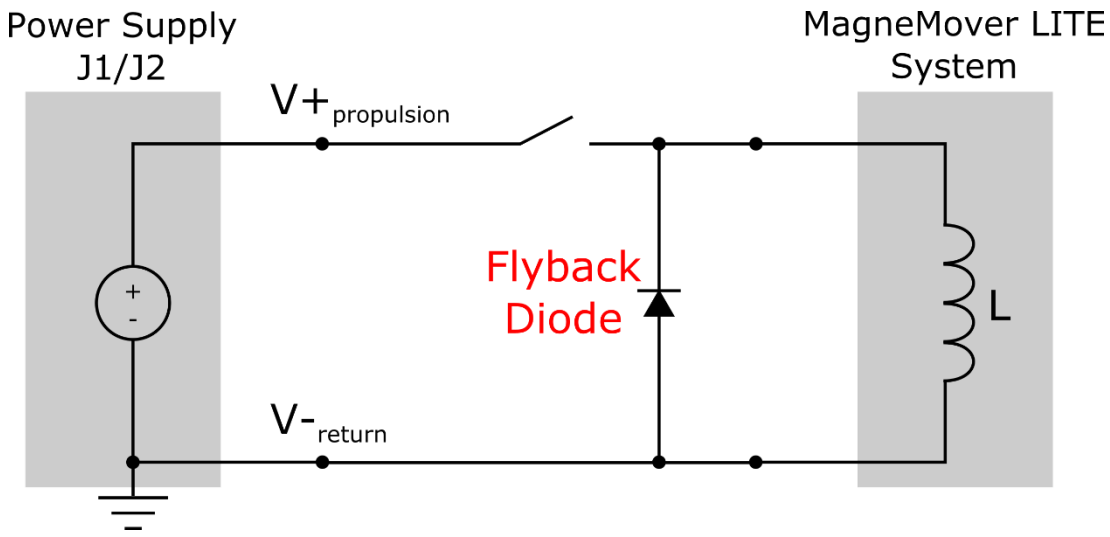

Figure 4: Schematic of the Circuit with a Flyback Diode

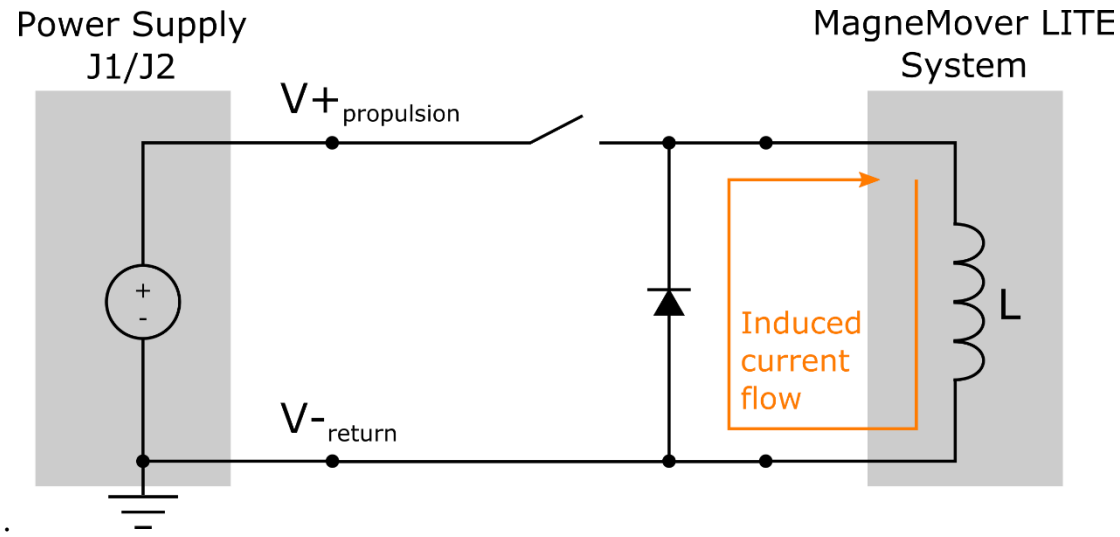

Figure 5: Induced Current Flow

Summary

It is often preferable to only remove propulsion power from a MagneMover LITE system while keeping logic power in order not to lose tracking information of the vehicles. Propulsion Power can be removed by using the DC propulsion power enable/disable jumper, a solid state relay or a mechanical relay with flyback protection. While MagneMotion recommends using the DC propulsion power enable/disable jumper, the best method has to be selected based on the requirements of the application including applicable safety regulations.

For any questions related to the content of this document, please contact MagneMotion Customer Support.
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Email: customersupport@magnemotion.com

Related Documents:

990000410 – MagneMover LITE Manual

More Information

MagneMotion Website: www.magnemotion.com

Questions & Comments: www.magnemotion.com/about-magnemotion/contact.cfm

Revision History

Rev.	Change Description
A	Initial release