APPLICATION NOTE

ML Layout Constraints

Purpose

This application note is to present information on specific MagneMover® LITE layouts that can exhibit anomalies in vehicle motion due to mechanical constraints and methods to resolve such behavior.

Introduction

There are some MagneMover LITE layouts and vehicle configurations using standard switches that can result in anomalous vehicle motion. This document describes each case and potential solutions to resolve the anomalous motion.

Glide Puck Layouts

1. Standard Switch-Standard Switch and Curve-Standard Switch Layouts
    a. S-Curves in Back-to-Back Standard Switches
    b. U-Curves in Standard Switches and Curves
2. Cantilevered Loads
    a. Cantilevered Loads without Switches
    b. Cantilevered Loads with Standard Switches
3. Wide Symmetrical Carriers
    a. Wide Carriers in Curves and Standard Switches

Wheeled Puck Layouts

1. Standard Switch-Standard Switch and Curve-Standard Switch Layouts
    a. S-Curves in Back-to-Back Standard Switches
    b. U-Curves in Standard Switches and Curves

Glide Puck Layouts

Standard Switch-Standard Switch and Curve-Standard Switch Layouts

S-Curves in Back-to-Back Standard Switches

In applications where two MagneMover LITE standard switches are placed back-to-back as shown in Figure 1, glide pucks can yaw at the switch, and "clip" the triangular shape at the junction in the second switch (also called the "frog").

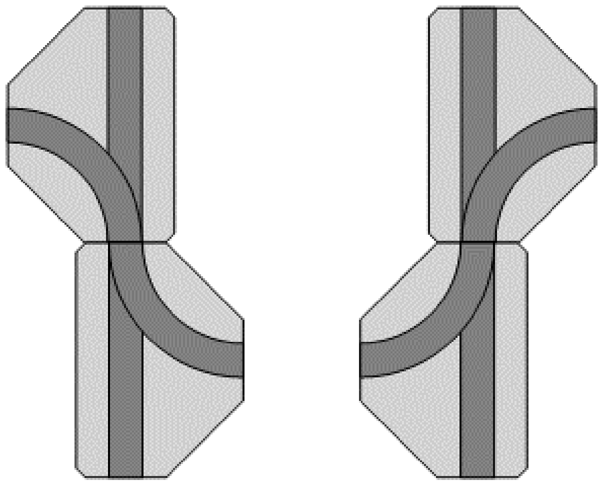

Figure 1: Back-to-Back Standard Switches in an S-Curve

MagneMover LITE standard switches use embedded ferrous material to provide a lateral bias ensuring the puck takes the straight path when commanded. When standard switches are placed back-to-back, this ferrous material can cause the puck to yaw. In Figure 2, the ferrous material is shown in red, and the puck is shown in yellow. For this example, the puck is commanded straight through the switches from right to left. When the puck transitions the gap between the switches, the magnet array is more engaged with the ferrous material in the first switch (switch on the right) than the second switch, which causes it to yaw towards the curve of the second switch as it transitions as indicated in yellow even though it is commanded straight.

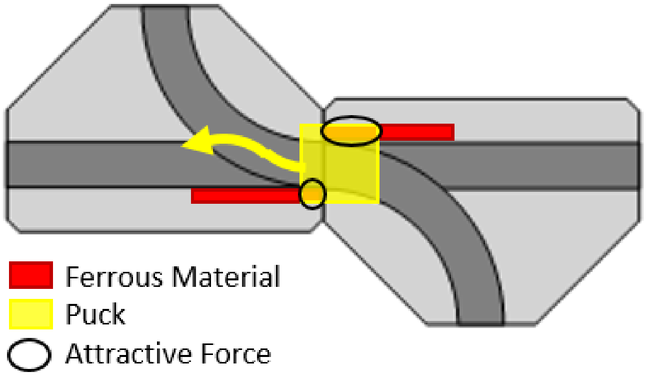

Figure 2: Vehicle Traveling Through S-Curve

U-Curves in Standard Switches and Curves

In applications where MagneMover LITE standard switches and curves are placed back-to-back as shown in Figure 3 and the direction of travel is as indicated, inertia can cause the puck to take the wrong path of the switch.

When traveling from a curve path (either a curve motor or the curve part of a switch), inertia can cause the puck to continue along the curve path of the switch, despite a command to the straight path as indicated. This anomaly is not always the case and is dependent on the pallet geometry, payload, and velocity of the glide puck.

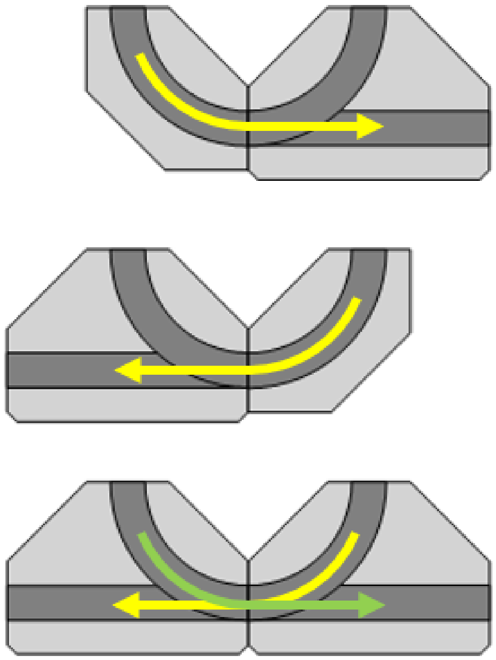

Figure 3: U-Curve Layouts

Anomaly Determination

There are a few options to determine if this anomaly is present in a specific glide puck application.

- If the system is already installed and carriers that are already assembled, testing can be performed on-site using the necessary carrier, payload, and velocity for the application.
- If a system is not installed or testing cannot be completed on-site, contact Customer Support for assistance.

Solutions for Standard Switch-Standard Switch and Curve-Standard Switch Layouts

One potential resolution to the puck yaw and inertia issues in S- and U- Curves is to change from single pucks to tandem pucks as shown in Figure 4. Tandem pucks are 150 mm long, compared to the 62 mm long single pucks. This solution works for many cases, but may not be an ideal solution for applications with stations that are at a pitch closer than 150 mm center-to-center.

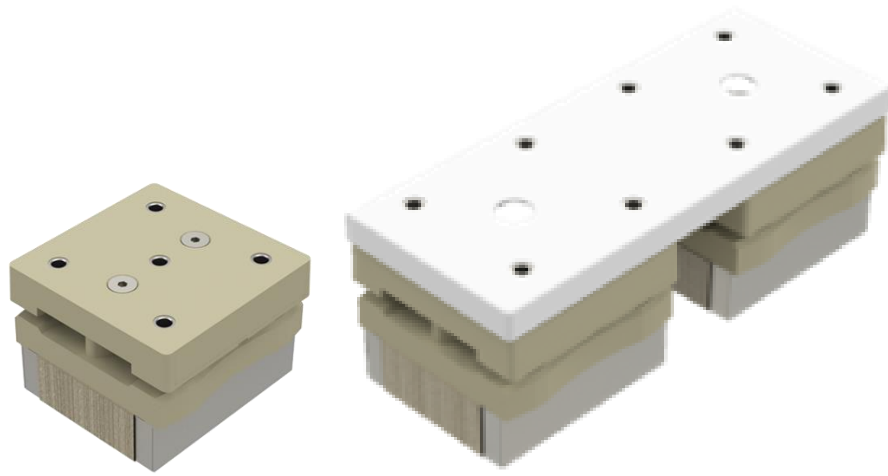

Figure 4: Single and Tandem Glide Pucks

Other solutions differ based on the direction of movement. For systems where movement is bidirectional (pucks move forward and backward), modify the configuration to include a ¼-meter motor in between the two switches[1], as shown in Figure 5.[2]

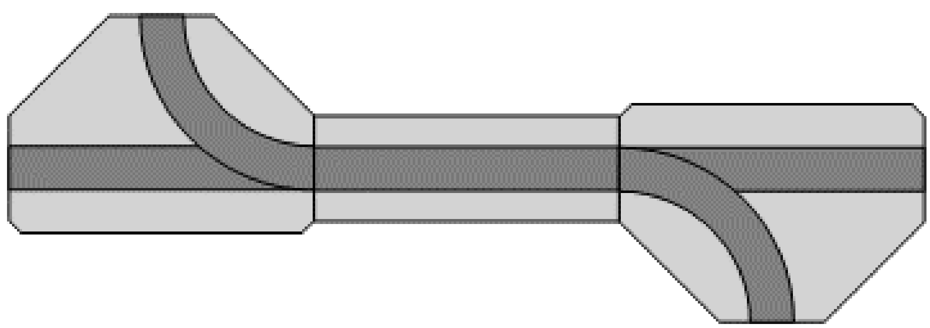

Figure 5: Add a Motor for Bidirectional Correction

For the case where movement is unidirectional (pucks move only forward or only backward), an additional piece of ferrous material, usually in the form of a biasing bracket, can be installed near the start of the second standard switch (where the blue star is in Figure 6).

[1] Note that in software this is now two separate nodes (merge and diverge, based on forward direction), and not a merge-diverge node.
[2] While this document focuses on mechanical constraints, it is important to note that using both tandem pucks and short paths (paths that consist of only a ¼-Meter motor or only a curve motor) may create startup concerns. See application note 990000770 for more details. MagneMotion recommends either switching to tandem pucks, or adding a ¼-Meter between switches, but not both.

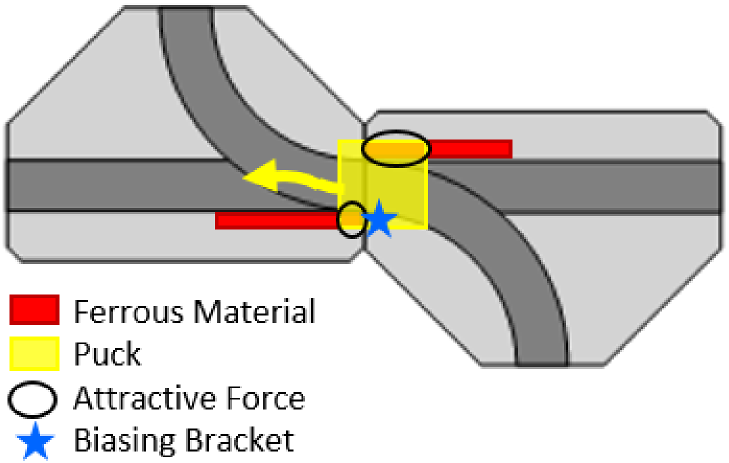

Figure 6: Ferrous Material for Biasing

This attracts the magnet array to the straight portion of the second switch during transition, and therefore greatly reduce the yawing. The implementation (size, shape, and placement) of the biasing bracket is different for every application, and is based on payload, carrier geometry, and velocity.

Cantilevered Loads

Cantilevered Loads without Switches

For applications using cantilevered loads in layouts without switches, the system may experience uneven wear patterns if the center of mass is offset.

Suppose that the carrier looks like Figure 7, where the skis that ride on the motor rails are labeled Ski 1 and Ski 2. If the center of mass is offset from the desired center of mass (the center of the motor, marked in red), more of the weight of the puck rides on Ski 2. This additional loading can result in Ski 2 wearing more quickly than Ski 1.

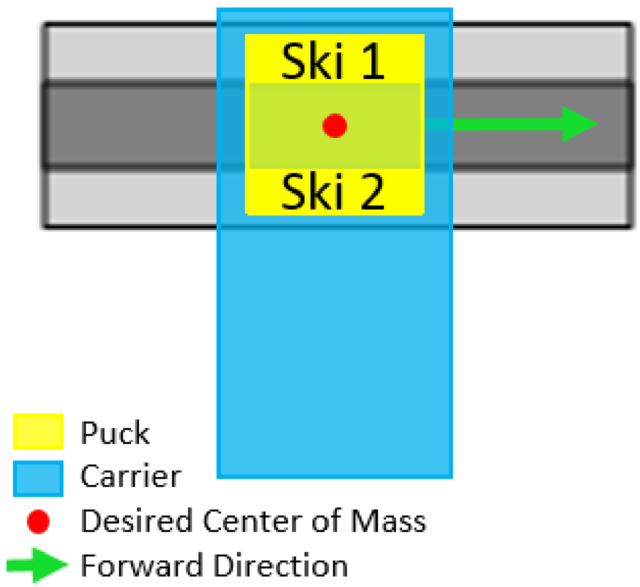

Figure 7: Puck with Cantilevered Load

Additionally, the lobes (shown in Figure 8) can exhibit different wear patterns that are based on the direction of travel.

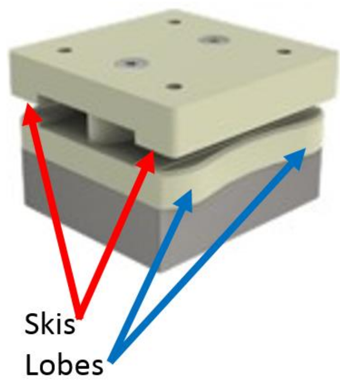

Figure 8: Single Puck Skis and Lobe

In this example, the direction of travel is from left to right. The higher frictional force on Ski 2 caused by the offset center of mass results in yaw under motion. This yaw causes constant contact of the leading lobe near Ski 2 and the trailing lobe near Ski 1 with the rails, leading to additional wear on those lobes. The opposite is true when running in the other direction.

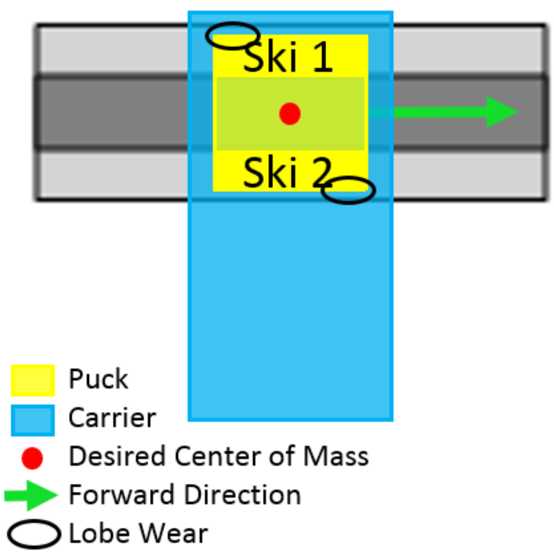

Figure 9: Lobe Wear Locations Caused by Yaw

Cantilevered Loads with Standard Switches

In addition to the uneven wear, a frictional yaw issue can occur if a carrier with an offset center of mass traverses a standard switch, as shown in Figure 10. The offset center of mass can cause the puck to yaw toward the cantilever and take the curve path, even if it is commanded straight. This anomalous motion is dependent on pallet geometry and velocity, so it is important to test carrier designs to determine if anomalous motion occurs.

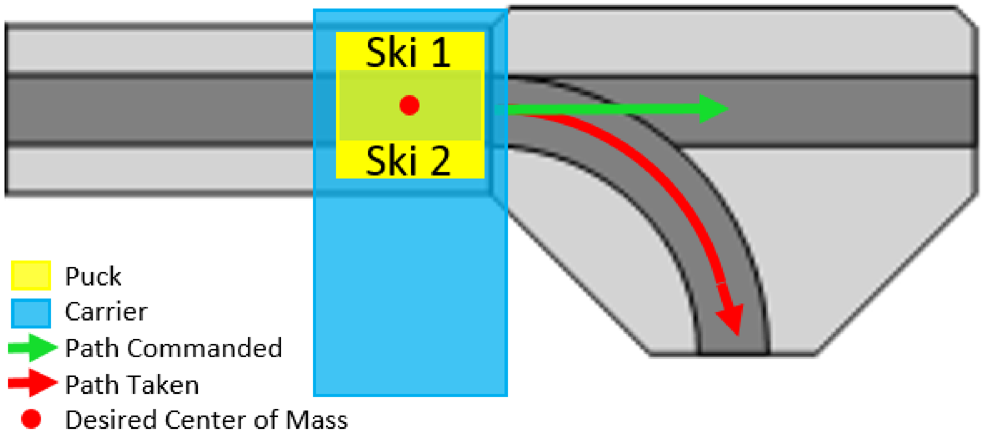

Figure 10: Cantilevered Load Traversing Standard Switch

Solutions for Cantilevered Loads

The anomalous behavior that is associated with cantilevered loads can be mitigated by designing the carrier such that the center of mass is over the center of the motor. If the current design does not already have the center of mass over the center of the motor, consider adding counter-weights or reducing weight of the cantilever to bias the center of mass inward.

Similar to Solutions for Standard Switch-Standard Switch and Curve-Standard Switch Layouts, using tandem pucks instead of single pucks or adding ferrous material for biasing (a biasing bracket) may assist the puck in taking the correct path if a frictional yaw issue occurs.

Wide Symmetrical Carriers

Wide Carriers in Curves and Standard Switches

For layouts where wide vehicles traverse curves and switches, there are some cases when the transition from straight to curve paths (shown in Figure 11) may not be smooth. This is because the 125 mm radius of the curve motor can be too sharp of a turn to rotate high rotational inertia payloads.

Anomalous motion that is caused by the rotational inertia is dependent on the velocity, payload, and geometry of the carrier. This behavior can occur even if the mass of the payload is less than the specified 1 kg per single puck.

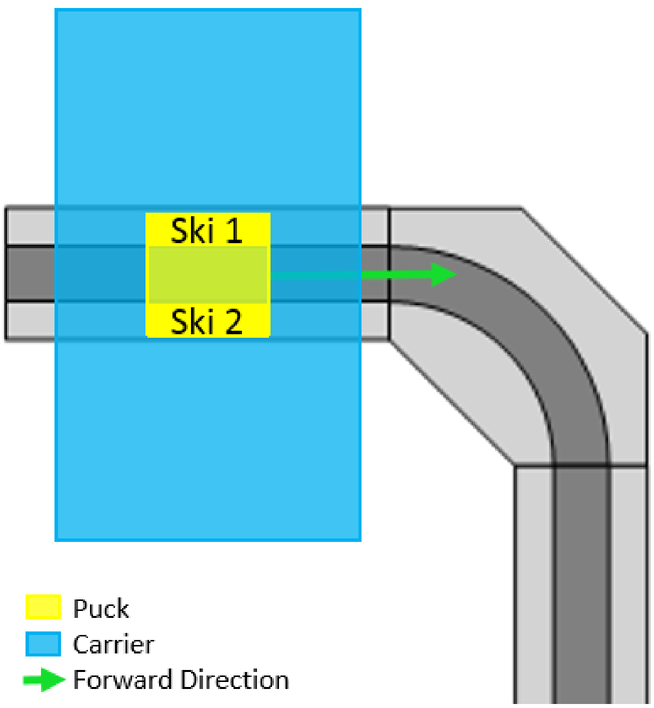

Figure 11: Wide Vehicle with Single Puck

Solutions for Wide Carriers

There are two methods to resolve this anomalous motion. One method is to modify the existing carrier/application for reduced inertia and/or lower velocity through curved sections of track. Another method is to switch to using tandem pucks as shown in Figure 12. Tandem pucks are two pucks that are tied together with a linkage plate, as shown in Figure 4. The tandem steers the carrier through the curves, greatly reducing the impact of the sharp curve.

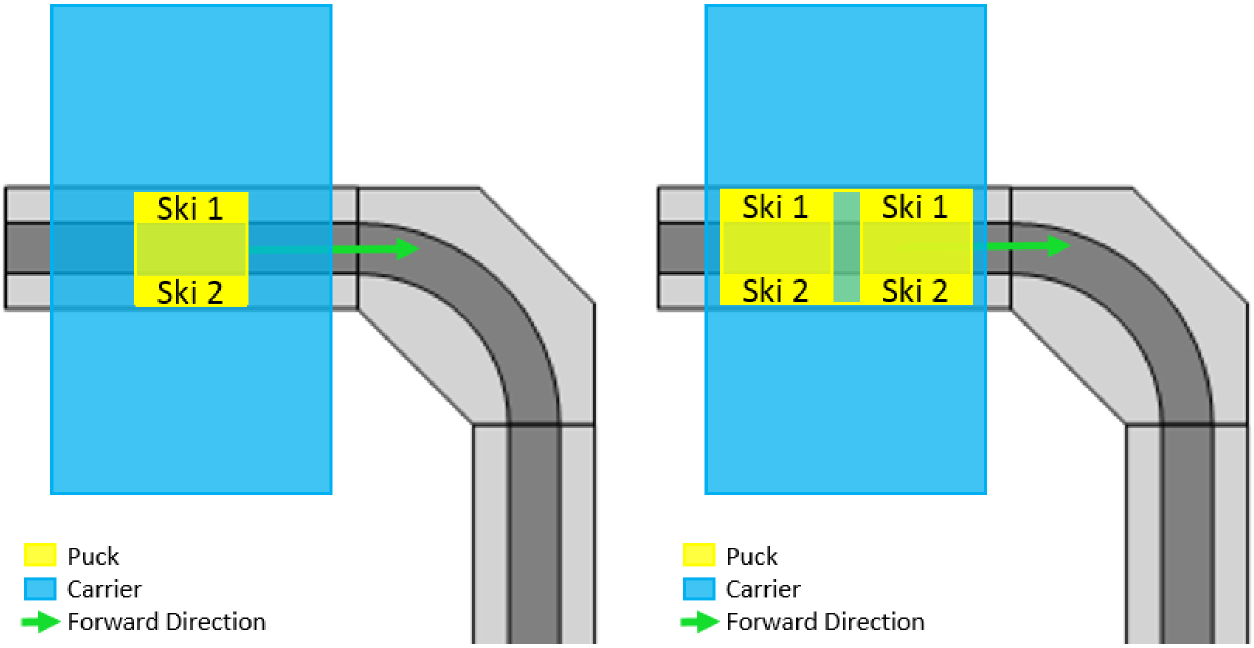

Figure 12: Wide Vehicle with Single Puck vs Wide Vehicle with Tandem Puck

Wheeled Puck Layouts

Standard Switch-Standard Switch and Curve-Standard Switch Layouts

S-Curves in Back-to-Back Standard Switches

In applications where two MagneMover LITE standard switches are placed back-to-back as shown in Figure 13, wheeled pucks can yaw at the switch, and "clip" the triangular shape at the junction in the second switch (also called the "frog").

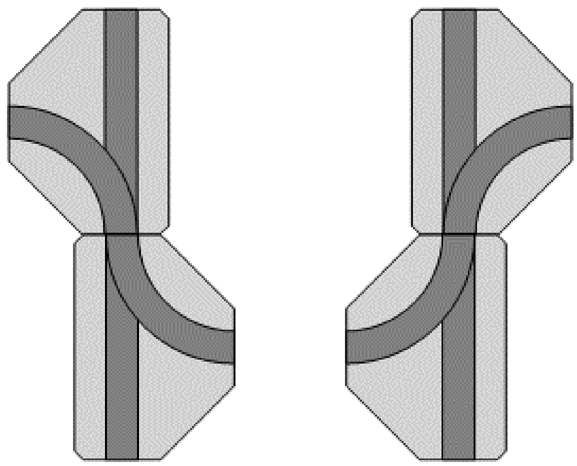

Figure 13: Back-to-Back Standard Switches in an S-Curve

MagneMover LITE standard switches use embedded ferrous material to provide a lateral bias ensuring the puck takes the straight path when commanded. When standard switches are placed back-to-back, this ferrous material can cause the puck to yaw. In Figure 14, the ferrous material is shown in red, and the puck is shown in yellow. For this example, the puck is commanded straight through the switches traveling from right to left. When the puck transitions the gap between the switches, the magnet array is more engaged with the ferrous material in the first switch (switch on the right) than the second switch, which causes it to yaw towards the curve of the second switch as it transitions as indicated in yellow even though it is commanded straight.

With wheeled pucks, this yawing can create a jam condition where the septum wheels on the puck engage on the tip of the switch frog.

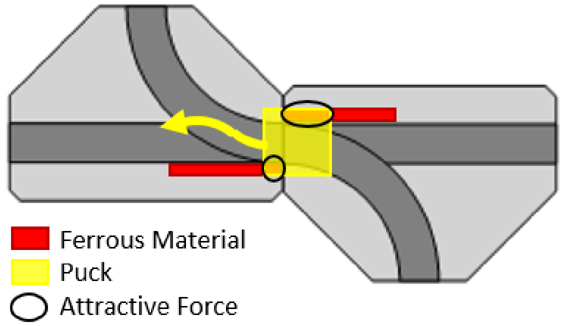

Figure 14: Vehicle Traveling Through S-Curve

U-Curves in Standard Switches and Curves

In applications where MagneMover LITE standard switches and curves are placed back-to-back as shown in Figure 15 and the direction of travel is as indicated, inertia can cause the puck to take the wrong path of the switch.

When traveling from a curve path (either a curve motor or the curve part of a switch), inertia can cause the puck to continue along the curve path of the switch, despite a command to the straight path as indicated. This anomaly is not always the case and is dependent on the geometry, payload, and velocity of the wheeled puck.

With wheeled pucks, this configuration can create a jam condition where the septum wheels on the puck engage on the tip of the switch frog.

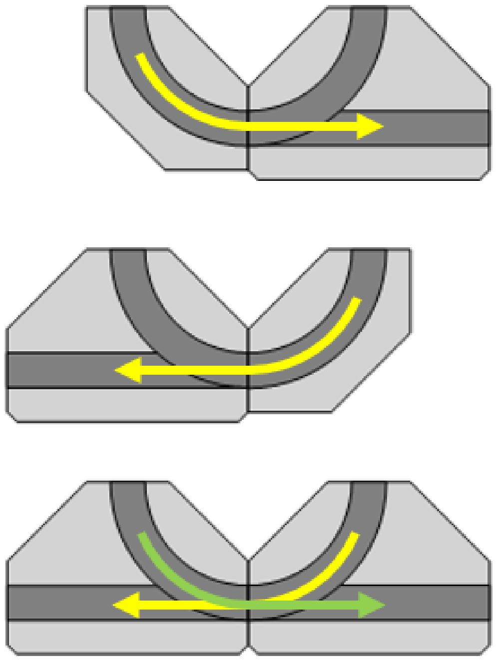

Figure 15: U-Curve Layouts

Anomaly Determination

There are a few options to determine if this anomaly is present in a specific wheeled puck application.

- If the system is already installed and carriers that are already assembled, testing can be performed on-site using the necessary carrier, payload, and velocity for the application.
- If a system is not installed or testing cannot be completed on-site, contact Customer Support for assistance.

Solutions for Standard Switch-Standard Switch and Curve-Standard Switch Layouts

Standard switch – standard switch and curve – standard switch layouts are not recommended when using wheeled pucks, which are shown in Figure 16. Use high payload switches, which are shown in Figure 17, with wheeled pucks in these layouts.

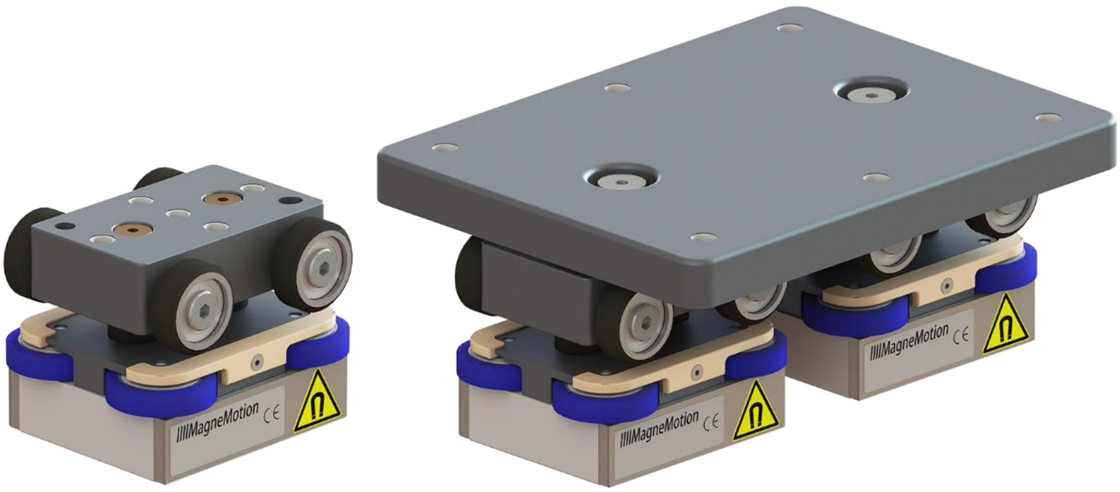

Figure 16: Single and Tandem Wheeled Pucks

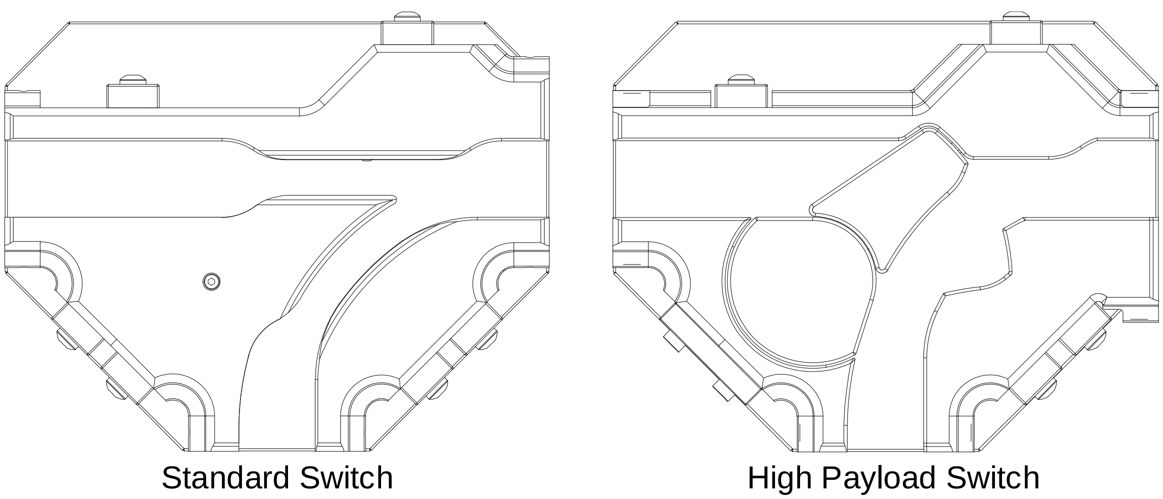

Figure 17: Switch Top View

Summary

When designing a MagneMover LITE layout for an application, please note the layout constraints and solutions. To resolve glide puck yaw or inertia concerns on single puck systems, switch to tandem pucks, add a ¼-Meter Motor in areas of concern, or work with MagneMotion to develop a biasing bracket. To resolve cantilevered load wear concerns, design the carrier with the center of mass over the motor. To resolve cantilevered load yaw concerns, switch to tandem pucks or work with MagneMotion to develop a biasing bracket for standard switches. For wide carriers, switch to tandem pucks or reduce the inertia of the carrier. To resolve wheeled puck concerns, switch to high payload switches.

Related Documents:

990000410 – MagneMover LITE User Manual

990000770 – Application Note, MagneMover LITE Tandem Puck Startup

10003622192 – MagneMover LITE User Manual Addendum, Wheeled Puck

10003865989 – MagneMover LITE User Manual Addendum, Ethernet Motors

More Information

MagneMotion website: http://www.magnemotion.com/

Questions and Comments: http://www.magnemotion.com/contact/

Revision History

Ver.	Change Description
A	Initial release
B	Added U-curves, cantilevered loads, and wide carrier cases
03	Added wheeled puck cautions

Rockwell Automation Support

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Direct Dial Codes	Find the Direct Dial Code for your product. Use the code to route your call directly to a technical support engineer.	http://www.rockwellautomation.com/global/support/direct-dial.page
Literature Library	Installation Instructions, Manuals, Brochures, and Technical Data.	http://www.rockwellautomation.com/global/literature-library/overview.page
Product Compatibility and Download Center (PCDC)	Get help determining how products interact, check features and capabilities, and find associated firmware.	http://www.rockwellautomation.com/global/support/pcdc.page

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