MOCO MODULE (MOTION CONTROL)

Manual for MoCo firmware V1.10

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PhotoShip One, LLC
Mesa, AZ 85209
USA

www.photoshipone.com

flyline@photoshipone.com

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MANUAL REVISION HISTORY

| REVISION	DATE	COMMENTS	DOWNLOAD LINK
1	4/15/2017	Initial Release	**X**
2	05/23/2017	• Firmware version 1.1 changes • Added Manual Revision History & Firmware Changelog • Added DX6 switch location graphic • Revised Ping-Pong Mode Operation • Added AR8000 rx setup information	**X**

FIRMWARE CHANGELOG

VERSION	DATE	COMMENTS
1.0	4/15/2017	Initial Release
1.1	05/23/2017	• Remote entry/exit of Ping-Pong Mode • Ping-Pong Mode Gain adjustment set to 1/2 of gain pot value • Throttle values to accommodate control transmitters end-point value at 100%. PWM scaling changed from 1000us/2000us to 1100us/1900us • Serial Protocol Added • 2 sec. Startup Delay added to prevent motor from spinning on power-up • Fail Safe sensing added for AR610 rx • LED light bug fixes

The MoCo Module allows the FlyLine trolley to 'know' its position on the rope. This is useful for automatic control of the system.

The user can set endpoints at each end of the rope that the trolley will not cross when properly configured.

The MoCo module also has an automatic 'ping-pong' mode which will automatically and repeatedly drive the trolley between two user set end points at a user set speed. This is perfect for live event coverage at concerts or festivals where you want continuous motion of the trolley and only want a single operator to control the camera gimbal.
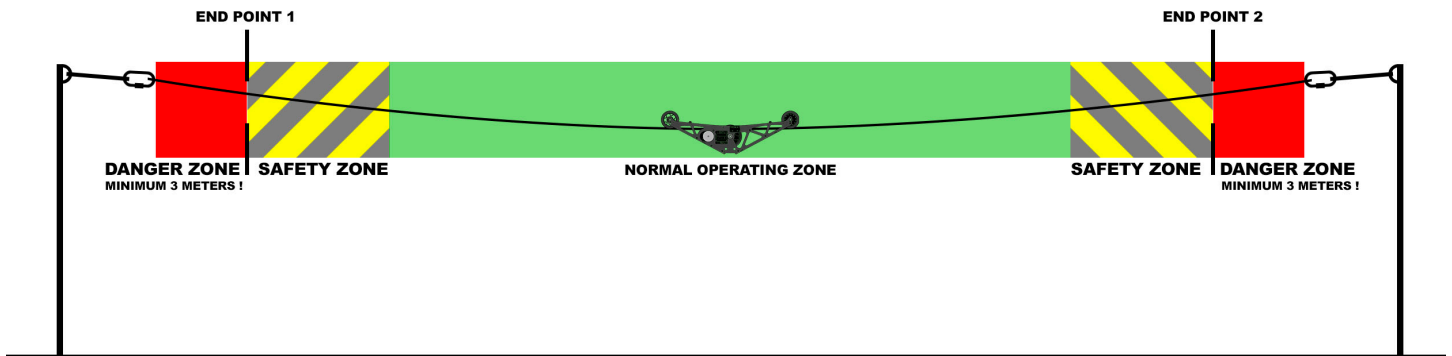
It is extremely important to follow these instructions carefully and conduct operation in accordance with all local safety regulations and best practices.

You MUST read thoroughly the Safety Section at the end of this instruction manual before operation. If you are unsure of any part of the operation of the MoCo, do NOT operate the system. Contact us for assistance.

Improper operation of the system can result in damage to property and/or injury/death to persons.

TABLE OF CONTENTS

1. MOCO MODULE INSTALLATION

1.1 Mount Sensor Disc to Front Outrigger Wheel

If looking at the FlyLine trolley with the motor controller and end of the motor facing you, the front of the trolley is to your right.

Front →
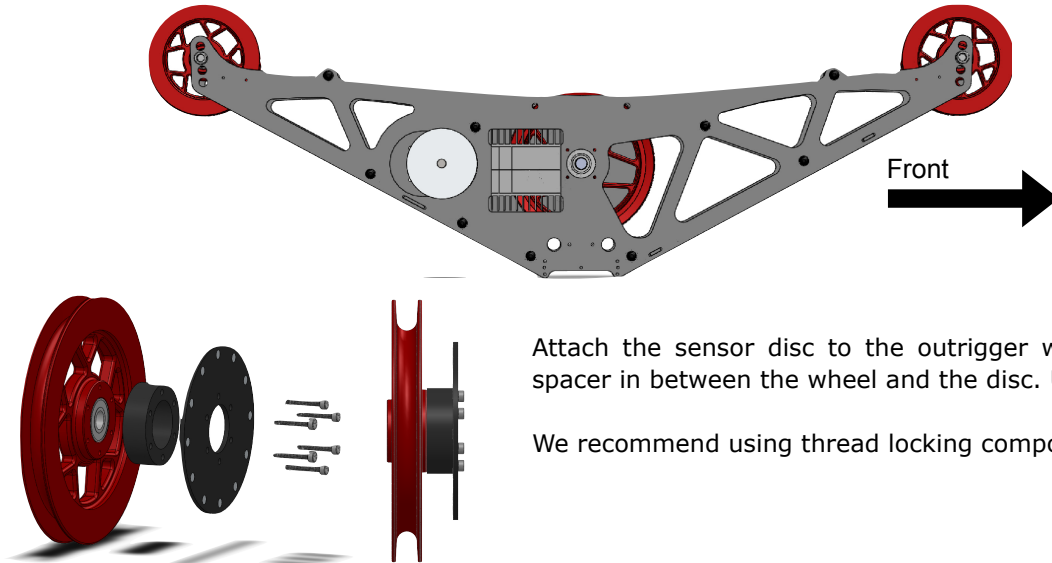
Attach the sensor disc to the outrigger wheel.   Place the spacer in between the wheel and the disc. Use 3x22 screws.
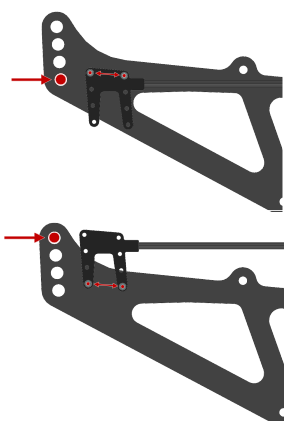
We recommend using thread locking compound like Loctite.

### 1.2 Mount Sensor to FlyLine Frame

The sensor mounts to the inside of the right side frame of the FlyLine next to the front outrigger wheel. Use M3x10 screws.

You will notice there are two M3 tapped holes in the FlyLine frame next to the wheel. The sensor has four hole selections that can be used.

The hole selections used with the sensor depend which of the four axle hole selections are used on the frame.

If the axle is in the lowest hole position on the frame, then use top holes in the sensor. Conversely, if the axle is placed in the top
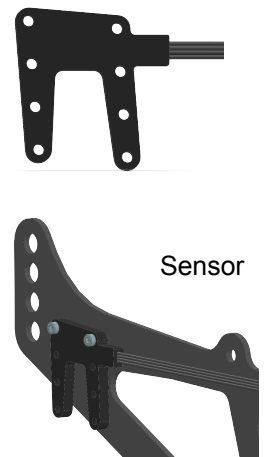
Sensor

Any other axle positions will correspond to the other holes in the sensor respectively. The idea is to keep the sensor aligned with the axle of the outrigger wheel so that the sensor is properly aligned with the sensor disc on the wheel.
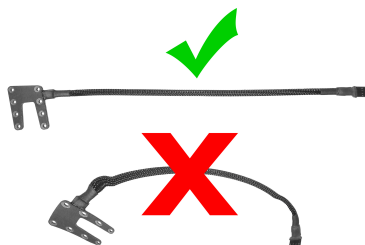

The sensor cable should NOT be bent or flexed sharply. Bending or flexing the cable near the ends can damage the connections inside the sensor or at the connector. Handle the sensor cable gently.

1. MOCO MODULE INSTALLATION

1.3 Mount MoCo Module to FlyLine Frame

The MoCo module mounts to the right FlyLine frame with double sided tape. Place the module in the position shown.
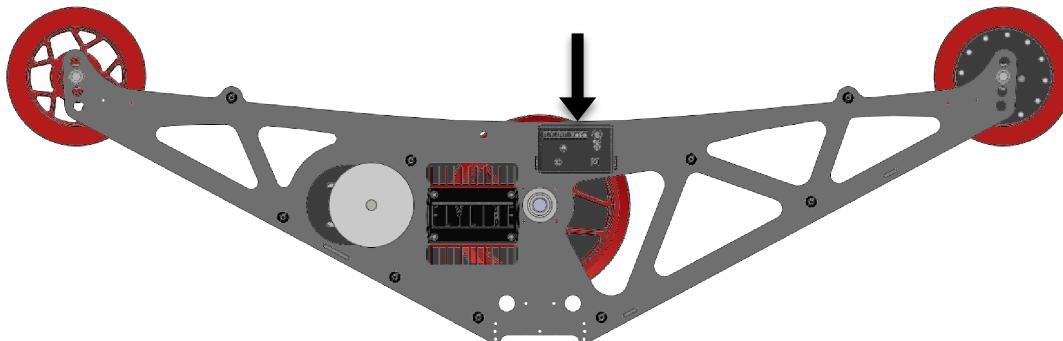

1.4 Connect RC Control Cables

Connect the RC control cables from the Spektrum AR610 to the left side of the MoCo as follows:

Position 1 on MoCo to Elev on receiver
Position 2 on MoCo to Gear on receiver
Position 3 on MoCo to Aux 1 on receiver
Position 4 on MoCo to Thro on receiver

WHITE wires of the cables should
be oriented to the top of the MoCo.

BLACK wires should be at the bottom.

AR610 connections
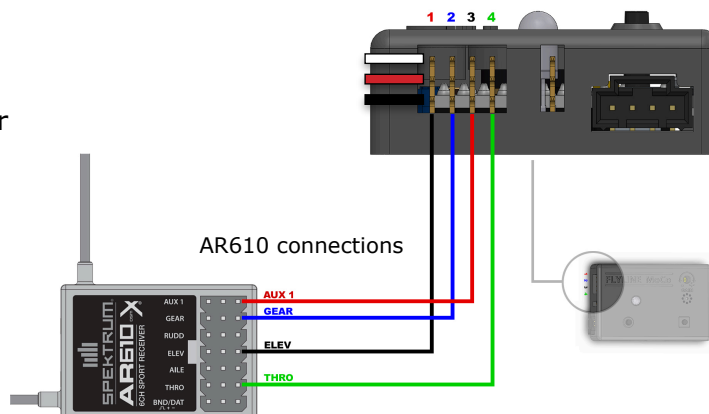
1.5 Connect & Route Sensor Cable

Connect the wheel sensor cable to the connector on the right side of the MoCo unit. Route the cable along the trolley frame and secure with cable ties. The cable will need to route from the outside of the frame to inside of the frame at the sensor. The cable can be flexed smoothly. Do NOT sharply bend or flex the cable!

⚠️ Failure to secure the cable properly could result in the cable being pulled from the sensor or MoCo which could result in a dangerous crash. Be sure the cable is properly secured!
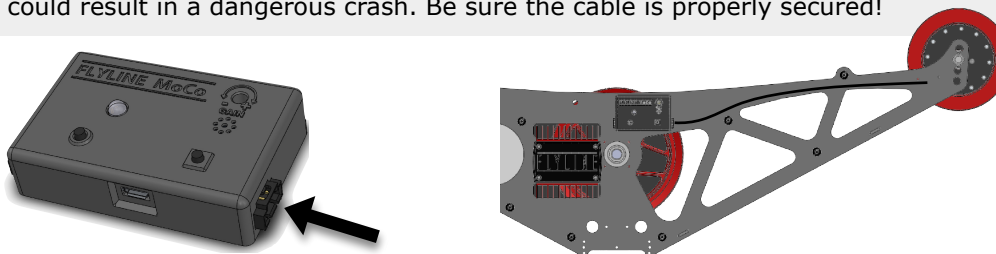
2. MOTOR CONTROLLER SETUP

2.1 - DIP SWITCH ASSIGNMENTS

In order for the MoCo unit to operate properly it is important that the motor controller DIP switches be configured.

The DIP switches on the motor controller circuit board MUST be configured with switches 1 & 2 in the 'OFF' position and switches 3, 4, 5, 6 in the 'ON' position as shown below.
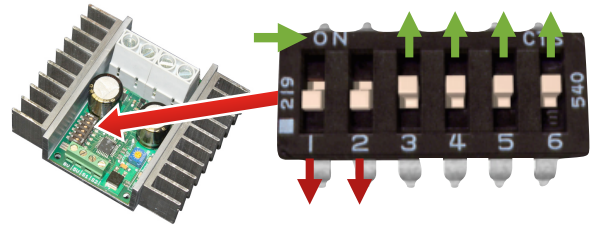
Look for the 'ON' printed on the DIP switch block above switches 1 & 2. Switches flipped towards this direction are 'ON'.

2.2 - CURRENT LIMITER ADJUSTMENT

Locate the current limiter adjustment potentiometer on the motor controller. It is blue with a yellow adjustment screw in the middle.

Set the adjustment screw to 50% by rotating it so the arrow portion of the screw points to the '50' on the motor controller circuit board.
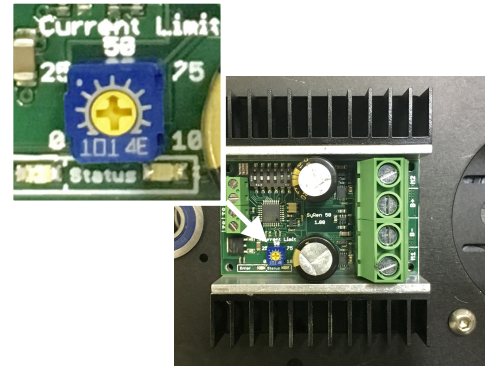
2.3 - Data Cable Connection

Install the supplied Data Cable to the terminals on the motor controller marked 0V, 5V, S1.

Black wire connects to 0V
Red wire connects to 5V
White wire connects to S1

Connect the plug end of the data cable to Position 5 on the MoCo unit with the WHITE signal wire on the top position, BLACK at the bottom.
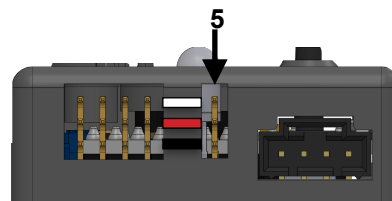
2. MOTOR CONTROLLER SETUP

2.4 - Connections Diagram for Spektrum AR610

When all connections are made the system should be as follows:
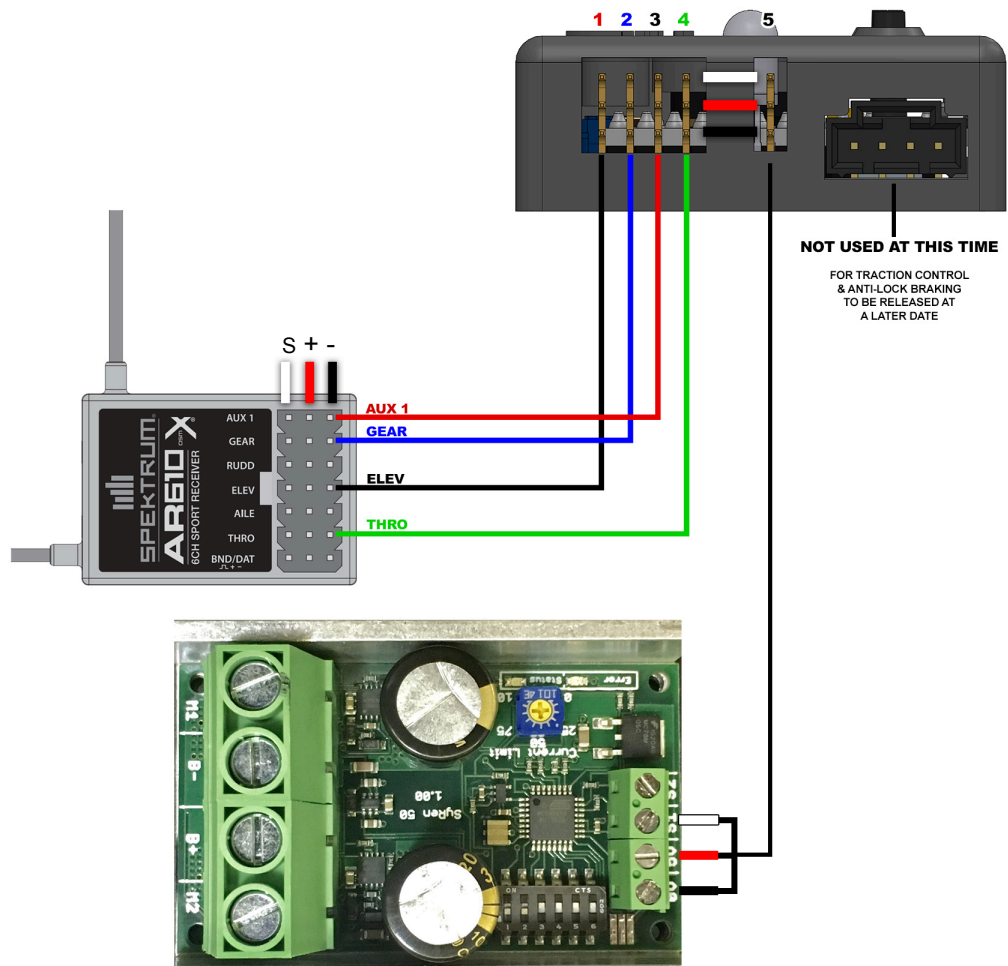
NOT USED AT THIS TIME

FOR TRACTION CONTROL
& ANTI-LOCK BRAKING
TO BE RELEASED AT
A LATER DATE

S + -

AUX 1
GEAR
RUDD
ELEV
AILE
THRO
BND/DAT

AUX 1
GEAR
ELEV
THRO

Verify RC controls and data cables are oriented correctly with WHITE, RED, BLACK wires in proper position.

2. MOTOR CONTROLLER SETUP

2.5 - Connections Diagram for Spektrum AR8000/AR8010T

When all connections are made the system should be as follows:

Verify RC controls and data cables are oriented correctly with WHITE, RED, BLACK wires in proper position.

2. MOTOR CONTROLLER SETUP

2.6 - Motor Wire Connections Diagram

You may **NOT** ignore this page if you have ordered the MoCo module separately from a FlyLine and you are installing it yourself.

You **MAY** ignore this page if you have received a prebuilt FlyLine system from PhotoShip One with the MoCo already installed as we have already completed this verification.
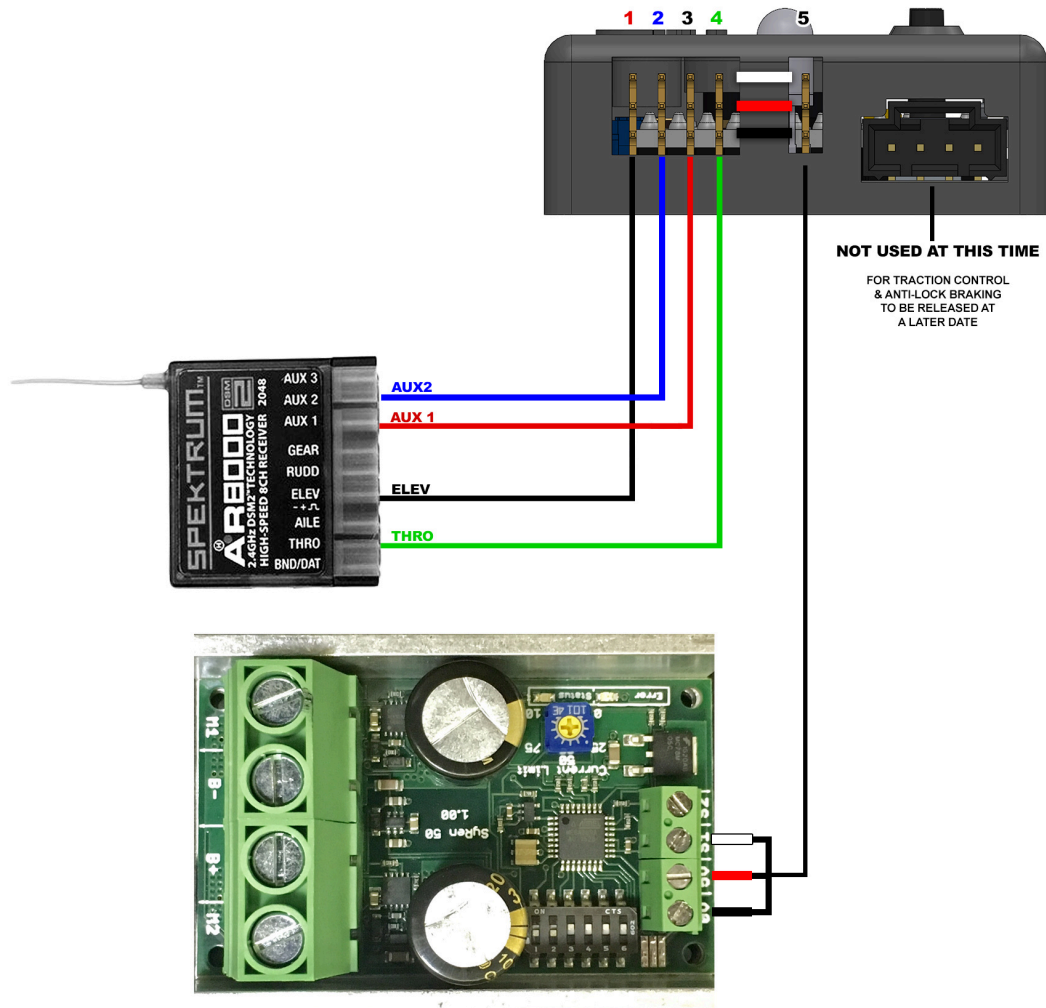
Depending on the motor you have please set the motor wire +/- as shown below. If you are unsure which motor you have you can determine by looking at the back of the motor opposite the shaft.

If the motor has four black plastic caps on a silver housing, the motor is the A28-150.

If the motor does not have plastic caps on a silver housing and the end is black, the motor is the E30-150

A28-150 MOTOR(3HP)

NEGATIVE (-) WIRE CONNECS TO 'M1' ON MOTOR CONTROLLER

POSITIVE (+) WIRE CONNECS TO 'M2' ON MOTOR CONTROLLER
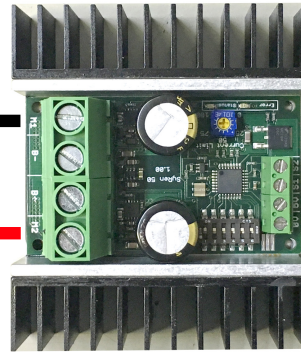
E30-150 MOTOR (1HP)

POSITIVE (+) WIRE CONNECS TO 'M1' ON MOTOR CONTROLLER

NEGATIVE (-) WIRE CONNECS TO 'M2' ON MOTOR CONTROLLER
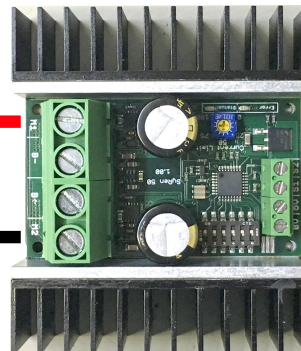
FAILURE TO VERIFY THESE CONNECTIONS CAN RESULT IN THE FLYLINE TROLLEY GOING FULL SPEED IN AN UNCONTROLLED 'RUNAWAY'. THIS IS EXTREMELY CRITICAL STEP. DO NOT IGNORE IT!

3. SPEKTRUM CONTROLLER SETUP

We use exclusively Spektrum RC controllers. The instructions below are for a DX6 but other Spektrum systems like the DX7, DX8, DX9 will be similar or exactly the same. We have made model files available for Spektrum DX6, DX7S, DX8 (silver & black), and DX9 here:

http://www.photoshipone.com/documentation/Spektrum_MoCo.zip

Other RC systems (Futaba, JR, etc) have not been tested and may not work properly with the MoCo module.

If you purchased your FLyLine system from us with the Motion Control module installed, disregard this Section.

3.1 - Servo Setup -> Reverse

Enter the 'Servo Setup' menu on the Spektrum. (refer to Spektrum manual on how to enter this menu).

Then, scroll to the 'Reverse' menu.

Verify all channels are in the normal and not reversed setting.
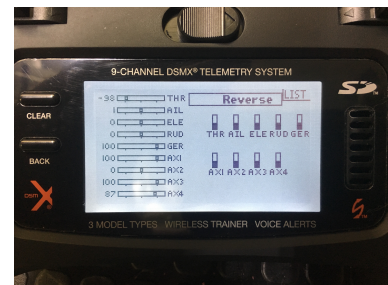
3.2 - Servo Setup -> Travel

From the 'Servo Setup' menu, scroll to the 'Travel' menu.

Set all channels to 100/100 if they are not already at that value.
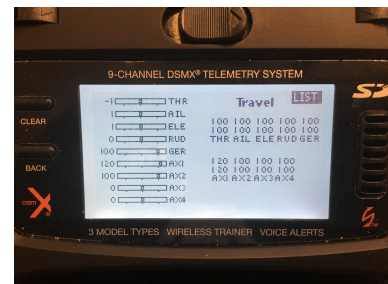
3.3 - D/R and Expo

Enter the 'D/R and Expo' menu.

Set the dual rate for Elevator channel as follows:

Position 0 - Dual Rate: 100% 100%
             Expo: 45%   45%

Position 1 - Dual Rate: 50% 50%
             Expo: 25% 25%

Assign the switch to whatever switch you prefer. We recommend a two position switch. See Spektrum manual for assigning switches.

NOTE - The values above are settings to start with. You may adjust them to suit your preference for control response and feel.
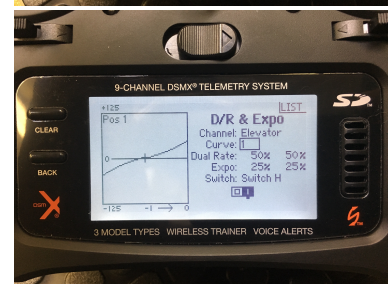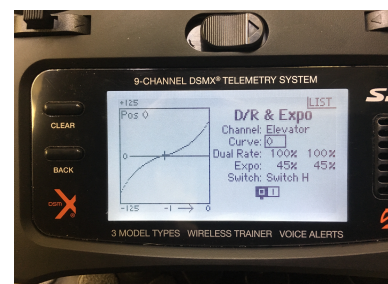
3. SPEKTRUM CONTROLLER SETUP

3.4 - Switch Assign Aux 1 Channel to Button

We recommend the Aux 1 channel (used for setting end points) be assigned to the 'Bind' button on the Spektrum controller. On the DX 6 this button is defined as button 'I'.

Go to System Menu > Channel Assign, press roller button.

Select NEXT under RX Port Assignments

Select Aux 1 under Channel Input Config menu and change to button 'I'. Button 'I' is the Bind button on the top left of the controller.
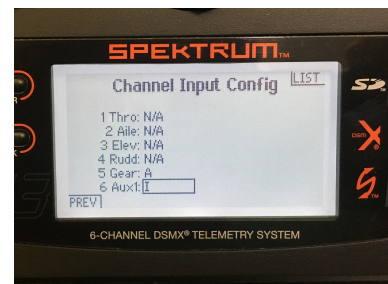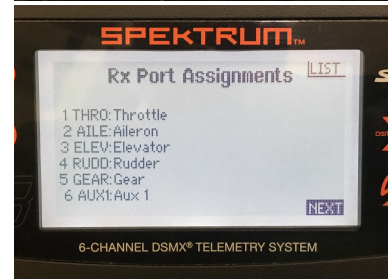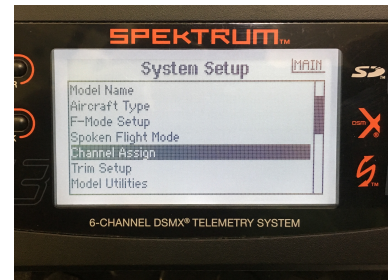
3.5 - AR8000 RECEIVERS ONLY
Assign Aux 2 Channel to Button 'A'

If you are using an AR8000 receiver you must be also using a Spektrum DX8 or DX9 and assign the Aux 2 channel to switch 'A'.

In the Switch Assign menu you will need to first set Gear to something other than 'A' so that Aux 2 can be set to 'A'. In the example shown here, 'E' was used.

Now, Aux 2 can be set to 'A'.

Important note for AR8000 users! - You MUST bind your AR8000 receiver to the transmitter in Fail Safe mode with the throttle stick set to low position, and Switch 'A' in position 1. Failure to do so can result in a crashed trolley if the system were to go into Fail Safe. See AR8000 manual for details on how to bind in Fail Safe mode.
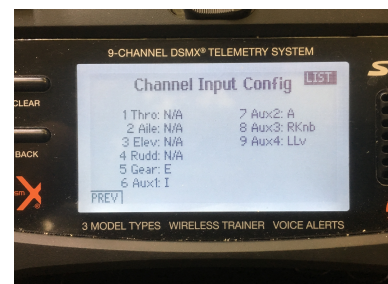
4. MODE SELECTION

There are three operating modes with the MoCo Module. This section explains how to enter the modes. For instructions on operation of the modes see Section 5.

1. **Manual Control/Auto End Point** - With this mode the user sets end points on the rope where they want them while in manual control. Then when Auto End Point is toggled the FlyLine trolley will not exceed the endpoints once the gain setting is correct and End Point mode toggled. LED color **GREEN.**

2. **Ping-Pong Mode** - With this mode the user sets end points on the rope where they want them and when activated the Ping-Pong mode will drive the FlyLine trolley automatically between the two points continuously at a speed set by the user. The trolley will "ping-pong" until the battery dies or until the user deactivates the mode. LED color **BLUE.**

3. **Sensor Test Mode** - This mode is recommended to be used only once per session/rigging. It allows the user to verify the wheel sensor is collecting pulses from the wheel sensor disc. LED color **RED.**

4.1 - Manual Control/Auto End Point Mode

The MoCo defaults to Manual/End Point Mode each time it is powered up.

The LED indicator will illuminate **GREEN** when Manual Control/Auto End Point Mode is entered.

Any end points stored from a previous session are erased upon power up. Thus, it is required that upon powering up the unit each time, new end points must be set.

For information on setting end points and operating in Manual Control/Auto End Point Mode, please refer to section 5.2.

4.2 - Ping-Pong Mode

To enter Ping-Pong Mode there are two methods. Manually & Remotely:

MANUALLY
1. Set the throttle stick (left stick on the Spektrum) all the way to the down/low position.
2. Set the GEAR Switch to the OFF position.
3. Push and hold the left 'Circle' button on the MoCo Module for 2 seconds.

REMOTELY
1. Set the throttle stick (left stick on the Spektrum) all the way to the down/low position.
2. Set the GEAR Switch to the ON position.
3. Push and hold the AUX button on the Spektrum for 2 seconds.

The LED indicator will illuminate **BLUE** and the beeper will beep two short tones when Ping-Pong Mode is entered. Any end points stored from a previous session are erased upon power up. Thus, it is required that upon powering up the unit each time, new end points must be set.

For information on setting end points and operating in End Point Mode, please refer to section 5.2.

To exit Ping-Pong mode push and hold the left 'Circle' button on the MoCo Module or AUX button on Spektrum for 2 seconds. The LED indicator will illuminate GREEN and you will hear one short tone from beeper letting you know you are back in Manual Control/Auto End Point Mode.

4. MODE SELECTION

4.3 - Sensor Test Mode

To Enter Sensor Test Mode:

Simultaneously push and hold the left 'Circle' button and the right 'Square' button on the MoCo Module for 2 seconds.

The LED indicator will illuminate **RED** and you will hear three tones from beeper when Sensor Test mode is entered.

For information on conducting sensor test please refer to section 5.4

To exit Sensor Test mode simultaneously push and hold the left 'Circle' button and the right 'Square' button on the MoCo Module for 2 seconds. The LED indicator will illuminate GREEN and you will hear one tone from the beeper letting you know you are in Manual Control/Auto End Point Mode.

5. OPERATION

5.1 - Manual Control/Auto End Point Mode

The MoCo Module is in full manual control when the 'Gear' switch on the Spektrum controller is in the 'Off' position. The LED indicator will be solid GREEN.

⚠️ When in manual control the operator has complete manual control. It is possible to drive the trolley and crash into attach points at either end of the rope! Be VERY careful when operating in manual control.

When in manual control the 'Aux' and 'Gear' switches work as follows:

Gear switch is a two position switch. In the 'OFF' position the trolley is operated in Manual Control. With the Gear switch in the 'ON' position the trolley is operated in Auto End Point mode.

The Aux 1 switch is a momentary push button (Bind button). When the Gear switch is in the 'OFF' position and the Aux 1 button is pushed the first end point is set where the trolley is on the rope. When the Aux 1 button is pushed a second time the second end point is set where the trolley is on the rope.

Thus, to set end points for Auto End Point mode, do the following:

1. With the Gear switch 'OFF' drive the trolley in Manual Control mode to a desired end point.
2. Press the Aux 1 (bind) button. You will hear one long tone from the beeper indicating that position on the rope has been set as end point 1.
3. Drive the trolley to the desired end point position at the other end of the rope.
4. Press the Aux 1 (bind) button. You will hear two long tones from the beeper indicating that position on the rope has been set as end point 2.

At this point the end points have been stored and the system is ready for Auto End Point mode.

To activate Auto End Point Mode, flip the Gear switch to the 'ON' position.

Once Auto End Point Mode is activated the system is ready for Gain Calibration. See Section 5.2.

ONLY AFTER GAIN CALIBRATION CAN YOU USE AUTO END POINT MODE!

5. OPERATION

5.2 - Gain Calibration

After the end points have been set as described in Section 5.1, the next step is to adjust the gain calibration.

Gain calibration adjusts the brake start point. If the FlyLine trolley is loaded down with heavy camera and equipment and/or would be traveling at a fast speed it would require an earlier brake start point than lightly loaded and/or slower speed. Thus, you MUST calibrate the Gain setting on the MoCo unit every time the system is rigged or the weight/speed operating profile changes.

Press and release, listen for number of beeps to determine Gain value

The Gain is adjusted via a potentiometer on the MoCo module. The Gain potentiometer is located near the upper right corner of the module.

Adjustment is done with a small flat blade screw driver.

Gain has settings of fully counterclockwise of a value of 1, through fully clockwise to a value of 10.

To know which number value the Gain is currently set to, simply push the right Square button on the MoCo module for 1/2 second then release. You will hear a series of tones from the beeper that denote what value the gain is set. 1 beep = Gain Value 1, 2 beeps = Gain Value 2, 3 beeps = Gain value 3, and so on to 10.

Rotating counterclockwise towards 1 reduces the Gain. Reducing Gain has the effect of setting the brake start point closer to the end point.

Rotating clockwise towards 10 increases the Gain. Increasing Gain has the effect of setting the brake
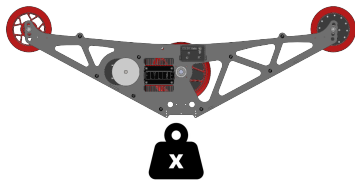
A system with low mass and/or low speed operation will require a LOW Gain value
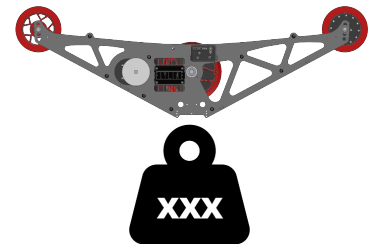
A system with high mass and/or high speed operation will require a HIGH Gain value

GAIN VALUE

1   2   3   4   5   6   6   7   8   9   10
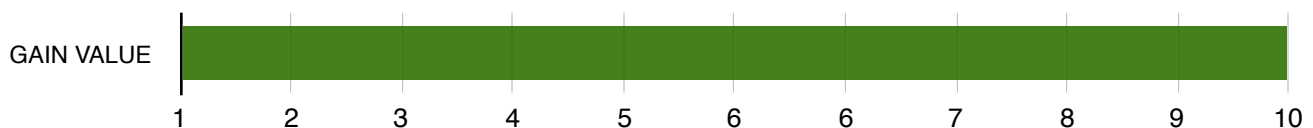
5. OPERATION

5.2 - Gain Calibration (continued)

The Gain calibration procedure should be conducted as follows:

1. Set the Gain value fully clockwise to 10. Take care not to over rotate the Gain adjustment. Applying too much force with the screwdriver can damage the adjustment potentiometer.

2. Verify the Gain value is set to 10 by pressing and releasing the right 'Square' button on the MoCo module and listening for the number of tones from the beeper. There will be 10 tones if the Gain value is set to 10.

3. Be sure end points have been set as described in Section 5.1 and that Auto End Point Mode is active!

4. Drive the trolley at a medium speed towards an end point. The trolley will begin to decelerate to a stop before reaching the end point.

If the rate of deceleration is very slow and the system takes a long period of time to reach a stop, you may increase the Gain value by one increment and try the test again.

Subsequent tests can be conducted at a faster speed, but be sure the first test is no more than a medium speed since until the Gain value is set, the risk of crash is still present.

Repeat the test a couple of times, increasing the Gain value each time so that at fast speed the system will safely bring the trolley to a smooth stop before reaching an end point.

Once the Gain value is set the system is ready for operation in Auto End Stop or Ping-Pong Mode.

NOTE - Any changes to the mass of the system (adding a heavier lens for example) would require a recalibration of the Gain value.

NOTE - If the rope rigging/installation is sloped at an angle, conduct all Gain calibration tests with the trolley system driving DOWNHILL.
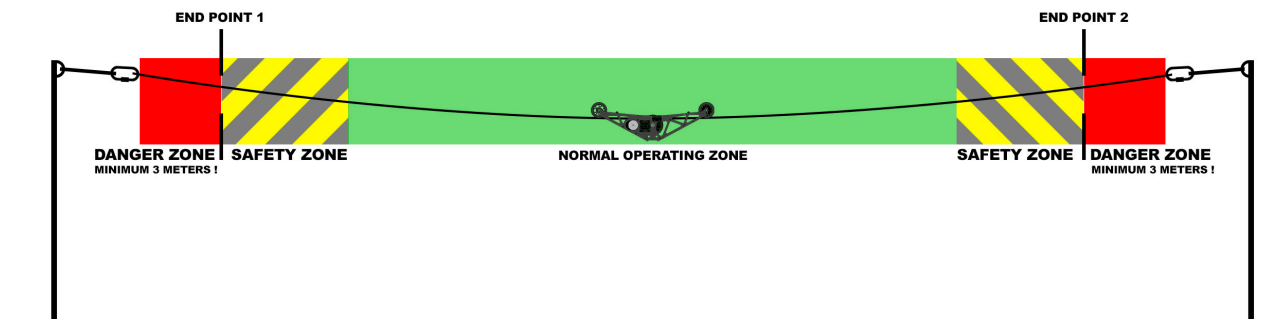
It is important to understand how end points work. The location of end point 1 and end point 2 are NOT the locations where the trolley will stop, but rather the locations where the trolley should not exceed.

In normal operation, with the Gain value adjusted correctly, the trolley will start braking before the Safety Zone and come to a stop INSIDE the Safety Zone BEFORE reaching an end point. The Safety Zone size and brake start points are dependent on the Gain value.

⚠ ALWAYS set end points at least 3 meters from the last rigging point! NEVER operate a system with less than 3 meters Danger Zone. Ever!

5. OPERATION

5.3 - Ping-Pong Mode

Ping-Pong mode is useful for live events and where only a single operator is available and that operator must focus attention to operating the camera gimbal. With Ping-Pong mode the operator let Ping-Pong mode automatically drive the trolley continuously back and forth at a desired speed.

To use Ping-Pong mode:

1. Set end points as described in Section 5.1
2. Calibrate Gain value as described in Section 5.2
3. Enter Ping-Pong mode as described in Section 4.2
4. Set the throttle stick (left stick on the Spektrum) to the desired speed
5. Activate Ping-Pong mode by flipping the Gear switch to the 'ON' position

To cease operating Ping-Pong mode:

1. Set the throttle stick to the low throttle position
2. Flip the Gear switch to the 'OFF' position

If the trolley stops at an end but will not begin to move back to the other end, the gain value is set too high. Reduce the gain value by one and try again.

NOTE - Anytime the Gear switch is in the 'OFF' position, the MoCo Module is in Manual Control mode!

NOTE - Over distance traveled the end points may drift slightly. Average drift is approximately 25mm per 1 kilometer traveled. After traveling several kilometers total, check that the trolley does travel into the Danger Zone.

5.4 - Sensor Test Mode

Sensor test mode is used to verify the sensor is sensing the magnets on the sensor disc mounted on the front outrigger wheel.

To use Sensor Test mode:

1. Install the front outrigger wheel onto the trolley. Tighten the axle nut only enough to make contact. Do not over tighten.
2. Enter Sensor Test mode as described in Section 4.3
3. Slowly rotate the front outrigger wheel. You will see the LED alternate between blue and green each time a magnet passes the sensor. The beeper will beep each time a magnet passes the sensor.
4. Rotate the outrigger wheel one revolution and count the number of beeps you hear. You should hear 24 beeps with one full revolution.

Sensor test mode should be done each time the FlyLine is rigged on a rope to verify the sensor, sensor disc, and sensor cable are properly functioning.

6. SAFETY

While we've done a great deal of work designing the MoCo Module and tested the system extensively, it is impossible for us to test every combination of parameters.

As such, we urge you to take extra care and precautions when operating the FlyLine with the MoCo.

It is important that the FlyLine trolley be attached to a secondary safety rope rigged above the primary line. A zipline trolley and tether are perfect for this purpose.
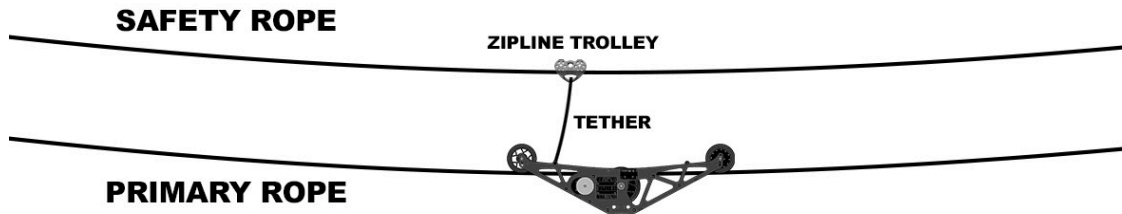
Before operating the system please verify the motor wire connections at the motor controller as specified in Section 2.5. Failure to verify the connections can result in a runaway scenario.

The effectiveness of the end point braking with MoCo is dependent upon proper Gain calibration.

DO NOT operate the FlyLine until a thorough Gain calibration procedure has been completed! Failure to complete a proper Gain calibration can result in a trolley crash and damage/injury to property and persons.

Be sure your Spektrum controller will set the channels as follows in Fail Safe Mode (See spektrum manual for Fail Safe setup):

Elev- NEUTRAL
Gear - ON
Aux1- OFF
Thro - LOW

With these settings stored in Fail Safe of the Spektrum, a loss of signal would force the MoCo unit into Auto End Point or Ping-Pong mode with motor power set to off or very slow.

Do NOT operate the trolley if the motor temperature is in excess of 165F (74C).

Use Locktite thread locker on all pulley set screws. If a set screw works loose, all control can be lost!

Operation in wet or icy conditions will affect traction severely. Take extra precautions and watch speed in these conditions.

It is recommended to reset the end points after the system has travelled a total distance of 5 kilometers due to the possibility for a slight drift of end points. It is normal for the system to drift the end points by an average of 25mm per 1 kilometer traveled.

We hope you enjoy the FlyLine. If you have further questions please contact us at flyline@photoshipone.com or visit our contact page of our website at http://photoshipone.com/contact-us/

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