Ver:Draft 08a for Firmware 0.96a
2012/04/12

Bay-Tec MX31 Flybarless System
Manual

Contents

1   Standard receiver connection

⬆ TopSide
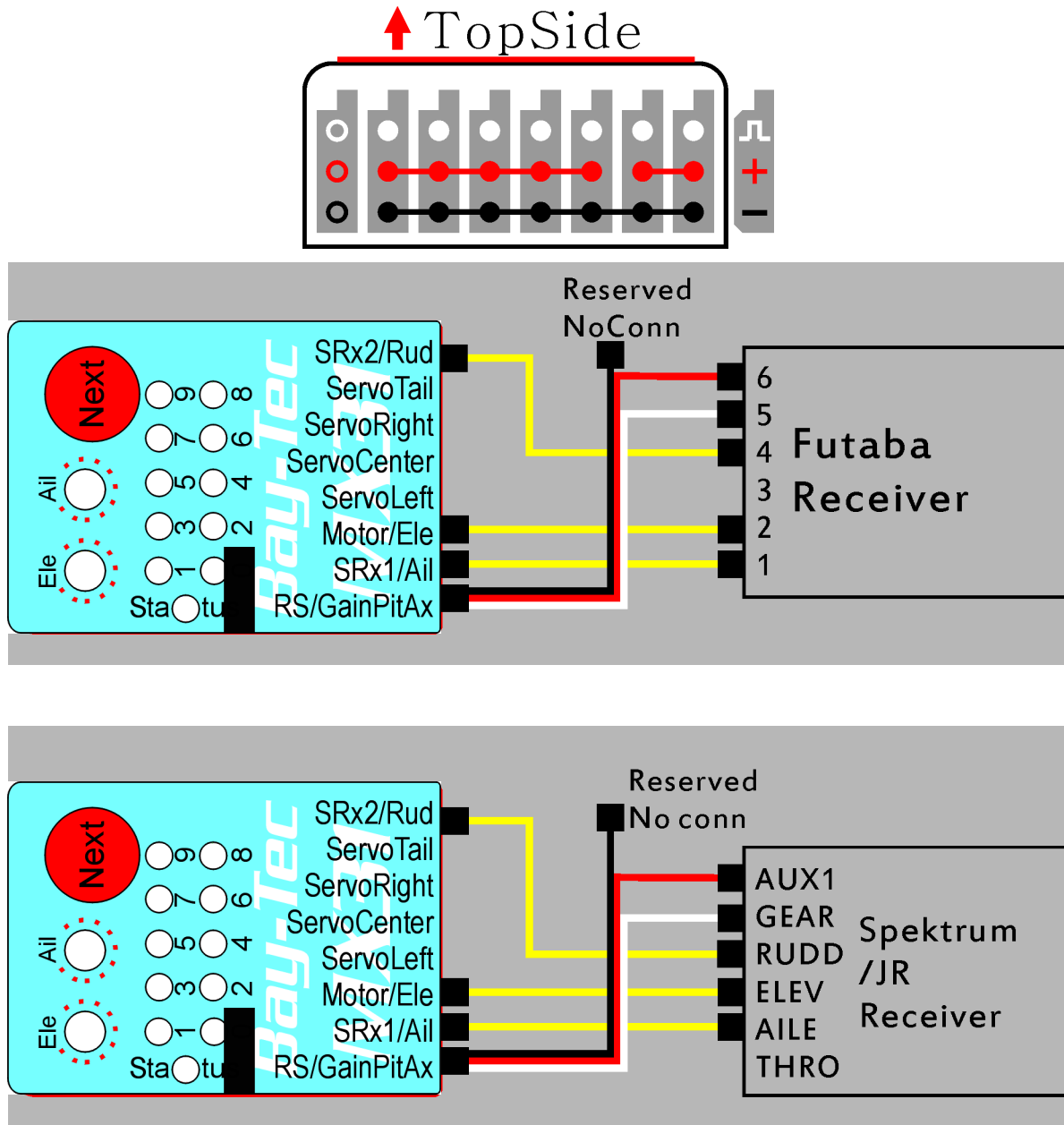
MX31 Port	Futaba Receiver Channel	JR/Spektrum Receiver Channel
Ail	1	AILE
Ele	2	ELEV
Rud	4	RUDD
Gain	5	GEAR
Pit	6	AUX1
Ax	N/A	N/A

All input channel must be connected with signal except [Ax], otherwise MX31 will stop at LED1!

Do NOT connect the combo port [Gain, Pit, Ax] with power supply!

2   Connecting single-line receivers

MX31 can also connect to kinds of single-line receivers.

While using single-line receivers, the SRx connecter accessory is needed.
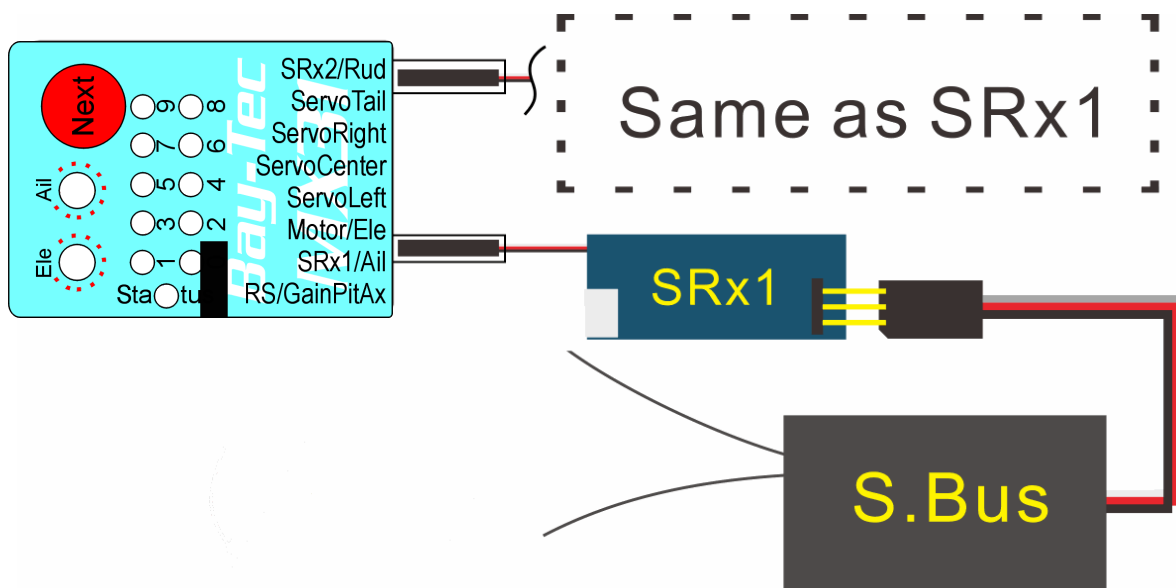
Connect to S.Bus receiver(R6203SB, R6108SB, R6208SB...)
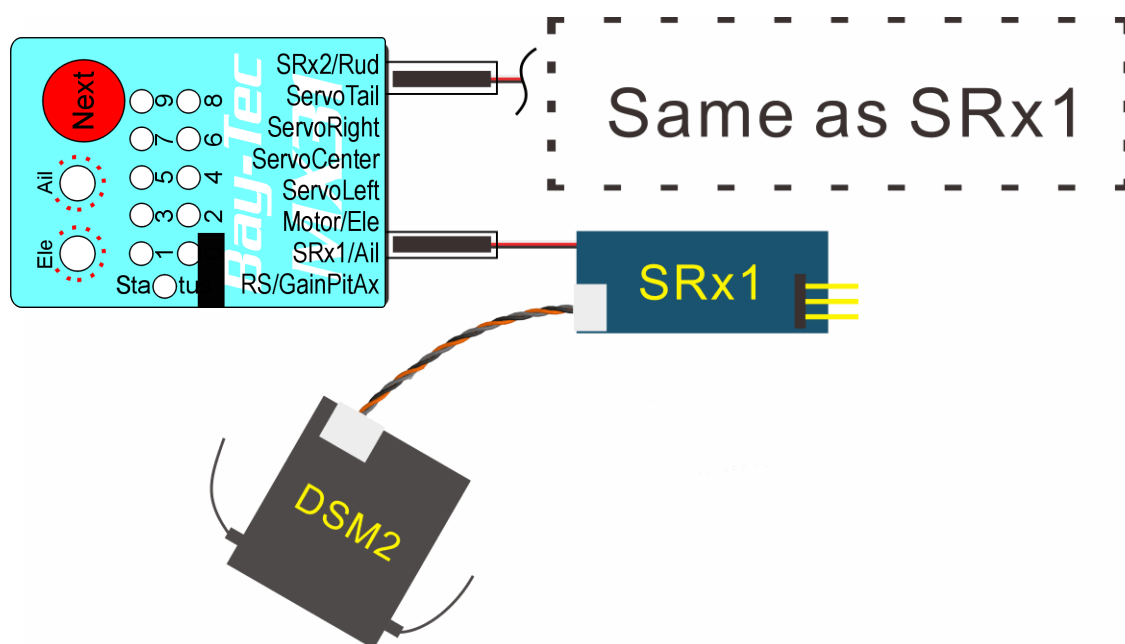
Connect to DSM2 receiver(EA101...)

While using DSM2 receiver, the free 3 pin port on SRx can be connect to [Rud] port on MX31 as power supply for tail servo.

Both SRx1 and SRx2 port are equivalent to each other. The 2 SRx port can be used at same time. Use 2 single-line receiver can perform better reliability.

3   Servo connection

[ServoLeft, ServoCenter, ServoRight] each connect to[Left, Center, Right] 3 swash plate servos. ServoTail connect to tail servo.

Attention! Left and Right mustn't be wrong, otherwise pirouette will not be stable!

4   Power supply

Fbl system self supports HV(High voltage), the voltage within 4.1V~9V is supported.

Tail servo, swash plate servo and USB has 3 separate power supply circuit. So that HV servo and normal servo can be used together.

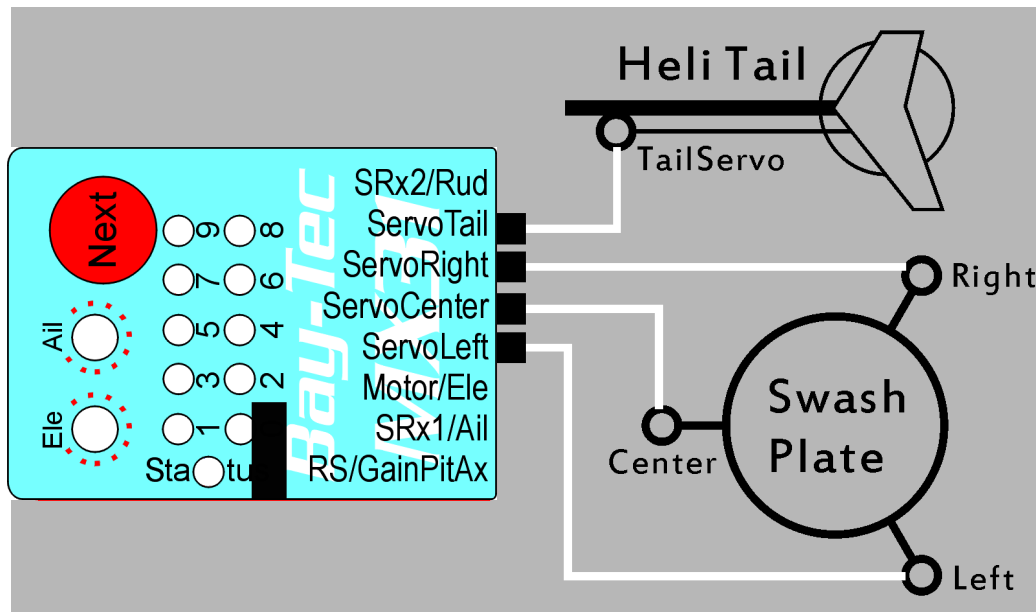The swash plate servos [ServoLeft, ServoCenter, ServoRight] are powered by [Ail, Ele] such 2 ports, each port can afford 5A current, 2 ports can afford 10A for swash plate servos in total.

The tail servo is powered by Rudd port, which can afford 5A current.

USB will NOT power the servos, so that if you only connected USB, the servos won't move. For the same reason, if you only powered the Rudd port, the swash plate servos won't move either.

5   Transmitter setup

Swash plate type should be set to H1 mode (the mode without swash servos mix, the mode used while using simulator). The swash plate mix is done by FBL system self.
Don't use the stick trim on transmitter.

6   Configure MX31 by PC

Please download PC software from www.bay-tec.de/MX31. Connect MX31 and your PC with USB wire, then you can configure it by PC software.

7 Configure MX31 by transmitter

Hold the [Next] button pressed to enter [Configure Menu]. Press and hold the button down, the menu LED next to menu point 0 will begin to flash and then after a while will be steady on.

You will enter [**Setup Menu**] if you release the [Next] button while the 0 LED has already been **steady on**; Otherwise you will enter [**Adjust Menu**] if you release the [Next] button while the 0 LED still **flashing**.

Press the [Next] button briefly for go to next menu point. After pushing the button at the last menu point you will exit the [Configure Menu] and the system is ready for operation again.

By moving the sticks to the left or right, you can select the different options within a menu point. The [Status LED] shows current setting of selected menu point. If you don't want to change the setting of a menu point, just leave it without moving the sticks on transmitter. The [Rudd], [Ail] and [Ele] stick may be used in different menu points.

Status LED figure example		Black No light
Red Steady on	**Blue Steady on**	**Purple Steady on**
Red Flashing	**Blue Flashing**	**Purple Flashing**

7.1 Setup menu overview(Menu LEDs steady on)

LED	Function	Operate	Status LED							
0	Receiver Type	Hold [Next] pressed	PWM	S.Bus	DSM2	DSMX	Custom			
1	Servo Type (Swash-Tail)	[Rudder]	Custom	Digital-Digital	Digital-760us	Analog-Digital	Analog-760us			
2	Swash servo neutral position	[Rudder] [Elevator]	Neutral	Center	Left	Right				
3	Swash servo direction (Center-Left Right)	[Rudder]	Custom	Nor-Nor	Nor-Rev	Rev-Nor	Rev-Rev	All 3 Nor	All 3 Rev	
4	Center servo location Positive pitch direction	[Rudder]	Back-Up	Back-Down	Front-Up	Front-Down				
5	Positive/Negative collective pitch geometry Cyclic pitch geometry	[Pitch] [Rudder] Click [Next]	[Pitch]@Bottom ColPit = -12°	Invalid:[Pitch] stick not in max/min pos	[Pitch]@Top ColPit = +12°					
			CyclicPitch = 8°							
6	Horizonal/Vertical mount	[Rudder]	∥ Horizonal	⊥ Vertical						

7	Ail, Ele, Rud Operate direction	[Rudder] Click [Next]	Aileron = Normal	Aileron = Reverse
			Elevator = Normal	Elevator = Reverse
			Rudder = Normal	Rudder = Reverse
8	Swash limit Tail limit	[Rudder] [Elevator] NoOp 3s	[Rudder] adjust ± tail limit	[Elevator] adjust ± swash plate limit
9	CycPitch Limit	[Rudder]	[Rudder] adjust cyclic pitch range.	

7.2 Adjust menu overview(Menu LEDs flashing)

LED	Function	Operate	Status LED				
0	Swash plate calibration	[Aileron] [Elevator] [Rudder]	0 collective pitch	Positive collective pitch		Negative collective pitch	
1	Ail/Ele rate	[Rudder]	Custom	Low	Mid-Low	Mid-High	High
2	Rudd rate	[Rudder]	Custom	Low	Mid-Low	Mid-High	High
3	Pit->Tail	[Rudder]	Custom	Low	Mid-Low	Mid-High	High

8 Setup menu(Menu LEDs steady on)

0 Receiver Type

Menu LED 0(Green) would be steady on. Status LED(Red/Blue) shows selected receiver type.

Do NOT connect motor at this time! Disconnect the motor for safety reasons to avoid the possibility of unintentional motor start up!

Beside using conventional receivers, MX31 supports kinds of single-line receivers(satellite receivers). If you are using a single-line receiver because of the different signal protocols the receiver type must be selected in this menu point before the first use.

The receiver and transmitter will be used during further configuration.

Hold [Next] pressed more than 2 seconds to change the receiver type that you selected.

Attention! Click [Next] briefly would go to next menu point.

Status-LED	Receiver Type
Black-Off	PWM, Standard receiver
Flashing Red	S.Bus: R6203SB...
Purple	DSM2: EA101...
Blue	DSMX: SPM9645
Flashing Purple	Custom, User defined by PC software

Click [Next] briefly would leave current menu point and go to next one.

Use PC software can assign receiver channel for the gain of Ele/Ail axis, so you can control the

gain by transmitter.

1 Servo Type

Menu LED 1(Green) would be steady on. Status LED(Red/Blue) shows selected servo type.

Move the [Rudder] stick to change the setting.

Status-LED	Swash plate servo type	Tail servo type
Black-Off	Custom, User defined by PC software	
Red	Digital	Digital
Blue	Digital	760us
Flashing Red	Analog	Digital
Flashing Blue	Analog	760us

Click [Next] briefly would leave current menu point and go to next one.

Use PC software can set the work frequency and neutral plus wide in detail.

2 Swash Servo Neutral Position

Menu LED 2(Green) would be steady on. Status LED(Red/Blue) shows which swash servo you are adjusting.

This menu point is designed for servo arm setup and neutral offset adjusting

When entering setup menu point 2 connect all swash plate servos as described in chapter 3. They now will be running to their mechanical zero position when the Status-LED is off(black). This state is designed for servo arm fixing.

Put on the link ball and push rod before fix servo arm screw. The servo arm should be perpendicular to push rod, and the collective pitch and cyclic pitch should be 0.

After fixed the servo arms, select the servo you want to adjust or return to mechanical zero state by [Rudder] stick.

The servo will swing once after it has been selected. You can change its center position by moving the [Elevator] stick back and forth.

Status-LED	Function
Black-Off	Swashplate servos at neutral position
Red	Center servo
Blue	Left servo
Purple	Right servo

Click [Next] briefly would leave current menu point and go to next one.

3 Swashplate Servo Direction

Menu LED 3(Green) would be steady on. Status LED(Red/Blue) shows direction of swashplate servos.

MX31 need to know which direction of servo movement can make the swashplate move up.

Warning! Just only consider of SWASH-PLATE, there is nothing to do with collective pitch.

Select swashplate servo direction by moving [Rudder] stick. There are 6 choice, select the one that makes the swashplate move up.
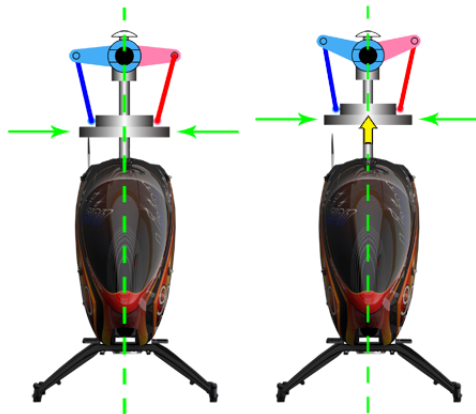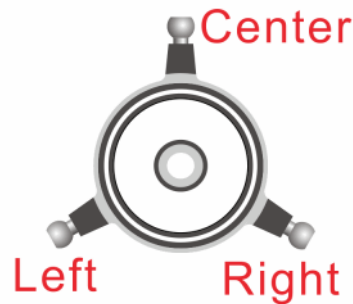

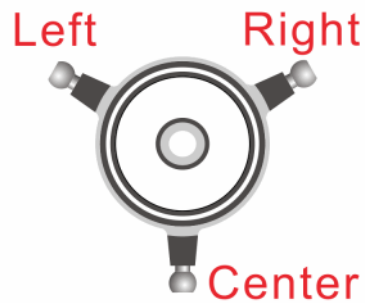| Status-LED	Center servo direction	Left servo direction	Right servo direction
Black-Off	Custom, User defined by PC software		
Red	Reverse	Normal	Reverse
Blue	Reverse	Reverse	Normal
Purple	Normal	Normal	Reverse
Flashing Red	Normal	Reverse	Normal
Flashing Blue	Normal	Normal	Normal
Flashing Purple	Reverse	Reverse	Reverse

Click [Next] briefly would leave current menu point and go to next one.

4 Center servo location& Positive pitch direction

Menu LED 4(Green) would be steady on. Status LED(Red/Blue) shows current setting.

If you are using non-120°(T90°, Y135°, Y140°) swashplate, please setup by PC software.

MX31 needs to know where is the Center-Swash-Servo, heli nose side or heli tail side.

CenterServo at Front   *CenterServo at Back*

MX31 needs to know how to move the swashplate can make a positive collective pitch, move up or move down.
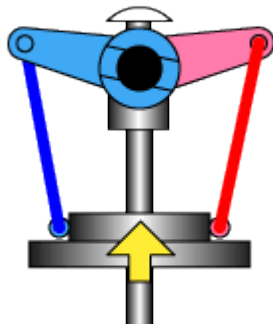
Up for Positive Pitch   *Down for Positive Pitch*
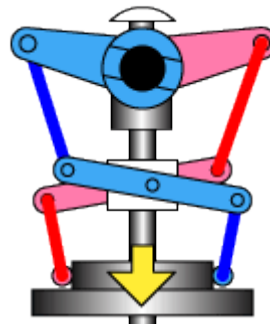
Status-LED	Center servo location	Swashplate direction for positive pitch
Red	Back	Up
Blue	Back	Down
Flashing Red	Front	Up
Flashing Blue	Front	Down

Click [Next] briefly would leave current menu point and go to next one.

5 Swashplate geometry calibration (Positive/Negative collective pitch geometry, cyclic pitch geometry)

Menu LED 5(Green) would be steady on. Status LED(Red/Blue) shows current setting step.

Don't use any pitch curves in your transmitter while doing these calibrations. Later on for the flights, you can adjust your pitch curves as you like and are used to.

For measure the pitch angle, a pitch gauge is needed in this menu point.

Move the [Pitch] stick all the way down and stay there. Now you can increase or decrease the minimum amount of pitch using the [Rudder] stick. Set the collective pitch to -12°.

Do NOT click [Next] for now.

When you adjusted the minimum pitch angle, move the [Pitch] stick all the way up and again. Now you can increase or decrease the maximum amount of pitch using the [Rudder] stick. Set the collective pitch to -12°.

When you adjusted BOTH the minimum and maximum pitch angle, click [Next] button briefly to enter next step within this menu point.

Move [Rudder] stick to increase or decrease the reference cyclic pitch angel, set it to 8°.

Always set the cyclic pitch to 8° at this time! This setup does not affect the maximum rotation rate of the helicopter but is only there to show MX31 the actual mechanical cyclic geometry. MX31 needs to know how much movement of servo can make a 8° cyclic pitch.

Status-LED	Function
Black-Off	Invalid, the [Pitch] stick is not at minimum/maximum position
Red	Calibrating **negative collective** pitch, [Pitch] stick at **bottom**
Blue	Calibrating **positive collective** pitch, [Pitch] stick at **top**
Purple	Calibrating **cyclic pitch**

Click [Next] briefly would leave current menu point and go to next one.

6 Horizonal/Vertical mount orientation

Menu LED 6(Green) would be steady on. Status LED(Red/Blue) shows current mounting orientation.

The MX31 unit can be mounted in nearly all possible orientations. The only restriction is that

the plug connectors have to point in or against flying direction.

You can choose whether the MX31 unit is mounted horizontally (printed surface 90 degrees to the main shaft, flat) or vertically (printed surface in parallel with the main shaft, mount on the side board).

Horizonal Mount

Vertical Mount

Move the [Rudder] stick to select choice.

| Status-LED	Function
Red	// Mount horizonal (Flat)
Blue	⊥ Mount vertical (On the side board)

Click [Next] briefly would leave current menu point and go to next one.

7 Operate direction (Aileron, Elevator and Tail)

Menu LED 7(Green) would be steady on. Status LED(Red/Blue) shows current step.

Step 1: Roll the heli left and right by hand, the swashplate has to steer against this movement. If this is not correct, you can reverse it by moving the [Rudder] stick.

Click [Next] button briefly to enter next step.
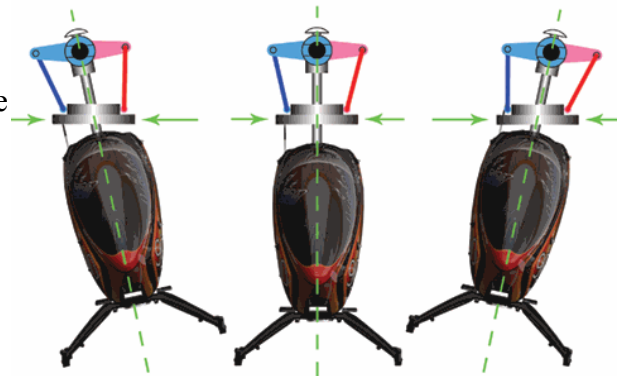

Step1, roll left right

Step 2: Tilt the heli up and down by hand, the swashplate has to steer against this movement. If this is not correct, you can reverse it by moving the [Rudder] stick.

Click [Next] button briefly to enter next step.

Step2, tilt up down

Step 3: Rotate the heli clockwise and CCW by hand, the tail rotor has to steer against this movement. If this is not correct, you can reverse it by moving the [Rudder] stick.
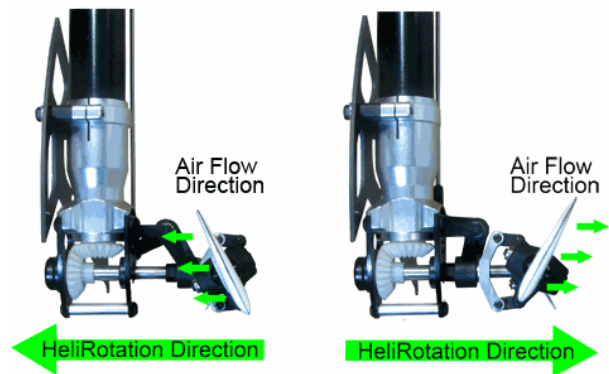
Step3, rotate clockwise CCW

Function	Normal	Reverse
Check and set **Aileron Sensor** direction	Red	Flashing Red
Check and set **Elevator Sensor** direction	Blue	Flashing Blue
Check and set **Tail Servo** direction	Purple	Flashing Purple

Long hold the [Next] pressed can return previous step.

After corrected all 3 direction, click [Next] briefly would leave current menu point and go to next one.

8 Servo(Swash and Tail) end point

Menu LED 8(Green) would be steady on. Status LED(Red/Blue) shows whether end point is big enough.

To adjust the limits, move the [Rudder] stick or [Elevator] stick in one direction until the tail servo or swashplate servos reach their maximum endpoint without any binding or stall and release the tail stick for a few seconds. If you move the servo too far you can steer the stick to the

opposite direction back.

If the setting is valid, the servos would return neutral and Status-LED turns Blue; If the travel range is too narrow, the servos would shock and the Status-LED turns Red.

Setup the other side limit of servos in same way.

Use [Elevator] stick setup swashplate servos; Use [Rudder] stick setup tail servo.

Click [Next] briefly would leave current menu point and go to next one.

9 Cyclic pitch limit

Menu LED 9(Green) would be steady on. Status LED has no light.

This menu point is designed to adjust the maximum possible tilting of the swashplate for aileron and elevator. The deflection will be limited in a circular path similar to a cyclic ring function.

Carefully move the sticks for [Aileron], [Elevator] and [Pitch] to all maximum end points and watch out if the swashplate, the linkage rods or servos are binding somewhere or even getting not more driven.

By moving the [Rudder] stick, you can adjust the aileron and elevator throw range. Always try to achieve the maximum possible cyclic throw. The higher the swashplate deflection is set the greater it will be in flight. This will achieve the maximum possible rotation rate of the helicopter without sacrificing the gyro control loop.

This is the last one in [Setup Menu]. Click [Next] briefly would leave current menu point and return [Fly State].

9 Adjust menu(Menu LEDs flashing)

0 Swashplate cyclic center adjustment

Menu LED 0(Green) would be flashing. Status LED(Red/Blue) shows current step.

This menu point gives you the possibility to easily adjust your servo centers on the flying field as for instance your helicopter is wobbling during pirouettes or when it doesn't climb out straight on quick pitch inputs.

The cyclic center at zero collective pitch, positive pitch and negative pitch can be setup separately. So there are 3 step: 0 pitch, positive pitch and negative pitch. Click [Next] briefly will enter next step.

By move the [Aileron] and [Elevator] stick can adjust the center of cyclic. At first step, 0 collective pitch, the center of collective pitch can also be adjusted by [Rudder] stick.

Status-LED	Function
Black-Off	Cyclic center at **0** collective pitch
Red	Cyclic center at **Positive** collective pitch
Blue	Cyclic center at **Negative** collective pitch

After all 3 step, click [Next] button briefly would leave current menu point and go to next one.

1 Max roll(Ail and Ele) rate

Menu LED 1(Green) would be flashing. Status LED(Red/Blue) shows current setting.

The maximum rotation rate of aileron and elevator can be changed by this menu point. Select choice by move [Rudder] stick.

Status-LED	Max roll(Ail and Ele) rate
Black-Off	Custom, User defined by PC software
Red	Low-180°/s
Blue	Mid Low-210°/s
Flashing Red	Mid High-240°/s
Flashing Blue	High-270°/s

Click [Next] briefly would leave current menu point and go to next one.

2 Max yaw rate

Menu LED 2(Green) would be flashing. Status LED(Red/Blue) shows current setting.

The maximum rotation rate of rudder(Max pirouette rate) can be changed by this menu point. Select choice by move [Rudder] stick.

Status-LED	Max yaw rate
Black-Off	Custom, User defined by PC software
Red	Low-450°/s
Blue	Mid Low-540°/s
Flashing Red	Mid High-720°/s
Flashing Blue	High-900°/s

Click [Next] briefly would leave current menu point and go to next one.

3 Tail – torque precompensation (RevoMIX)

Menu LED 3(Green) would be flashing. Status LED(Red/Blue) shows current setting.

The advantage of always knowing the pitch and cyclic load on the flybarless system, allows the

MX31 to pre-compensate for the torque variations on the tail before any noticeable deviation. This method of torque pre compensation (RevoMIX) relieves the tail control loop and improves the tail

performance especially when using MX31 on helicopters with insufficient tail authority and/or extreme motor torque (well powered electric helicopters).

To see the compensation direction, you can move the collective pitch, roll and elevator control stick at any time. With active feedforward the tail rotor has to produce a deflection which is must counteract the rotor torque. If you pitch in positive or negative direction or move aileron or elevator control, a deflection will be added to the tail rotor which must always act against the torque of the main rotor.

Status-LED	Tail – torque precompensation (RevoMIX)
Black-Off	Custom, User defined by PC software
Red	Low-45
Blue	Mid Low-55
Flashing Red	Mid High-64
Flashing Blue	High-72

This is the last one in [Adjust Menu]. Click [Next] briefly would leave current menu point and return [Fly State].

10 Firmware update

Online

    Press [Online Update] button in Welcome Page, then wait it finish.

Offline
1. Press the " Off line update" button.
2. Select the firmware file.
3. Wait 10 seconds until "All finished." displayed.

There is no danger while update process, even the USB line disconnected , just update once again.

The PC software can be run directly on Vista or Win7 OS, setupless and driverless. If you are using old Win XP, you may need to download the falling 2 update package of your windows from MS site:

Microsoft Visual C++ 2008 SP1 Redistributable Package (x86)
http://www.microsoft.com/download/en/details.aspx?id=5582

Microsoft .NET Framework 2.0 Service Pack 2
http://www.microsoft.com/download/en/details.aspx?id=1639

11 Version history

Version	Date	Content
Draft 08a	04/12/2012	Version 0.96a firmware DSMX receiver Setup Menu:Swash servo direction
Draft 08	03/28/2012	Version 0.96 firmware Setup Menu Adjust Menu
Draft 07a	11/28/2011	
Draft 07	11/21/2011	
Draft 06	10/01/2011	
Draft 05	08/14/2011	
Draft 04	08/07/2011	

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