TWINSYNC Instruction Manual DL502 By Down and locked VER:.5.0

The Twin Engine Synchronizer

This products intended use is unmanned Remote Control airplanes, Cars, Boats

Synchronizer Introduction and Feature Set

TWINSYNC senses RPM and controls throttle positions to synchronize twin engine airplane engines. Engines running at the same RPM produce that unique sound in flight. No worries in the case of one engine failure because you're TWINSYNC will automatically idle the remaining running engine. This SAFETY FEATURE prevents loss of control when an engine unexpectedly stops. The pilot regains control of the idling engine by simply moving the throttle stick to idle. Control is then returned to the throttle stick and the pilot has full control. This feature can be disabled if desired. If the loss of transmitter signal is detected the TWINSYNC SAFETY idles both engines. The TWINSYNC has several additional modes of operation adding capabilities beyond just keeping the engines synchronized. These modes will be described in detail later in this manual. Six LEDs provide operational status feedback and allow for easy installation and programming.

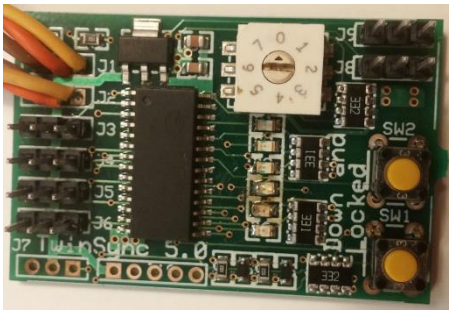
Overview of the steps to successfully install your TwinSync

1. Safety First:
    a. Ensure the engine will not fire during all manual operations requiring rotation of the propeller by removal of glow plug or spark plug. Power down ignitions.
    b. Stay clear of all rotating propellers, they will cut off body parts
    c. Avoid pinch points caused by moving parts
    d. Follow all safety suggestions of all products used
2. Ensure you have the most up to date instructions on the website www.downandlocked.com.
3. **Read and understand and follow the TwinSync Instructions.** Specific requirements exist for all the components used with the TwinSync.
4. Installing steps
    a. Set your throttles endpoints to 100% both directions. Successfully install engines, servos and run them one at a time directly with the radio and receiver. Ensure that there are no engine issues from starting; idle to full throttle and at engine kill.
    b. Ensure the model flies as it should prior to installing the TwinSync
    c. Follow the specific instructions found in this guide.
    d. **Before proceeding make sure both engines function properly run smoothly, and have no issues idling.**
    e. Install magnets - follow the specific instructions found in this guide
    f. Install sensors - follow the specific instructions found in this guide
    g. Connect the TwinSync – see the connection diagrams
    h. Program the TwinSync engines off – see the programming guide
    i. Test the TwinSync functions – engines off
    j. Test the TwinSync functions – engines on
    k. Fine tune TwinSync Functions as needed
    l. Pass Final testing of TwinSync functions
    m. **Always complete a successful range check prior to flight**.
    n. Pass successful Taxi Testing
5. Ready to fly

TWINSYNC **Instruction Manual** DL502 By Down and locked VER:.5.0

PROGRAMMING GUIDE

Safety first: Ensure the engine will not fire during all manual operations requiring rotation of the propeller by removal of glow plug or spark plug. Power down ignitions.



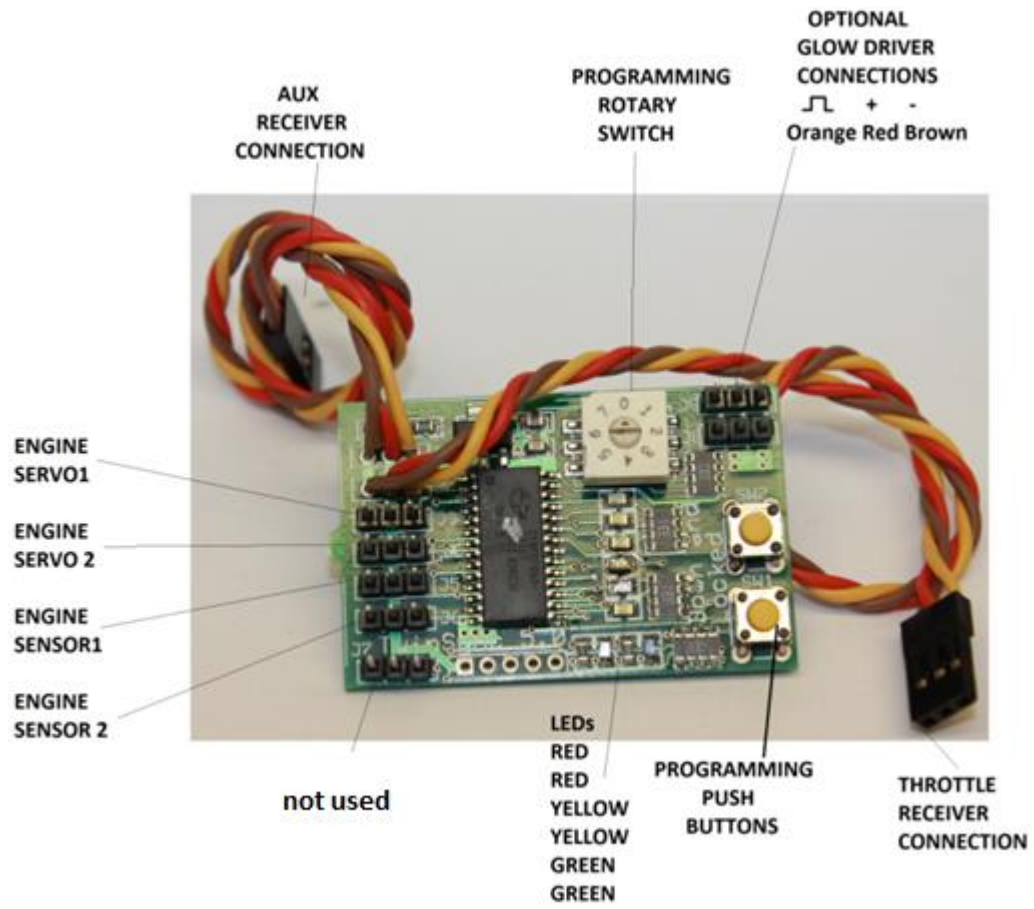
Red LEDs 1 and 2 flashing is normal, indicates the Optional DL506 Glow Drivers are off or not connected
To program, power off, move rotary, complete programming procedure as described, cycle power
After each programming step Cycle the Power to the TwinSync
Note: All connections are oriented so that the (-) ground is near the edge of the board, (+) Red is in the middle of the connector, and the signal wire (yellow, white) is toward the middle of the board. See Throttle and Receiver wires for a color example. Push buttons are labeled (SW1) and (SW2).

1. Complete section 3 of the instruction manual, Magnet, Sensors, TwinSync connections are assumed to be installed correctly
    a. A few things to confirm before programming
        i. If using DL503 and with power on the TwinSync the green LEDS flicker on or off as you rotate the magnet past the sensor
        ii. Sensor mounts must be made from non-magnetic, non-conductive, rigid materials; some examples are plywood and fiberglass. Follow all guidelines.
        iii. **Warning**: **Rout sensor wires away from engine parts, wires, magneto ignitions, electronic ignitions, metal, and other RFI sources. Metal shielded sparkplug caps must be used**
        iv. DL503-S Shielded sensor wires are custom made on request max length 3 ft
2. Ensure your Radio/Receiver's output channel is set to the correct direction. (throttle down 1ms, Full Throttle 2ms) (LEDs - LED1 Red, LED2 Red, LED3 Yellow, LED4 Yellow, Led5 Green, LED6 Green)
    a. Do not worry about your servos operating in the proper direction at this time we will check and or correct that in a later operation
    b. Red LEDs flashing or not flashing is normal
    c. Set your throttle channels endpoints to 100% and 100%
    d. Connect TwinSync's jumper J2 to the throttle channel of the receiver. Power on Transmitter then Receiver and TWINSYNC. Both yellow LED3 and LED4 should be off at idle and yellow LED4 on before full throttle and stay on through full throttle.
        i. If yellow LED4 is off at idle and on at Full Throttle Reverse your Radios throttle channel direction
3. **DO NOT PROCEEDE UNTIL: Both yellow LED3 and LED4 are off at idle and yellow LED4 on before full throttle and stay on through full throttle**
4. Servo throttle direction reversing: With the receiver and TWINSYNC power off; move the rotary switch to position "7". Power on Transmitter then Receiver and TWINSYNC. LEDs will flash several times indicating that you are in a programming mode. Press one button for about a half of a second to reverse one servo and repeat with the other button for the other servo. A yellow LED will come on when a servo is reversed and off when it is normal direction. Move the throttle stick up and down and confirm correct direction of the throttle servos. If the directions are correct then move the rotary switch back to position "0" cycle power and reversing is complete. Check the servo direction and repeat if necessary.

5. Programming order and relationship of Idle point, Sync point, Full Throttle are programmed so their relation to each other is; Idle is at least 1 click above full down, Sync point at least 1 click above idle and full throttle is at least 1 click above the sync point
6. LED3 is the sync feedback and will only come on when both engines are running and sync is commanded on
7. You will set idle point, Sync point, Full Throttle with the engines off then again with the engines running to final tune their operation as needed.
8. Idle point setting: The TWINSYNC will never move the throttles lower than this point while synchronizing engines or in the event of a dead engine this is the rpm where it will move the running engine to. Set the rpms high enough so the engine runs smoothly and won't die.
    a. With the receiver and TWINSYNC power off; move the rotary switch to position "3" and power on the transmitter then receiver, and TWINSYNC. The LEDs will flash a few times. After the LEDs stop flashing,
        i. move the transmitter stick to the idle point for engine 1, servo connected to J3, Sensor connected to J5
            1. Press SW 1 once to setting idle position for each engine 1 , a yellow LED will come on.
        ii. move the transmitter stick to the idle point for engine 2, servo J4 and sensor connected to J6
            1. Press SW 2 once to setting idle position for each engine 2 , a yellow LED will come on.
        iii. Move throttle stick all the way down and back to idle point to confirm the idle position
    b. Move the rotary switch back to position "0", IDLE POINT is set
    c. Cycle power
9. Full throttle point Setting: This limits maximum RPM of the motors.
    a. With the receiver and TWINSYNC power off; move the rotary switch to position "5"
    b. Power on Transmitter then Receiver and TWINSYNC. The LEDs will flash a few times. After the LEDs stop flashing, move the transmitter stick to full throttle. Press SW 1
    c. Move the rotary switch back to position "0", FULL THROTTLE is set
    d. Cycle power
10. Synchronization turn on point setting: When the throttle is moved above this point the TWINSYNC will synchronize the engines. Below this point synchronize is disabled. With the receiver and TWINSYNC power off;
    a. Move the rotary switch to position "5"
    b. Power on Transmitter then Receiver and TWINSYNC. The LEDs will flash a few times. After the LEDs stop flashing, move the transmitter stick at least 1 click above idle or to the sync point.
    c. Press the SW 2 in the middle of the board closer to the rotary switch.
    d. Move the rotary switch back to position "0", FULL THROTTLE is set
    e. Cycle power
11. Verification of settings: Power on and
    a. Check that both yellow LEDs (LED3, LED4) are off at idle and led4 yellow led comes on just above idle. Yellow LED3 will only come on when both engines are running at the same RPM, this is your Sync feedback indicator
12. You are now ready to fly with Synchronized engines

Always complete a successful range check prior to flight.

Connection Diagram 1:



J1 8” male JR lead	Auxiliary Function
J2 8” male JR lead	Receiver Throttle connection
J3 3 pin Jumper	Engine 1 Throttle Servo
J4 3 pin Jumper	Engine 2 Throttle Servo
J5 3 pin Jumper	Engine 1 RPM Sensor
J6 3 pin Jumper	Engine 2 RPM Sensor
J7 3 pin Jumper	QuadSync Connector
J8 3 pin Jumper	Optional Glow Driver Connector
J9 3 pin Jumper	Optional Glow Driver Connector
SW1 Button 1	See Programming for use
SW2 Button 2	See Programming for use
Rotary Switch	See Programming for use
LED 1 RED	Glow Driver Status, flashing is normal
LED 2 RED	Glow Driver Status, flashing is normal
LED 3 YELLOW	On when both engines are running at the same RPM, Sync feedback indicator. and for programming functions
LED 4 YELLOW	On Throttle >20% and programming functions
LED 5 GREEN	RPM sensor Engine 1
LED 6 GREEN	RPM sensor Engine 1

TwinSync Standard Components
1 pc DL502 TwinSync
2 pc DL503 Sensor, TwinSync
2 pc DL504 Standard Magnet, TwinSync
1 pc TwinSync Instruction Manual found at www.downandlocked.com

Five TWINSYNC connections are REQUIRED to operate the TwinSync:
Throttle channel from Receiver (J2)
Engine 1 - Throttle servo (J3), RPM sensor (J5)
Engine 2 - Throttle servo (J4), RPM sensor (J6)

Additional optional connections are available if needed:
AUX channel from Receiver (J1)
Engine 1 - Onboard glow drivers (J9)
Engine 2 - Onboard glow drivers (J8)

WARNING: Running sensor wires by a Gasoline engine with a magneto ignition and using rubber sparkplug caps will likely inject RFI from the magneto and spark into the sensor wires resulting is poor sync or erratic behavior. If used with gas engines only shielded metal sparkplug caps (like the Bosch) should be used and care should be used in routing sensor wire away from engine and magneto as far as possible.

NOTE: Red LED1 and 2 flashing or not flashing is normal. They are the Glow driver indicators. Flashing means the glow drivers are off. Not flashing means glow drivers are on if the glow drivers are attached.

Always complete a successful range check prior to flight.

1.0 System Operation and Theory

Rotating magnets mounted on your spinners (or optionally the prop hub for planes without spinners) are sensed by rigidly mounted sensors providing the TWINSYNC with RPM information needed to control the synchronization process. Engines can be synchronized from 1,500 to 23,000 RPM. Your Receiver's throttle channel signal is used as the "set-point" by the TWINSYNC to move dedicated throttle servos controlling engine RPM. Sync is off at throttle stick positions below the "sync Point" and the receiver's unfiltered signal is passed directly to the throttle servos. As programed from the factory when throttle position transitions below the sync point sync is off and glow drivers are turned on.
When the throttle transitions above the sync point and if both engines are running glow drivers turn off and sync on, the TWINSYNC moves the throttle servos to match the stick position then adjusts both engine throttles until the engines are synchronized. Yellow LED3 will only come on when both engines are running at the same RPM, this is your Sync feedback indicator.
The slow engine is increased and the faster engine is slowed to be synchronized. This process is continuous until the throttle stick is moved again. When the stick is moved the process is repeated again. Without a RPM signal from both engines the throttle signal is passed directly to the servos.

If you are using an engine with an electronic ignition, you can use the existing magnets mounted in the crank shaft to detect RPM. Use only the supplied sensors DL503 TS RPM sensor as other sensors may not be compatible with the TWINSYNC. DL530 is available to interface between a RCExcell ignition and the TwinSync

2.0 TWINSYNC Servo Adjustments

TWINSYNC is factory programmed to use without any additional program changes if used at 100% endpoints on a Futaba 9C. Use with other radio systems requires setting of idle, full throttle, and sync points. TWINSYNC functions are fully customizable with the following user settable servo parameters:
- Servo center/offset position: Servo fine tuning adjustments rather than manual adjusting linkage.
- Idle position: Dead stick or in independent run up mode idle RPM.
- Engine and servo response time: Adjustable servo response time provides compatibility with brushless esc (the fastest), digital servos on gas engines, digital servos on bug glow engine, to slow standard servos on high RPM glow engines (the slowest response time). The device comes preset to what is likely optimum position for glow and gas engines but if any "hunting" or oscillation is observed it can be removed with this setting.
- Full throttle position: TWINSYNC will not open the throttle past this position in synchronizing mode
- Sync Point: This is the throttle stick position that the synchronizer engages rather than just passing the throttle stick position to the servos like a "y" cable. Above this it syncs the engines. Factory setting is about 20% throttle.
- Servo reversing: Each throttle servo can operate in normal or reverse direction. Servo reversing and center positions are always in use regardless if the device is managing synchronization or not. This aids with setting up a twin engine airplane and provides the additional safety of killing the engines with the loss of TX signal. The servos are moved to idle if 1/4th of a second passes with no transmitter signal. Control is returned once the transmitter signal is received again for 1/10th of a second. If the device senses a loss in transmitter signal it moves the servos to low throttle. Several other options are available by connecting a second auxiliary channel (AUX CH) to the TWINSYNC. Programming and options available to use a second AUX CH are described later in detail in this manual.

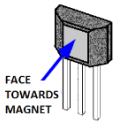
3.0 Sensor Choices


Magnet and sensor orientation is critical.
You have 2 sensor choices with the TwinSync.
DL503 The TwinSync comes with 2 standard sensors left picture.
DL530 The TwinSync can directly interface with a RCExcell ignition via the ignitions digital readout connection, right picture. The short lead connects to the ignition and the long lead to the TwinSync's sensor connection. Standard Servo Extensions can be used to lengthen the long lead.

3.0.1 Minimum and maximum sync rpm

The TwinSync can synchronize engines operating from 1,500 and 23,000 RPM. The device has a limit of 23,000 RPM and treats RPMs above 23,000 as zero RPM

3.0.2 Using existing magnets



If you already have a magnet installed on your crank (gas engine, magneto or other type) you might be able to use it instead of mounting a new one. Pass the sensor over the magnet to determine which side must face it, as described in 3.1 below. In the case of magnet orientation requiring the opposite side of the sensor faces the magnet, know that that side of the sensor is not as sensitive to the magnetic field. And since the strength of the magnet is not known you may need to mount the sensor closer than the required ¼"gap. Ensure that the green LED illuminates when the magnet passes the sensor.

3.0.3 Using Multiple Magnets

2 or more magnets can be used on engines operating below (23,000/2) 11,500 rpm. Using 2 magnets will allow you to sync effectively down to 750 rpm. Magnet and sensor orientation is critical, Precision magnet placement is necessary when using multiple magnets (+- .05 degree). If you do not align them properly it will cause the TwinSync to oscillate RPM. Hand alignment is not acceptable. Sufficient magnet separation (circumferential distance) must be provided so that the green LED goes out completely between magnets. Do not use multiple magnets where engine rpm will cause more than 23,000 sensor reads per minute (magnet count x Motor max RPM > 23,000 = bad). Engines can be synchronized from 1,500 to 23,000 (RPM or sensor reads per minute).

3.1 Installing Spinner Mounted Magnets DL504

Standard Magnet DL504 (3/16" OD x 1/16" thick) orientation is critical before gluing it with JB Weld or slow curing epoxy as the north south poles of the magnet are end to end. Determine the polarity of each magnet. The rpm sensors are polarity sensitive so they only detect one side of a magnet. The sensing side of the sensor is the beveled side which has writing on them. The correct side of the magnet must face the correct side of the sensor for predictable results.

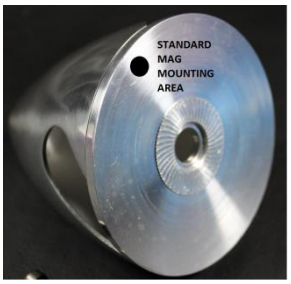
3.1.1Find the correct orientation of the magnet DL504:

Connect one of the sensors to the TwinSync along with the throttle channel and apply power to the twin TwinSync by powering your receiver. Move the sensor's beveled/marked side in front of one side of the magnet then the other to find out which side of the magnet turns on one of the green LEDs. Mark the side of the magnet that turns one of the green LED on with a marker to identify the side of the magnet that will face the sensor, repeat for the second magnet.

3.1.2 Find the correct location to mount the magnet DL504 DL505, or existing magnet:

The magnet should not be in front of the sensor when the prop is rotated to the start of the compression stroke. In the event of a dead stick the dead engine prop will rotate to the start of compression stroke and stay there. Vibrations at this point can make the device think both engines are running and try to synchronize them. If this happens the remaining motor will be at idle for the remainder of the flight. Mount the magnet 90 degrees away from this location.

3.1.3 Mounting the magnet DL504:



Mount a spinner mounted magnet by drilling a 3/16" hole in the outer part of the spinner back just deep enough for the magnet to be flush with the back of the spinner. With the magnet properly oriented (marked side out) glue the magnet into the spinner using slow curing epoxy. Balance the spinner if necessary by drilling away some material near the magnet or install a second magnet 180 degrees away orient this magnet backwards so the sensor cannot detect it. Extra magnets Part Number DL504 can be purchased through TWINSYNC dealers.

3.1.4 Mounting the sensors DL503:

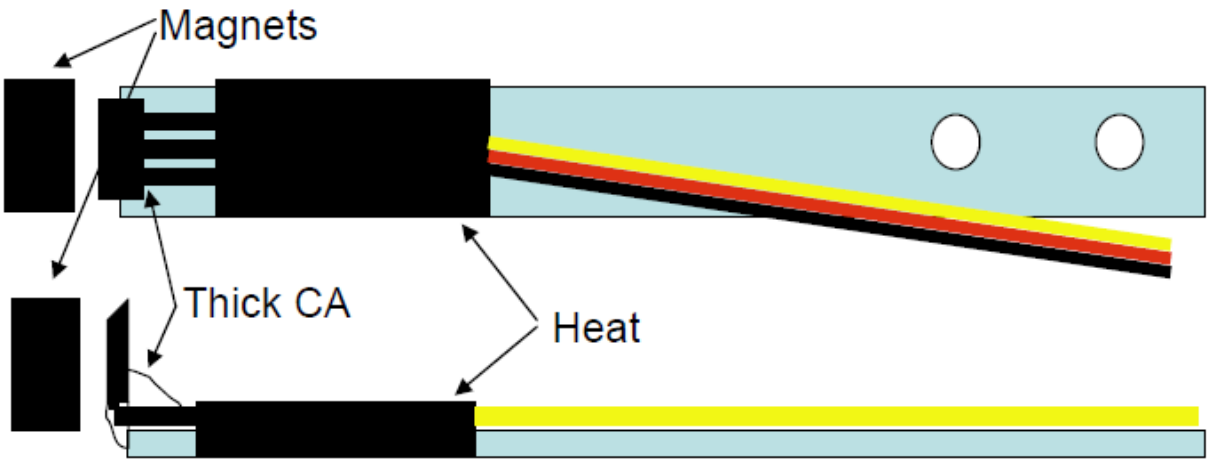
Magnet and sensor orientation is critical. Locate a spot on the cowl or fuselage where the magnet will pass within 1/8" from the magnet. You may need to bend the sensor wires at 90 degrees so the angled/marked face of the sensor will directly face the magnet. Epoxy the sensors to the fuselage or cowling along with the wires immediately behind the sensors. It is critical to support the sensor solder points and wires within ¼" of the solder points rigidly or vibration will break the sensor wires over time. Broken sensor wires due to vibration are not covered under warranty. If a suitable location is not available on the cowl or fuselage make a sensor mount from 5-ply aircraft plywood or 1/16" or thicker printed circuit board material. Mount material must be ridged, **non-conductive** and mounted by at least 2 points as shown in the example below. Maximum air gap is ¼ inch between the magnet and sensor face. If your mount vibrates excessively the TwinSync may not work properly.

DO NOT USE METAL OR CONDUCTIVE MATERIAL FOR SENSOR MOUNTS. ROUTE SENSOR WIRES AWAY FROM THE MOTOR CASE, OR ANY IGNITION COMPONENTS.

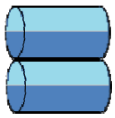
EXCESSIVE VIBRATION THAT CAUSES THE MAGNET AND SENSOR TO MOVE AWAY FROM EACH OTHER CAN CAUSE A LOSS OF SYNC

EXCESSIVE VIBRATION = ERATIC OPERATION

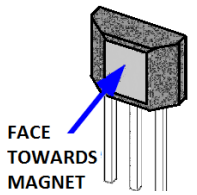
Down and Locked can custom fabricate your sensor mounts per your requirements. Email your request to us and we will provide a quote that meets your needs.

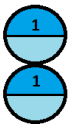


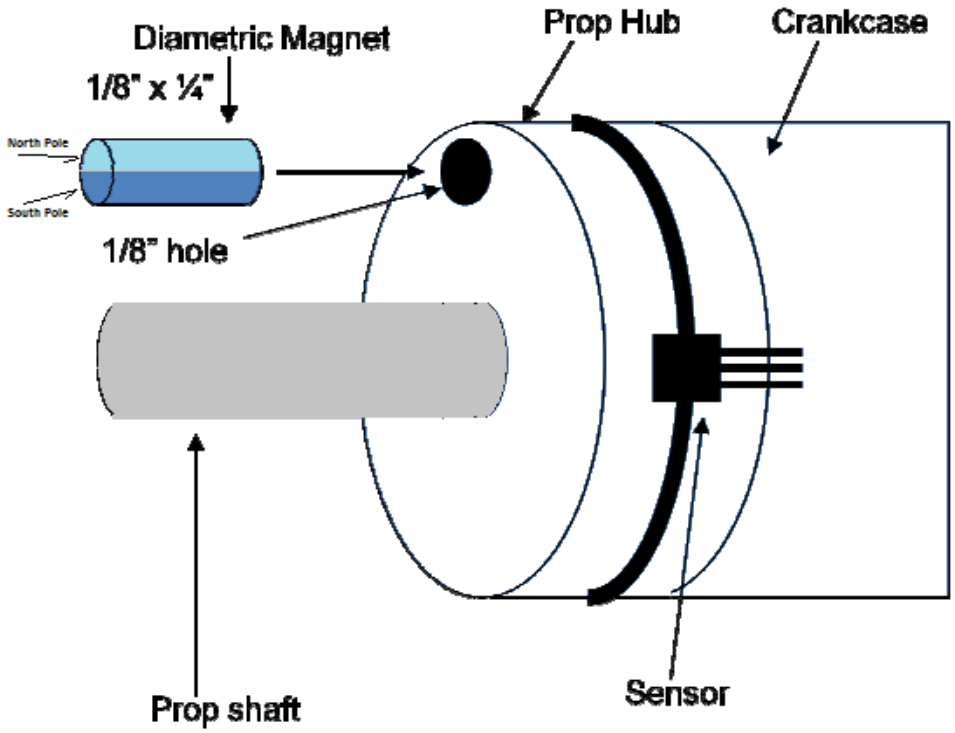
3.2 Installing Prop Hub Mounted magnets DL505 DIAMETRIC MAGNET



Magnet alignment is critical; ensure it is installed correctly prior to gluing it in place with JB Weld or slow curing epoxy. The north and south poles of the magnet are not end to end the poles are half of the round cylinder. Determine the polarity of each magnet by laying two of them together length wise; they will automatically align to dissimilar poles of the magnets. Mark a line across the magnets and color ½ with a marker or paint pen. The picture to the left shows both light blue are of the same pole and dark blue are of the opposite pole. The rpm sensors are polarity sensitive so they only detect one side of a magnet. The sensing side of the sensor is the beveled side which has writing on it. The correct side of the magnet must face the correct side of the sensor for predictable results. Center the sensor on the magnet length. **The magnet must not be in front of the sensor when the prop is rotated to the start of the compression stroke.**







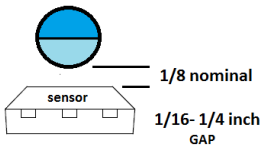
3.2.1 Find the correct side/orientation of the diametric magnet DL505:

Connect one of the sensors to the TwinSync along with the throttle channel and apply power to the twin TwinSync by powering your receiver. Pass the marked magnet under the sensor beveled/printed side if it lights the Green LED on the TwinSync if not turn it over until the green light lights. Rotate CCW until the light goes out make a mark, then rotate CW the green light comes on and continue until it goes out make another mark. Now make a make in the middle of the two marks made. This middle mark must face the center of the sensor. When placing it in its 1/8 inch mounting hole, face the line you made out towards the sensor. Check to be sure the green LED turns on as you rotate the prop hub and magnet past the sensor, before gluing it in place. Mount the sensors in a similar manner as described for spinner mounted magnets. The face of the sensor with this method should face the prop hub.

3.2.2 Find the correct location to mount the diametric magnet DL505:

The magnet should not be in front of the sensor when the prop is rotated to the start of the compression stroke. In the event of a dead stick the dead engine prop will rotate to the start of compression stroke and stay there. Vibrations at this point can make the device think both engines are running and try to synchronize them. If this happens the remaining motor will be at idle for the remainder of the flight. Mount the magnet 90 degrees away from this location.

3.2.3 Mounting the diametric magnet DL505:



Mount a prop hub mounted magnet by drilling a 1/8" hole in the face of the hub just deep enough for the magnet to be flush with the face of the hub when inserted into the drilled hole. With the magnet properly oriented (center mark facing the sensor) glue the magnet into the spinner using slow curing epoxy. Balance the spinner if necessary by drilling away some material near the magnet or install a second magnet 180 degrees away orient this magnet backwards so the sensor cannot detect it. Extra magnets Part Number DL505 can be purchased through TWINSYNC dealers.

3.2.4 Mounting the sensors DL503:

See Mounting The Sensors DL503 Above. Magnet and sensor orientation is critical. Do not mount sensors or wires near ignition sensors or wires or parts. Ignition interference can cause sensor misreads causing the engines to hunt RPM. Down and Locked can custom fabricate your sensor mounts per your requirements. Email your request to us and we will provide a quote that meets your needs.

3.2.5 DL503-S-xx Shielded Sensor Cable

The Shielded Sensor Cable is used when electrical interference form ignitions or other high RFI environments are encountered. The Shielded cable is made to your specified length. When ordering provide the length you require (**-xx**) up to 32 inches in length. See "3.2.4 Mounting the sensors DL503" for install instructions.

3.3 Installing Everything Else

Connect everything including throttle servos, sensors, and throttle channel from the receiver. Connect the Auxiliary channel if you are going to use an AUX CH mode. The device comes preprogrammed to use the AUX CH input for turning the glow plugs on and off. If you want to use AUX channel for a different function, please refer to the AUX CH programming section.

3.3.1 Throttle Linkage

MECHANICALLY SET UP YOUR AIRPLANE THROTTLE LINKAGES TO USE AT LEAST 100% THROW FOR ENDPOINTS IN BOTH DIRECTIONS (IDLE AND FULL THROTTLE) BEFORE INSTALLING THE TWINSYNC.

a. Set your radio endpoints for the throttle channel to (2ms) 100% up and (1ms)100% down. If there is a difference in the % signal width set in favor of the 1ms and 2ms settings.
b. Plug in one of the throttle servos directly to the receivers throttle channel
    i. Mechanically adjust throttle linkage so the engine runs like you want it to taking into account
    ii. The radio kill feature, stick all the way down
    iii. Idle speed, where the engine idles smoothly and does not die
    iv. Full throttle, stick all the way up
    v. Remember the carburetor position where the engine idles smoothly
c. Repeat step 3.3.1.b for the other throttle servo
    i. Remember the carburetor position where the engine idles smoothly
    ii.
d. a

The TWINSYNC needs precise servo control of throttles in order to synchronize the engines. With endpoints set at 100% and with a Futaba 9C no programming of the device is required (depending on your brand and model of radio and unless you have to change servo direction).

If you want to reprogram the device to use the endpoints you already have you can. However, the change in RPM per 1 degree of servo movement dictates how accurate the device can synchronize the engines. For example if 1 degree of servo movement results in a 200 rpm change then the device may only be able to synchronize the engines within 100-200 RPM rather than the typical 50 RPM difference.

If your endpoints on low throttle are less than 100%, the TWINSYNC may not disengage at idle unless you reprogram the Sync point. You can check this by turning on the transmitter and receiver with throttle connected to the TWINSYNC. The Yellow LED4 should go off at idle and turn on just about idle at the set sync point and stay on through full throttle. **DO NOT PROCEEDE UNTIL: Both yellow LED3 and LED4 are off at idle and yellow LED4 on before full throttle and stay on through full throttle.** See programming guide step 2 at the top of this document.
It is better to adjust the mechanical linkage to get as close as possible before changing any programming settings. If you do have a computer or programmable transmitter and want to change end points, curves, etc. this device has the programmability to work with your setup but if end points are set to less than 100% (1ms stick all the way down and 2ms stick all the way up) a loss in resolution will occur and can result in throttle oscillation or less precise RPM control.

If you want to do some advanced programming and get the most accurate synced RPM possible, then you should set your throttle end points at their maximum travel limits (120- 150% depending on the

brand of radio you have). Then mechanically adjust the linkage so that one limit kills the engine and the other has the carb at wide open. Then adjust your transmitter so that one limit is reach when you give the engine kill command. The other limit is achieved at full throttle. Continue to adjust your transmitter stick result in the idle that you want (without turning on the engine kill mix/override or with the throttle trim up). Then after everything works like you want it to WITHOUT the synchronizer, install it and reprogram it to use your throttle position setup by storing the new idle, sync point and full throttle positions into the device. Yellow LED3 will only come on when both engines are running at the same RPM, this is your Sync feedback indicator.

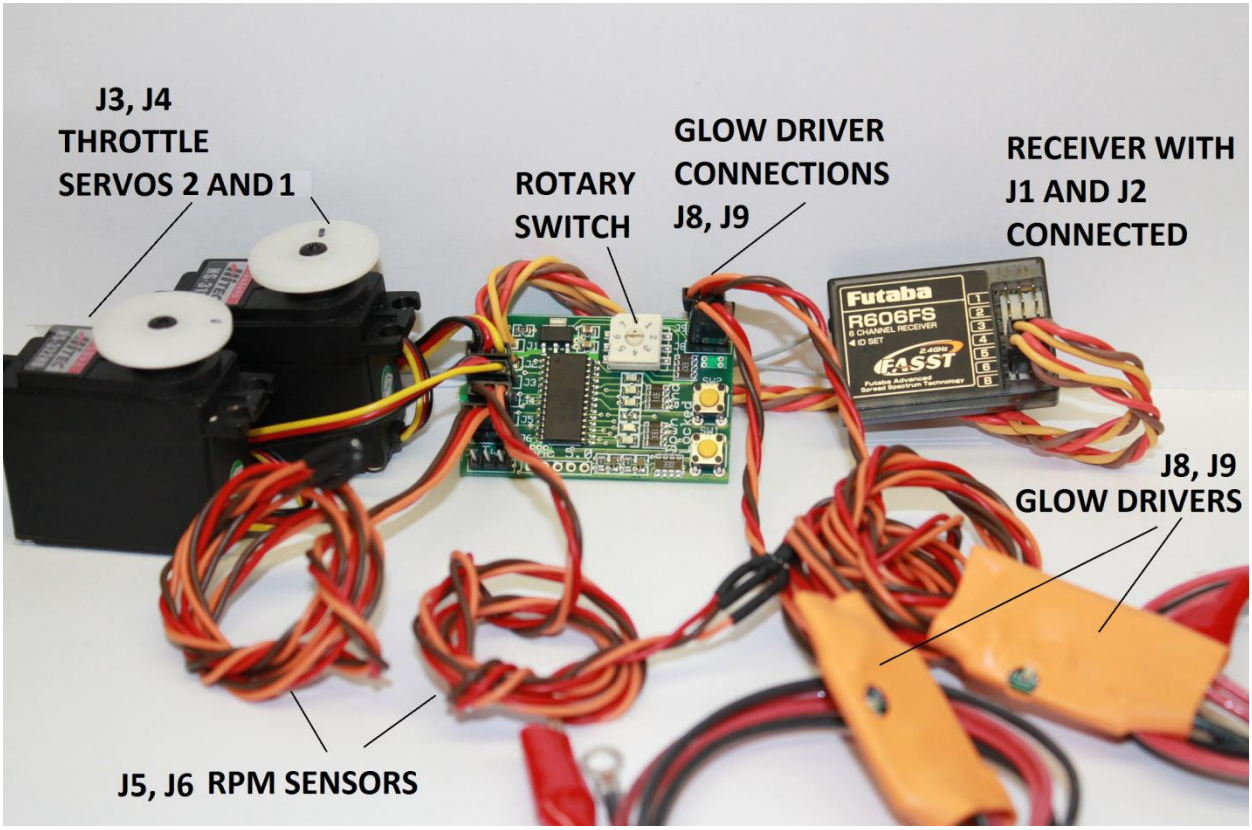
Connection Diagram

IMPORTANT: Note connector orientation White/Yellow/Orange signal wire is toward the middle of the board. Black/Brown wire is nearest to the outside edge.

REQUIRED connections:
Throttle channel from Receiver (J2)
Engine 1 - Throttle servo (J3), RPM sensor (J5)
Engine 2 - Throttle servo (J4), RPM sensor (J6)

Optional connections:
AUX channel from Receiver (J1)
Engine 1 - Onboard glow drivers (J9)
Engine 2 - Onboard glow drivers (J8)

REVERSING A PLUG CAN CAUSE DAMAGE



Connectors J1 through J6 all have the negative (nearest the edge of the board. The center pins are all battery positive (+), the pins nearest the large IC are the signal pins, either into the TWINSYNC or leading out from it. You warranty does not cover damage caused by improper connections.

All Futaba and JR connectors have the polarity correct with the negative wire black and the positive wire red. So long as you put the black wire toward the edge of the board you're fine. NOTE PLEASE: Some Airtronics connectors had the negative wire in the center. If you have one of these the wiring MUST be altered or the receiver, the servos, and the TWINSYNC unit can be destroyed.

ALWAYS DO A RANGE CHECK BEFORE FLIGHT.

Refer to the onboard glow plug driver section for setup and operation of the glow plug drivers.

Safety First: Restrain your model any time you run the engines. Avoid spinning props as they will injure you and spectators.

4.0 RUN Mode and Programming

4.1 RUN MODE

Run mode

1. Rotating the rotary switch to position zero (0)

Any time power is on and the Rotary switch is in position zero (0) the device is in the run mode

4.2 Programming Mode:

Programming mode

1. Power off to the TwinSync
2. Rotate the rotary switch to select the function to be programmed (select one of 1 thru 7 positions on the rotatory switch)
3. Power on (Both Yellow and the RED LEDs will flash ON and OFF for about 3 seconds, to indicate that you are in a programming mode. After that they will still flash at about a 1 second interval)
4. Follow the instructions how to program that function (found in the Programming Guide at the beginning of this document)
5. Return the rotary switch to zero(0)
6. Power off
7. The function is now programmed per your specifications

Changing the rotary switch after the device is powered up will not enter programming mode.

4.3 Functions of the Rotary Switch:

Rotary Switch Position 0: Run Mode

Rotary Switch Position 1: Set engine1 servo offset (repositions the entire move)
Press and hold SW1 to incrementally move 1 step every 1/4th of a second. SW2 moves the servo the other way. Prior to using this function mechanically adjust your linkage so full throw of the carburetor is accomplished with full through of the throttle stick
. Warning if you use this function: The function offsets or moves both endpoints of the servo in the direction you move the servo. If you move it far enough you might move one of the endpoints past max travel of either the carburetor or the servo itself; causing the servo to pull excessive amps at that end of the throw.

Rotary Switch Position 2: Set engine2 servo offset (Same as function 1 for engine 2)

Rotary Switch Position 3: Setting the Idle point (both engines)
The synchronizer moves the servos to idle when a dead stick is detected. Dead stick condition is cleared by moving the throttle stick to idle. This position is preprogrammed to be idle throttle stick with full trim on most radios. This is also the idle position an engine is held in when in the Independent Run-Up mode. Move the throttle stick to the desired idle position and press each SW one at a time. SW1 sets idle of the first engine and SW2 sets the idle of the second engine.

Rotary Switch Position 4: Setting the response time
If the throttle stick is stationary and both engines are speeding up and slowing down together (oscillating) the response time is too fast. When moving the throttle stick the TwinSync responds is to large of a step (takes too long to respond) the response time is too slow.

LED1&2 RED	LED3 YELLOW	LED4 YELLOW	MODE
ON	ON	ON	Fastest possible setting
ON	ON	OFF	Very fast setting good with ESCs
ON	OFF	ON	Fast glow engines and servos
ON	OFF	OFF	Slow glow, standard servos, very fast gas engines
OFF	ON	ON	Factory default, fast gas engines
OFF	ON	OFF	Slower
OFF	OFF	ON	Slower still
OFF	OFF	OFF	Slowest possible setting

This table gives a basic understanding of the available control curves and response time settings that are available. In general a very fast responding engine and servos needs a fast setting and a slow responding engine needs a slower response curve.

Rotary Switch Position 5: Full throttle and Sync Point Setting

This function is default set to work with a Futaba 9C at 100% EPA.

Pressing SW1 programs the Full Throttle Point:

To set a new full throttle point, move the throttle stick to the desired full throttle point and press SW1. To program more or less maximum servo throw, move the throttle stick to the maximum position the servos can travel and press SW1. The same value is stored for both servos. <u>You must mechanically adjust your linkage so full throttle on your transmitter results in full throttle on both carbs.</u> Think of this setting as just storing the end point in the synchronizer so that it can advance an engine to full throttle without binding a servo.

Pressing SW2 programs the Sync Point:

To set a new Sync Point, move the throttle stick until the carburetor is moved to the desired Sync Point RPM and press SW2. This is the point where the yellow LED4 is illuminated. LED3 is the sync feedback and will only come on when both engines are running and sync is commanded on. This must be set above idle. If the sync point is set below 1,500 RPM LED3 and 4 comes on but syncing will not occur until RPMs are 1,500 to 23,000.

Rotary Switch Position 6: Sets the function of the Auxiliary channel (AUX CH)
The LEDs display the mode the device is in when in this programming mode.

The following table allows the user to determine what mode you are in:

LED1&2 RED	LED3 YELLOW	LED4 YELLOW	MODE
ON ON	ON	ON	1 AUX channel not used, Glow Plugs based on RPM
ON ON	ON	OFF	2 Independent run up mode Glow Plugs based on RPM
ON ON	OFF	ON	3 AUX turns sync on/off Glow Plugs based on RPM
ON ON	OFF	OFF	4 Rudder throttle steering, Glow Plugs based on RPM
OFF OFF	ON	ON	5 AUX controls Glow Plugs FACTORY DEFAULT
OFF OFF	ON	OFF	6 No dead stick detection, AUX controls Glow Plugs

When in this programming mode hitting either BUTTON1 or BUTTON2 advances you to the next mode. If you are in mode 5 and hit a button the device goes to mode 1. If you are in mode 1 and hit a button the devices goes to mode 2. Yellow LED3 will only come on when both engines are running at the same RPM, this is your Sync feedback indicator.

Rotary Switch Position 7:
This is the servo reversing programming mode. The LED3 reflects whether engine1 servo is normal direction (LED3 off) or reverse direction (LED3 on). To change the engine1 servo direction push BUTTON1. Pressing BUTTON1 a second time reverses the direction again. LED4 reflects the servo direction for engine2 and BUTTON2 changes servo direction for engine2.

THE TRANSMITTER THROTTLE DIRECTION MUST BE SET SO THAT LED4 IS OFF AT IDLE AND ON ABOVE THE SYNC POINT THROUGH FULL THROTTLE.
TWINSYNC WILL NOT OPERATE WITH THE TRANSMITTER THROTTLE REVERSED.

If you want to erase all programming in the device and return it to the factory defaults it is possible.

1. Power off
2. Move the rotary switch to position 7
3. Power up the TwinSync
4. Press and hold down both button 1 and button 2 for 2 seconds
5. Move the rotary switch to position 0
6. After the LEDs stop blinking the device is reprogrammed to all of the factory defaults
7. Power off the TwinSync
8. Power up the TwinSync
   Red LEDs 1 and 2 flashing is normal, indicates the Optional DL506 Glow Drivers are off or not connected

Always complete a successful range check prior to flight

5.0 Auxiliary Channel Mode Functions and Details
The ability to connect an Auxiliary channel to the device is included and this section explains the detail operation of how the device performs in each mode of AUX CH input functions. The following sections explains each mode in detail:

MODE1: No AUX CH
This is the mode the device should be set to if an AUX CH is not connected to anything. The device lets the throttle stick control servos below 1/5th stick. Above 1/5th stick the devices moves the servos to that position and then synchronizes the engines. If the stick is moved the process is repeated.

MODE2: Independent Run Up Mode
In this mode it is assumed that the AUX CH input is connected to a 3-position switch. If the output of this channel is less than 1/3 deflection engine1 is controlled by the throttle stick while engine2 is held at the programmed idle position. If the AUX CH output is between 1/3 and 2/3rds full deflection then the throttle stick controls both engines and the devices operates just like it was in mode 1. If the AUX CH output is greater than 2/3rds deflection then the throttle stick controls engine2 and engine1 is held in the preprogrammed idle position. This mode is useful for carb adjustments and mixture fine tuning.

MODE3: AUX CH Sync Defeat
In this mode it is assumed that the aux channel input is connected to a channel with a 2-position switch on the transmitter. In one position the synchronization function is enabled. In the other position the device does nothing and is simply a "Y" cable (although servo directions and center is still controlled by the device). This is a useful mode for understanding how your plane will react while the engines are being controlled by the device. Yellow LED3 will only come on when both engines are running at the same RPM, this is your Sync feedback indicator.

MODE4: AUX CH is for Rudder Steering
In this mode the device operates as in mode 1 (no AUX CH) above 1/3rd throttle. Below 1/3rd throttle the AUX CH is assumed to be connected to the RUDDER receiver output. There is a dead band around the rudder center (so that rudder trim does not affect engine RPM). When the rudder stick is moved far enough past center to get out of the dead band it starts increasing the throttle on one engine. Moving the rudder stick in the other direction will result in increasing the throttle on the other engine. Full rudder on the stick at idle will result in about half throttle on the engine for that side.

This allows for taxiing airplanes with engine control rather than a steerable wheel. This mode should also result in some interesting aerobatic maneuvers not possible with single engine aircraft.

This mode is disabled if only one engine is running. It is operational when both engines or none is running. This allows for bench testing as well as operation only if both engines are running.

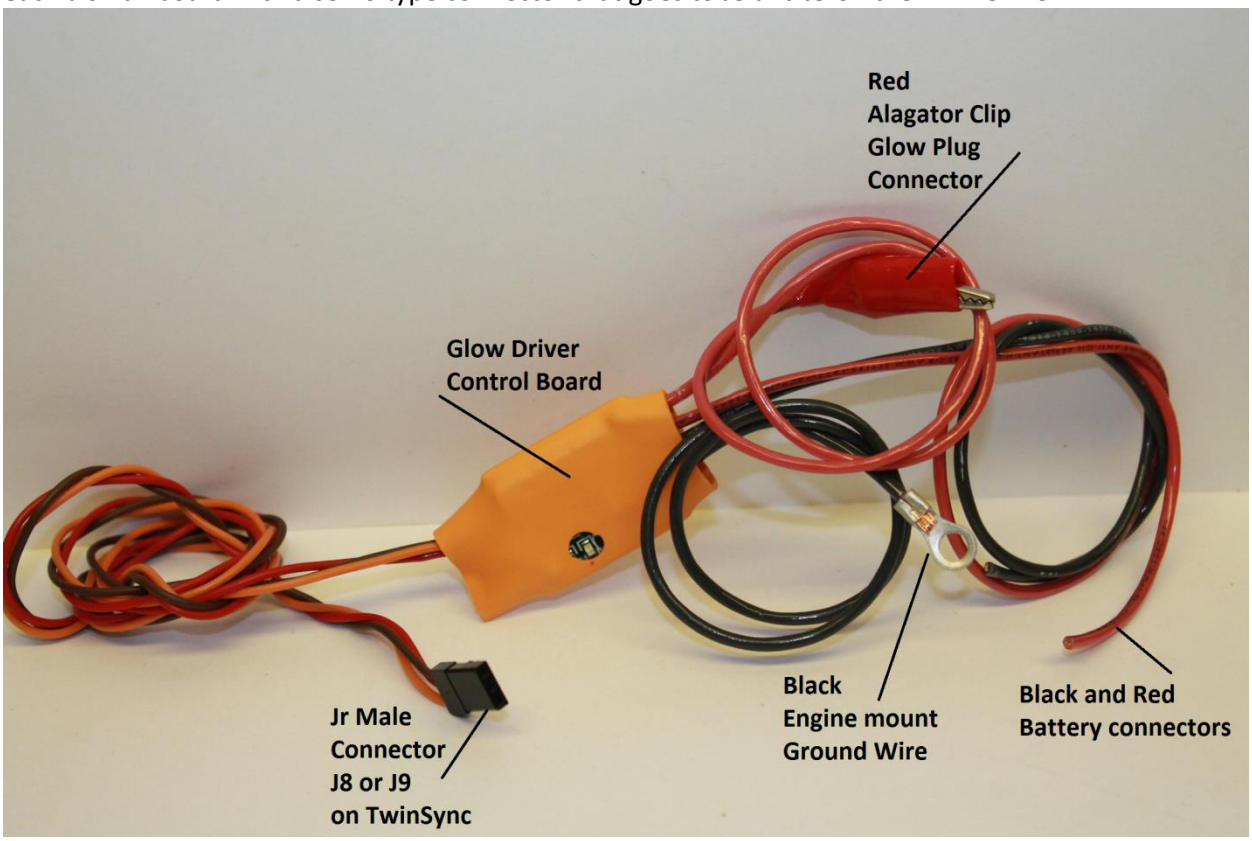
Engines are not synchronized until the stick is above the rudder steer disengagement point (33% throttle).

MODE5: AUX CH Controls Glow plugs on and off (FACTORY PRESET MODE)
In this mode the AUX CH turns the glow plug drivers on and off. A two position switch should be used and in one position glow plugs will be off and in the other position the glow plugs will be on.

MODE6: NO DEADSTICK DETECTION with AUX CH Controls Glow plugs
This mode is the same as MODE5 except that the engines are not idled in the event of a dead-stick. The engines are synchronized when the stick is above idle and both engines are running. If both engines are not running then the throttle servos are just moved to the transmitter stick position. This allows full throttle control of one running engine at all times.
The reason for this mode is if you have a very stable twin engine plane that flies well on one engine you may not want to idle the running engine in the event of a dead stick on one engine.
Plugs are controlled by the AUX Channel just like in Mode 5.
In this mode the AUX CH turns the glow plug drivers on and off. A two position switch should be used and in one position glow plugs will be off and in the other position the glow plugs will be on.

6.0 Glow Plug Drivers

The on board glow plug drivers are now supported by the TWINSYNC version 2.0. The glow drivers are each a small board with a servo type connector that goes to J8 and J9 on the TWINSYNC .



The wires going between the TWINSYNC and the glow drivers can be extended with standard aileron extensions. The intent with the new onboard glow drivers is that they could be mounted and in each nacelle with the battery to reduce wiring complexity of the original TWINSYNC with glow drivers. Additionally, all of the needed wiring and connectors is now included. So the additional purchase of glow plug clips and connectors is no longer required. Each glow driver operates on a single cell nicad or nimh . Each battery should be at least 1500maH. Each glow driver is capable of driving about 8 10 amps so twin cylinder engines can be handled.

Two 18 awg red wires on each glow driver. The one with the alligator clip goes to the tip of the glow plug. The other red wire goes to the positive glow battery terminal (+). There are also two black wires on each glow driver. The black wire with the ring terminal goes to the engine case. The intent is to put one of the engine mount through it. The other black wire goes to the minus (reduce wiring complexity of the cell nicad or nimh battery. (-) side of the glow driver battery.

The glow drivers can be programmed to operate with an auxiliary channel or based on RPM. If running based on RPM wiggle the propeller so that the magnet passes in front of the RPM sensor and glow plug should come on for 10 seconds. Using an electric starter on the engine will also automatically turn on the glow plugs. The glow plugs will come on when the engine is below 3500 RPM in automatic mode.

LED on the glow driver is on solid whenever the glow plugs are on. RED LEDs on the TWINSYNC will turn on continuous when the glow drivers are on. If the glow plug is not connected or burned out the RED led for that glow driver will flash slowly. If a glow driver battery is getting low (below 1.15 volts under load)

the RED led for that glow driver on the TWINSYNC will flash rapidly. A glow driver battery can heat a glow plug (depending on the plug) sometimes all the way down to 0.90 volts. The engine may start in this low voltage condition, when the LEDs are flashing it doesn't mean that the battery is dead, it means they are low. An engine can typically still be started even though the led started flashing. Ensure your batteries are charged correctly prior to flying.

7.0 Remote Display, This item is discontinued and not available

8.0 Service, Parts, and Software Updates

For Service, Warranty contact us www.DOWNandLOCKED.com

9.0 Disclaimers, legalities, and warranty.

1) Manufacturer, distributor, and retail agents make no warranty, express or implied, beyond the suitability of the TWINSYNC device as an engine control unit for synchronizing two engines in a model airplane.

2) Warranty period is 90 days from the date of retail sale, plus five days if supported by a mail order invoice. This warranty does not cover damage caused by improper connection or operation. Also excluded from warranty coverage is wire breakage due to any cause.

3) In common with other electronic devices, the TWINSYNC can be destroyed by improper connections. Any electrical damage deemed by the manufacturer or distributor to be due to improper connection or installation will be repaired at owner's expense.

4) By accepting the TWINSYNC unit you assume all responsibility for its use and operation, and any damages that may be incurred while using it. You must be fully familiar with its operation and limitations before flying your airplane with it installed. If you do not accept this return the unused TWINSYNC unit for a full refund, excepting mailing charges and costs.

5) Manufacturer's and distributor's liability is limited to the replacement cost of the TWINSYNC unit.

10.0 Specifications:

POWER Consumption: 15mA + 15mA per LED that is on 100ma Maximum
Operating Voltage: 6-9 volts
Servo Outputs: 5-2.5 us PWM, 40 fps (1.0-2.0us factory defaults)
Throttle input: 25-80 fps 0.5-2.5 us PWM (1.0-2.0us factory defaults)
0V to 2.0-5.0V peak-peak
RPM Acuracy: 100 rpm @23,000 and 10 rpm at 5,000
Synchronization accuracy: 25-130 RPM depending on programming and servo geometry
Synchronization range: 1,500 to 23,000 RPM
Yellow LED3 will only come on when both engines are running at the same RPM, this is your Sync feedback indicator.

<u>Always complete a successful range check prior to flight</u>.