MK II

QUADRUPLEX

INSTRUCTION MANUAL

DEE BEE
ENGINEERING CO.
WEST LAMBS ROAD
PITMAN, NEW JERSEY

PRICE: Seventy-Five Cents

"QUADRUPLEX"

INSTALLATION AND SERVICE NOTES

Your new QUADRUPLEX Control System is of proven design. It has been field-tested through prototype models and developed into what we sincerely believe to be the finest, most precise and reliable piece of R. C. equipment on the market today. The original production prototypes have made thousands of flights under all environmental conditions in the latest type of competition and sport aircraft. Much of the circuitry in QUADRUPLEX is unique in the R C application. The lack of complexity is outstanding in such a capable control system. Much of the credit for this simplicity and reliability goes to an outstanding Radio Engineer and modeler, Carl Schwab, with whom we have collaborated throughout the development of this control system. It is seldom that such a capable intellect is directed to the radio control field.

Adherence to the following instructions and installation data will bring many enjoyable hours in a most rewarding hobby.

The QUADRUPLEX Receiver consists of a superregenerative detector, chosen for its extreme sensitivity and logarithmic signal detection characteristics. Following the detector are tone amplification and separation circuits The critical, delicate components are molded in epoxy for secure mounting and complete protection. Transistor circuits are temperature immune under all conceivable flying conditions A special D. C. Power Supply is incorporated which operates from the Servo Battery Supply (4.8 volts center tapped). Use Nicad type batteries of at least 1 ampere hour capacity for this application.

Install the Receiver and all airborne equipment with the following notes in mind.

1 RECEIVER/SERVO INSTALLATION

1 1 Install all servos with one wire of each servo to the Battery Pack Center Tap (Pin No. 1 of Receiver Plug and Socket). Phase the servos so that application of the servo plus (2.4 V) voltage to the remaining servo wires will give left aileron, left rudder, up elevator, and low motor control.

1 2 Keep all wiring short and well anchored in the fuselage (Walther's "GOO" does a good job). Wires left loose and "floating" will eventually vibrate loose or cause excessive electrical noise to be radiated.

1 3 Observe polarity of the servo battery wires very carefully when soldering to Connector J1. If these are reversed, extensive damage will result in the Receiver.

1 4 Mount the Receiver on or in foam rubber, but not so rigidly that the benefit of the foam is lost. Vertical mounting of the Receiver Case is to be preferred with the Receiver wiring cable running out the top or rear as viewed in the aircraft fuselage (bottom or rear in the case of a low-wing airplane)

1.5 The Antenna should be kept as far from the servos and wiring as possible to avoid transfer of electrical noise to the Receiver. Antenna length should be approximately thirty inches (30") total, from the Receiver Case. The QUADRUPLEX Receiver is extremely sensitive and will be adversely affected by electrical noise picked-up from the servo motors if wiring is not kept short and direct, or if the antenna is routed too near the servos or servo wires This condition would show-up as unsteady progression of motor control servo from high to low motor position. If this condition exists it is a sure indication of poorly placed antenna or wiring. Excessive antenna length can cause a noise condition also. Do not use more than necessary. Start with 30", 40" is maximum.

2. OPERATION AND TUNING

2 1 Motor Control is progressive and can be positioned at any desired setting between high and low. This is accomplished by a high-speed, transformer coupled, pulse omission detector used in conjunction with the Rudder Control Circuit. When changing throttle position the rudder momentarily neutralizes until Motor Control Servo reaches its desired position. Motor-control to rudder-change-over-time is adjustable by use of the miniature potentiometer located on the top deck of the Receiver. Counter clockwise rotation of this control will decrease the delay time and clockwise will increase it. M. C. switching time is factory adjusted, and will not require attention unless the servo batteries used are of higher impedance than the 1.2 ampere hours type that are used in our set-up procedure. If it becomes necessary to readjust this potentiometer to eliminate either motor control servo creeping or excessive change-over time, use the following procedure: Make sure that all Receiver and Transmitter batteries are fully charged. Then operate the entire system for about fifteen minutes to establish the battery plateau. Place one finger lightly upon the M. C. relay armature and turn the potentiometer C.C.W. until M. C. relay begins to pulse in conjunction with the rudder. Now, rotate M. C. potentiometer clockwise until the tendency to pulse just ceases. Check for no pulsing of M. C. relay in extreme rudder control positions. Motor control action should now be rapid with no movement of M. C. servo with change in rudder position Pot adjustment is quite sensitive and will always be located near the extreme C.C.W. rotational position.

2.2 Receiver R. F. tuning is accomplished by adjustment of the R. F. coil slug for proper pulsing in neutral position at maximum range from the Transmitter. Remove the Transmitter Antenna completely and insert the nylon tuning tool in the R. F. slug. Place the system in operation and walk out to the maximum range where all surfaces will pulse properly at their neutral positions Rotate the slug right and left to find where pulsing ceases at each extreme Carefully find the center of this rotational range. Walk out a few more feet and repeat the adjustment until the proper tuning point becomes very sharp. Find the center of rotational range and leave the slug in this position. Once the R. F. section is tuned properly it will not shift and need be rechecked only in the event of a crash or when changing from one airplane to another. Tuning should be rechecked if antenna length is altered. R. F. coil is adjusted through the hole near the corner of the Receiver Lid Always make final adjustment with Lid in place!!!!!

2 2 (Continued)

NOTE: Always turn Transmitter on before the Receiver and off last as the servo batteries will discharge unequally if Receiver is left on without Transmitter. Without a Transmitter signal on the air the control surfaces may dither slightly. This is O.K. and normal.

2 3 The QUADRUPLEX Receiver sensitivity is factory controlled for optimum performance in a simulated flight test set-up. It is assumed that DEE BEE Servos are to be used and wiring will be neat and intellegently placed. Should more or less sensitivity be desired due to peculiar requirements, it can be readily controlled. A mica capacitor will be found connected between the detector tube grid and filament. Increasing this capacity up to a maximum of 4 mmf will increase sensitivity. To decrease sensitivity remove the capacitor entirely. Any change in the sensitivity capacitor will necessitate retuning of the R.F. slug.

The need for these sensitivity changes cannot be foreseen, but if attempted, should only be done by one thoroughly familiar with superregenerative receivers. EXTREME sensitivity is accompanied by electrical noise interference susceptability.

3. TRANSMITTER

The QUADRUPLEX Transmitter is entirely vacuum tube operated. One 3B4 is used for a Power Amplifier and as a frequency doubler. One-half of a 3A5 tube is the crystal controlled oscillator. 3A5 tubes are used for each channel of audio tone generation and pulse switching. One basic blocking oscillator is employed to key all three pulser tubes. The audio amplifier and mixer utilizes one-half of the blocking oscillator 3A5 tube. Tones are generated by three Hartley sine-wave oscillators. Electronic switching is employed to pulse tones on and off.

Flight control is via a conventional aircraft joy stick. Right and left aileron and up-down elevator are regulated by conventional stick positions. The rudder position is proportional to joy stick knob rotation in the uncoupled mode, and moves in conjunction with aileron control when the coupling switch is in the "UP" position. Trim knobs are provided for aileron and elevator (located in upper-right corner of Transmitter Case on a right-hand model). The motor control advances when the red button is depressed and retards when the black button is depressed.

The Transmitter is factory adjusted for proper operation and should require no attention except for proper battery maintenance. Tone frequencies are rock solid and should never be tampered with. Their adjustment requires special alignment instruments.

4. CALIBRATION CONTROL LOCATIONS

As a matter of information, the location of various Transmitter set-up controls should be identified. The crystal oscillator is resonated by the ceramic padder capacitor located at the corner of the Transmitter P C board nearest the antenna lead-out wire. The final amplifier resonating capacitor is the metal plate air trimmer beside the left-hand gimbal bracket. Modulation level is controlled by the miniature potentiometer on the component side of the P. C. Board located directly behind the black motor control button. The pulser frequency control is the potentiometer mounted on its stand-up terminals in the upper right-hand corner of the P. C. Board. This control may be adjusted by the user for a faster pulse rate if desired with no fear of up-setting the Transmitter. Lowest pulse rates give optimum servo centering performance and develops the lowest battery drain in the aircraft. Faster pulse rates have no flight advantage but may be used if desired recognizing the resultant higher drain on aircraft-borne batteries. Tone frequencies are controlled by the nylon slugs on the P.C. side of the Board under the pot core transformer. (If These slugs are moved from factory-set position, you are on your own!!!!!!!!)

5. COUPLED/UNCOUPLED OPERATIONAL MODES

A special feature of the QUADRUPLEX Transmitter is the Rudder-Aileron Coupling Switch located beside the Low Motor Control Button. When this toggle switch is in the "DOWN" position, the Transmitter is in its triple simultaneous mode and controls are as described above. By moving this switch to the coupled (UP) position Rudder and Aileron controls are ganged so that operation of control stick for right and left aileron will produce an "in phase" rudder response. This does not affect any other control action. It is useful for any maneuver when coordinated control is desired. Change to or from coupled mode can be done at any time during flight. It will be found helpful in increasing roll rate in many otherwise sluggish airplanes. When in the coupled position, the rudder pulse is suppressed and overridden by the aileron pulser tube. During the use of R-A coupled mode, the rudder knob should not be turned as this adds the rudder pulse to the already existing aileron pulse and will produce an undesired change in motor control. Note that all controls except rudder are completely locked-up at extreme stick positions. Rudder pulses slightly at each extreme to keep the pulse omission detector (Motor Control Circuit) in its desired condition.

6. IN-FLIGHT TRIM ADJUSTMENTS

Trim knobs are provided for aileron and elevator surfaces. These trim controls will effectively assist in compensating for slight out of alignment conditions in your airplane. However, they are not to be considered a cure all for a grossly misadjusted airplane. The trim knobs are actually potentiometers used as series resistors in the blocking oscillator voltage divider. Their action will not necessarily be equal for trim on each side of center. Keep your airplane in good trim alignment so that neutral flight is achieved when the servo is pulsing at neutral. The servo output vs input response is not linear

6. IN-FLIGHT TRIM ADJUSTMENTS (Continued)

This is a planned condition. If servos are operated with neutral control position off center, the control stick response will be too fast in one direction and may not achieve "lock up" in the opposite direction Use your trim knobs only for small in-flight touch-up! Corrections should then be made in the airframe itself for a neutral trim, neutral stick condition.

7. TRANSMITTER MAINTENANCE

Maintenance of the Transmitter Nicad batteries is most important for satisfactory performance. The Nicads supplied with your system are of four-ampere hour capacity. When in use the Transmitter draws 1.2 amperes from these cells. This will more than provide a full day's flying; but don't fail to recharge them before every flying session.

Should the system be flown with Transmitter batteries running low, it will provide you with enough warning time to avert trouble. The first signs of low battery voltage will be an unwanted motor control change when right rudder is applied. At this time you will find yourself holding some left aileron and up elevator to maintain level flight.

Transmitter batteries should be charged to a total of six-ampere hours to assure a full charge condition. Use a charge rate of 400 ma for fifteen hours, or, a lower rate (minimum 100 ma) for a proportionately longer time. During the final hours of charging, check the electrolyte level in each cell and add distilled water if necessary to bring fluid level just above the plates of each cell. During charge, the Nicads will gas and bubble freely -- should a cell produce a "head" of foam during charge, it is an indication that it requires additional electrolyte rather than distilled water. During the next few charge cycles, add thirty per cent (30%) solution of Potassium Hydroxide rather than distilled water to maintain fluid level. After a few recharges and Hydroxide additions, the cell will cease foaming and can be treated in the normal manner until the foam condition reappears. Don't use Potassium Hydroxide unnecessarily as the concentration of Hydroxide must be maintained at a reasonable level. Too much is no better than too little. Note that all transmitter cells are wired in series for easy maintenance. Consequently, the Transmitter filament voltage is negative in respect to ground. Normal voltage per cell is 1.2 V under operating load.

Preparatory to charging, always remove plugs from Transmitter Nicads. Gas generated during charge will surely ruin them if left capped. After charging, do not replace caps until gassing has ceased. This will be about four hours.

We suggest that during charge the battery plug wells be lightly packed with absorbent cotton. This will absorb any of the corrosive electrolyte that is prone to escape as batteries gas during charge.

8. SERVOS

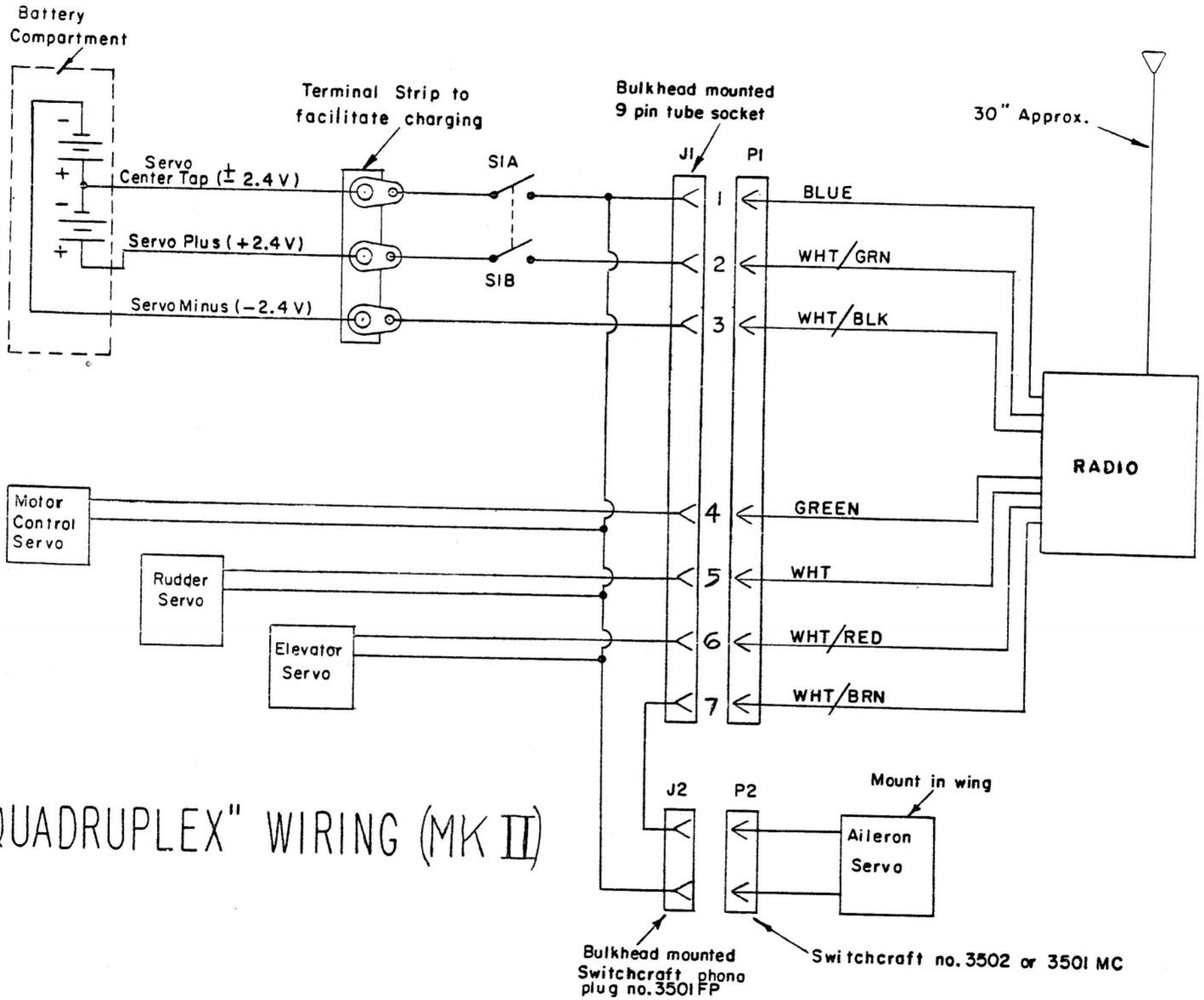
The DEE BEE Servo is a simple, rugged device. It should require no explanation except to note its unique nonlinearity feature. The Servo centering spring features an inverse empirical response. This offers a firm neutralizing effect near center while allowing maximum torque at extreme control positions. The term "pressure proportional" befits the output vs input response of QUADRUPLEX due to this effect. When bench testing QUADRUPLEX, the control surfaces may seem to reach their extreme positions before it is desired. That is to say, you have moved the control stick only two-thirds of the way to a given direction and the Servo has already gone to extreme position. However, consider the position of your control surface with the aircraft at full-flying speed! Back pressure is developed upon your control surface in proportion to stick movement. At high aircraft speed, a greater stick movement is required for a desired surface deflection. The smoothness of pressure proportional flying can be readily realized through this explanation. DO NOT ATTEMPT TO ALTER SERVO SPRING TENSION FOR EXACT SERVO VS STICK POSITION ON THE BENCH !!!!! In high-speed flight it will just reach extremes at the same time as control stick.

9. GENERAL

One of the principal pitfalls of proportional flying has been the tendency to use a greater amount of control surface area and surface deflection than actually necessary for desired aircraft response. This has grown out of a feeling that "we now have proportional control of our flying surfaces, so lets use plenty of deflection and utilize only a portion of it when flying." This approach will only lead to a dissatisfaction with proportional control. Elevator control is particularly susceptable to overcontrol and should be tailored to the minimum deflection necessary for clean inside and outside loops. In aircraft design consideration, keep control surface aspect ratio high and use only the necessary amount of angular deflection.

If for personal satisfaction a true distance check is desired, remove the antenna from the connector on its base by loosening the set screw. Replace in the connector a six inch (6") length of brass tubing, etc, about 5/16 diameter. Replace connector and stub on Transmitter, set it on the ground, turn on, and start walking with the aircraft. Keep retuning until maximum range is reached, This exercise is unnecessary but if felt desired, due to the six inch (6") stub giving some radiation other than off of the Transmitter Case, is a more exact way of tuning. Range will vary somewhat with weather conditions but usually will be at least a hundred feet.

DEE BEE ENGINEERING COMPANY
West Lambs Road
Pitman, New Jersey



"QUADRUPLEX" WIRING (MK II)