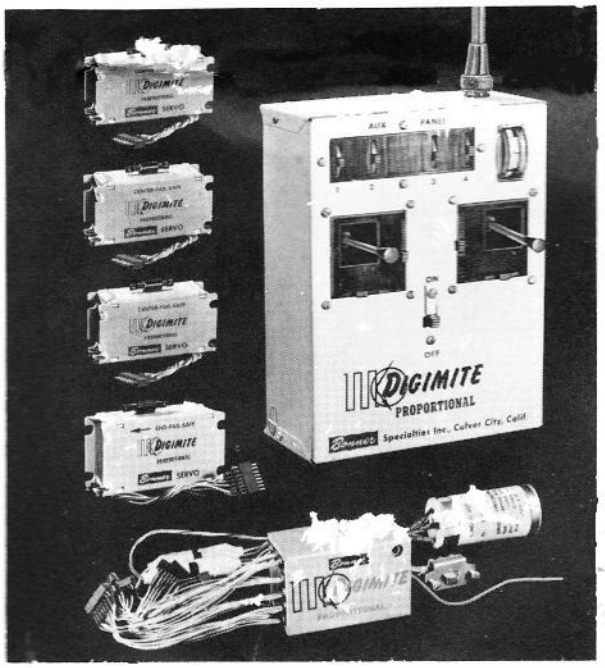
THE BONNER

DIGIMITE 4

AND



THE BONNER

DIGIMITE 8

RADIO CONTROL SYSTEMS

INSTALLATION & OPERATION

Bonner Specialties, Inc. 9522 W. JEFFERSON BLVD., CULVER CITY, CALIF. 90230

INTRODUCTION

These instructions have been written to cover both the Bonner Digimite 4 and Bonner Digimite 8 systems, as both systems operate in an identical manner, with the exception that the Digimite 4 has provisions for operating up to four servos, while the Digimite 8 provides for operating up to eight servos. The units were designed for the remote control of model airplanes, and these instructions have been written to cover this usage. Installation in RC boats, cars, etc. is similar.

The system operation is on a digital principle (hence the name "Digimite"). The transmitter continually sends frames of 16 pulses, the spacing of these pulses providing eight pieces of control information. This type of system is inherently more stable and accurate than other types. As a result there is no discernible neutral drift, and the control surfaces follow the sticks with exacting accuracy.

A superheterodyne receiver is the heart of the airborne equipment. Three intermediate frequency (IF) stages assure sensitivity and selectivity. The detected pulses from the superheterodyne circuit are fed to a logic cir-

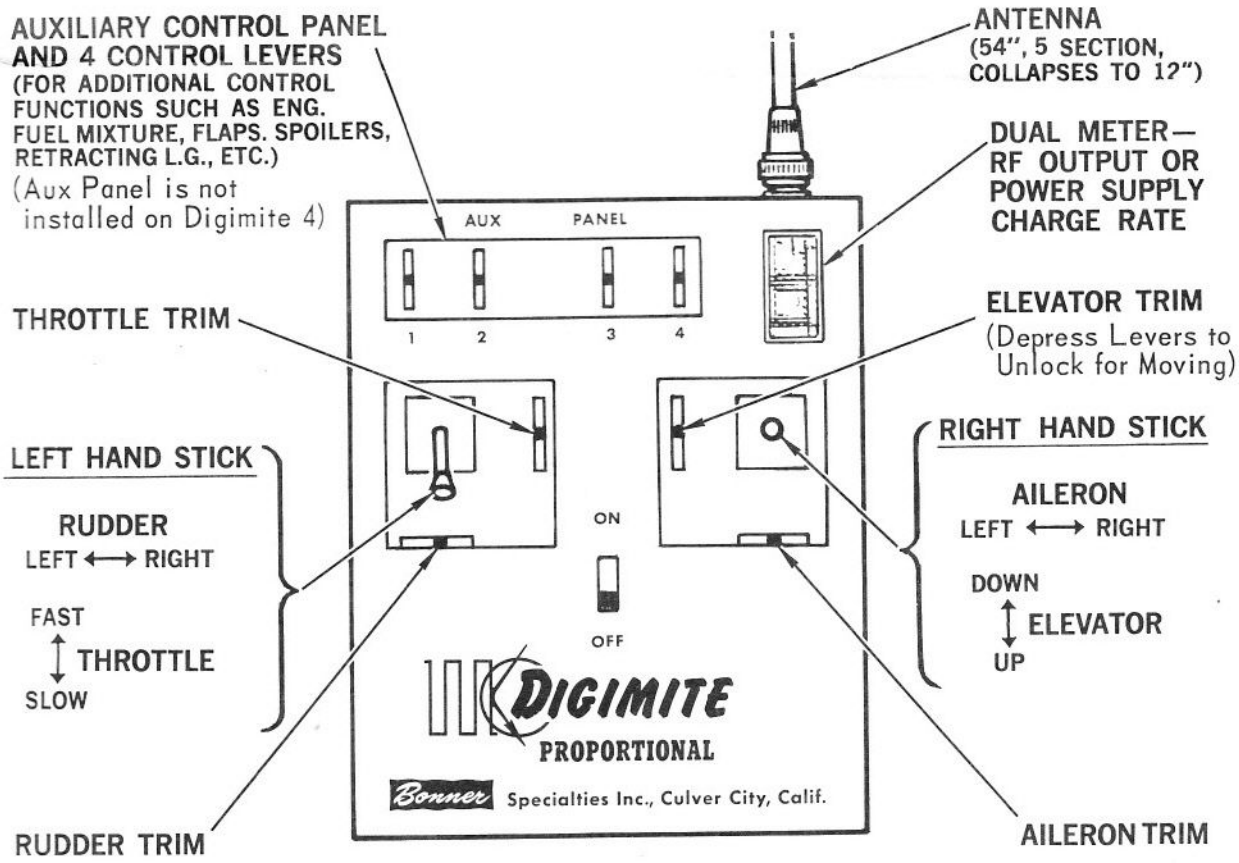


Figure 1. Digimite Transmitter.

cuit which examines each digital pulse frame for completeness. In the event of any interference or missed pulses this circuit rejects the entire frame of information. Furthermore, if an intelligible frame is not received for .25 seconds, the receiver and servo systems go to a fail-safe condition until valid transmitted information is received. Control surfaces neutralize and the throttle retards during the fail-safe condition.

The receiver package separates the 16 pulses in each pulse frame into eight pairs of pulses representing the eight pieces of information. These pulse pairs are then sent to the Digimite servos. Each servo has an integral electronic module which measures the distance between pulses fed to it by the receiver. It may be considered that the servo electronic module acts as a switch. When the servo mechanical output does not coincide with the transmitter stick position, the electronic module switches full voltage to the servo drive motor until the error is cancelled. Since the system does not provide a voltage to the motor in proportion to the error, air loads and linkage friction do not degrade the servo-loop performance.

Two types of Digimite servos are available and are completely interchangeable. The first type of servo is the center-fail-safe type which drives to a center position when the system goes to a fail-safe condition. This type of servo is used for flight controls which should neutralize on fail-safe (elevator, aileron, rudder, etc.). The second type of servo is the end-fail-safe type which drives to one end when the system goes to a fail-safe condition. This type of servo should be used for throttle control (retard fail-safe) and auxiliary controls such as landing gear actuation (gear down fail-safe).

The Digimite transmitter controls are shown in Figure 1. This Figure should be used with checkout process (page 4). The two main sticks are set up with rudder and throttle control on left stick (i.e. left stick is not self-centering on throttle control). Aileron and elevator control are on the right stick. Proportional pilots, experienced reed flyers, and beginners quickly adapt to this two stick arrangement. When experienced reed pilots no longer find the elevator in the left thumb position, they divorce themselves more rapidly from the old reed practice of pulsing. The arrangement of sticks permits manipulating all prime controls simultaneously without removing hands or thumbs from any of the controls. Also, when auxiliary controls are utilized, only the left hand is required to move the auxiliary levers while the right hand still handles the prime aerodynamic controls.

The meter on the front of the transmitter has two modes of operation. When the transmitter is turned on, the meter reads relative power output (RF output). This RF power reading is also indicative of power supply condition. This meter also reads charging rate when the power supplies are being charged.

CHARGING THE POWER SUPPLIES

Bonner Digimite Power Supplies are constructed by the General Electric company specifically for the Digimite system. Although power supplies are charged at the factory prior to shipping, they might be received in a discharged state. Therefore charging would then be required prior to initial operation of the Digimite system. The receiver power supply is plugged directly into the appropriate socket on the bottom of the transmitter as shown in figure 2. Charging the transmitter without the receiver power supply can not be done since both power supplies are charged in series.

The series charge rate of the transmitter and receiver power supplies is indicated on the transmitter meter. The normal charge rate is approximately 40 milliamperes. A 24 hour charge insures that the power supplies are ready for use.

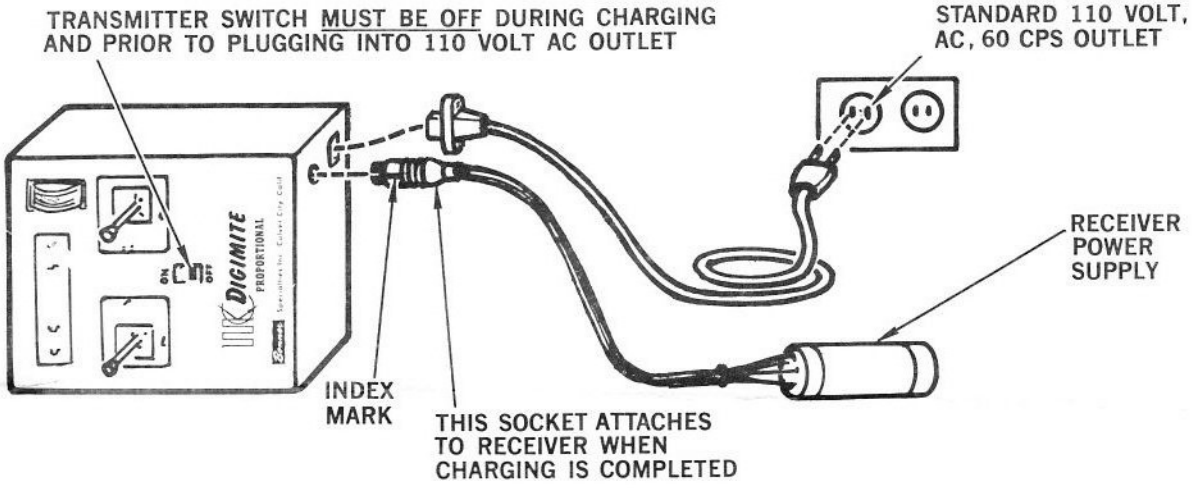


Figure 2. Charging the Power Supplies.

If desired, flight pack charging may be performed through the airplane harness as shown in figure 3. with the equipment installed in the airplane.

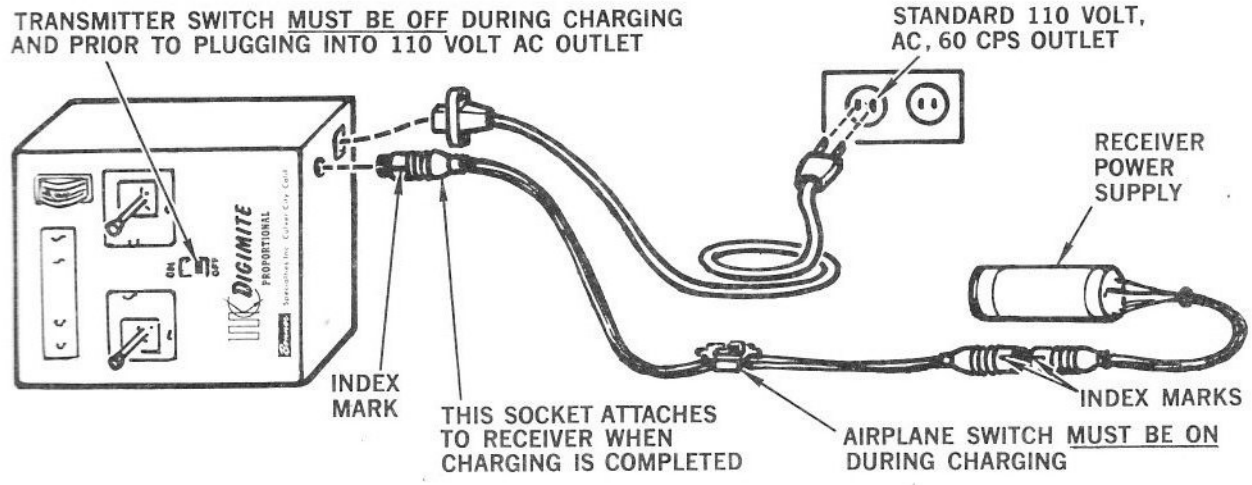


Figure 3. Charging the Power Supplies—Receiver Power Supply Being Charged Through Airplane Harness.

SYSTEM CHECKOUT AND OPERATION

Before installing the Digimite system in a model, it is recommended that it be put into operation on the bench to familiarize the owner with the operation. Before this is done, be sure the power supplies are charged in accordance with the preceding section.

All that is needed to place the transmitter into operation is to turn the switch on. The antenna may be attached if desired and can be retained in the collapsed condition for bench work.

To operate the airborne equipment, plug the servos into the appropriate receiver sockets, connect the receiver to the power supply using the switch and wiring harness and turn the switch on. Although the servo plugs are polarized, care should be taken in mating the servo plugs to receiver sockets to avoid bent pins. Check index marks on plugs and sockets, before connecting.

Switch the receiver on and study the control operation. Note that when the transmitter is turned off, the servos go to their respective fail-safe position, either at center or at one end according to the type of servo.

When operating trim levers, the correct method is to depress the trim lever and then move it. This unlocks levers for movement.

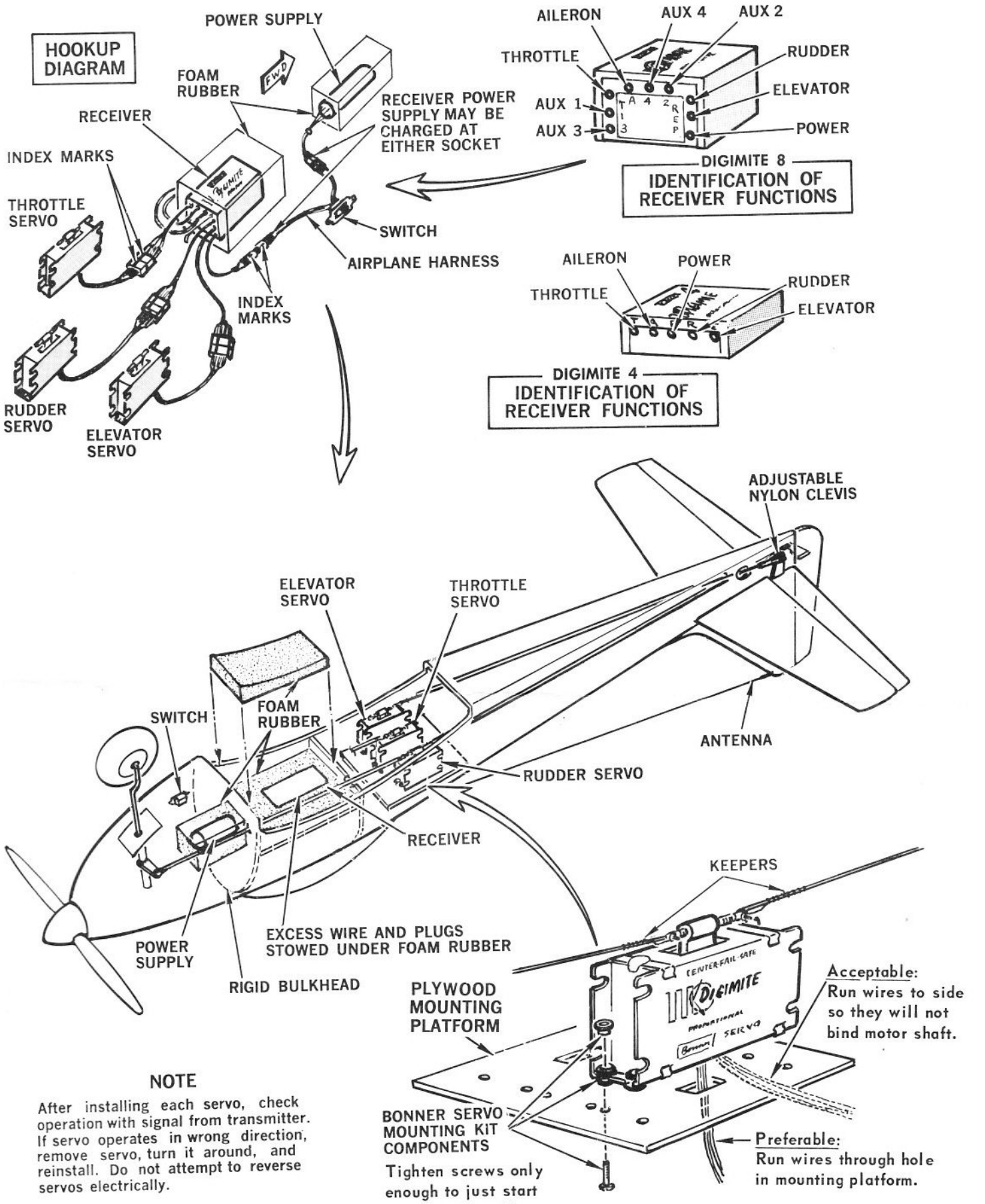
INSTALLATION

The installation of the Bonner Digimite system is straightforward. Good practices commonly employed when installing reed systems are acceptable. These practices should include the following usual precautions to keep electrical noise from the superheterodyne receiver:

1. Route the receiver antenna directly out of the fuselage close to the receiver and back to the top of the fin. This places it far from any electrical wiring and metal linkage. Do not route the antenna back through the fuselage and then out.

2. Avoid metal-to-metal linkage joints as these generate radio noise. Use nylon clevises when control horns are metal and vice-versa.

Figure 4 shows a typical fuselage installation of the rudder, elevator and throttle control servos in a low wing model. Servos are placed according to center-of-gravity and space considerations. Bonner Servo Mounting Kits are a superior method of fastening. Be to securely mount the servos to plywood. It should be noted that whenever several devices



NOTE

After installing each servo, check operation with signal from transmitter. If servo operates in wrong direction, remove servo, turn it around, and reinstall. Do not attempt to reverse servos electrically.

Figure 4. Installation

operate from one servo (such as for rudder control and nose wheel steering) both ends of the servo clevis can be utilized for a neat and workmanlike installation. Rigid push-pull rods made of 1/4-inch square hardwood or 3/8-inch square balsa should be used to the elevator and rudder horns to prevent any flexing under air loads or "G" loads.

The switch is attached to the fuselage side with the button protruding. The wiring harness may now be connected and the wire bundles are stowed under foam rubber in out-of-the-way places.

Both the receiver and power supply should be wrapped in foam rubber or foam plastic prior to sliding in place. The receiver foam wrapping should be tight enough that the receiver will stay in place when the wing is attached. To stop damaging forward motion in the event of a crash, both the receiver and power supply should be close to a rigid bulkhead.

Ream the holes in nylon linkage parts oversize to prevent binding. Binding results in excessive battery drain. All servo linkages should be checked for binding without the servo installed. Then install the servos and check for operation and sense (direction). Those servos which operate backwards should be turned around; never try to electrically reverse them.

No unusual techniques are employed when installing the aileron servo linkage. Each end of the output arm is linked to an aileron using 1/16 - inch diameter wire and nylon bellcranks.

TRIM ADJUSTMENT

After installing the servos, linkages, and other equipment, the exact trim adjustments can be made. The receiver should be turned on momentarily with the transmitter off which allows the system to go to fail-safe and all flight-control servos to neutralize. Mechanically adjust the linkage so that the controls are in neutral. When the transmitter is turned on; all controls should still be in neutral when the trim levers are in neutral. As a result, full trim in any direction is available. Also, a fail safe condition positions controls to flight neutral.

Adjust the throttle control linkage so that full travel of the servo drives the throttle to both extremes. The radius of the engine throttle arm may have to be shortened to provide enough throttle throw, or lengthened to stop excessive overtravel stresses on the linkage and servo.

RECEIVER-ANTENNA MATCHING

NOTE:

Changes in check-out techniques at the factory have made it unnecessary to tune the antenna of the receiver for the average installation. Please install receiver in airplane and range check first before changing tuning.

The average installation gives full ground range with the tuning as received from the factory. If you feel that range after installation is not adaquate, then the following tuning procedure should be followed.

A 1/8 inch hex-shaped plastic tuning wand is supplied with the Digimite system. Any attempt to use anything other that the proper tool for tuning will result in breaking the powdered iron slug in the receiver.

RECEIVER TUNING PROCEDURE

Properly locate receiver, switch and all wiring in your airplane. Locate your antenna so that it is approximately the same position relative to wiring, servos, etc., as when the the airplane is ready for flight.

Set your transmitter on the ground with its antenna removed. Use a rubber band to hold the elevator stick in the "down" position and move the throttle control stick to the low speed position. Turn on your transmitter and receiver and bring the model close to to the transmitter and note that the elevator servo moves to the "down" position. During the turning procedure be sure to keep your body and hands as far as possible from the antenna and receiver as this will affect the tuning. Slowly back away from the transmitter with the model until the controls become quiet; i.e., fail-safe position. Now step in closer until the servos start to chatter and the elevator servo tries to move to the down position.

Slowly and carefully turn the antenna slug with hex tuning wand supplied, right or left, while watching the elevator servo. The antenna slug should not have to be rotated more than one turn in either direction. Tune for maximum "down". If it should become solid "down", back away slowly until it again fail-safes. Move closer until elevator servo chatters toward down elevator and again tune for maximum "down". Repeat the above until tuning is extremely sharp and there is no further increase in range. The antenna now is properly tuned.

The "chatter" of the servos is caused by electrical noise from the servo motors getting into the receiver under extremely weak signal condition. To explain the action that has been observed during the tuning procedure, the following brief explanation will be helpful:

The servo has only 3 modes of operation: 1) it moves toward command position only upon receipt of proper command information, 2) it moves to fail-safe position after one second of continuous absence of correct command information, and 3) it remains stationary.

The receiver is capable of accepting only correct information and preventing incorrect information from getting into the servo. Each sequence of command information is

examined by a counter and reset generator for the correct number of pulses; i.e., any extra pulses because of noise or any pulses missing because of interference. Working in connection with this error detection circuit are two other circuits we call lock-out and fail-safe. The purpose of lock-out is to prevent incorrect information from getting to the servo. The purpose of fail-safe is to drive the servo to a neutral position after the receiver has been in continuous lock-out for one second. If at any time during lock-out, or during fail-safe, a correct sequence of command is received, this information will be passed on to the servo. After a correct sequence of command information, the fail-safe circuit will not operate for another full second of absence of correct command signal.

Relating the above information back to the tuning sequence, the chatter can now be understood as a condition in which a servo is receiving only correct information during a relatively small period of time. The remaining time being lock-out; i.e., the servo remains stationary and will wait for more correct commands or be switched to fail-safe. So you can see that if the servo receives several bits of command information it will move toward the command position but while on the way to command position it may be interrupted, thus causing the servo to stop while awaiting further command. Further command may be in the form of "no command signal" for one second and go to fail-safe, or sporadic bits of good information may be received which jogs the servo toward its command position. This chatter, or gray zone area, enables the operator to RETAIN CONTROL EVEN THOUGH A VERY SMALL PERCENTAGE OF CORRECT INFORMATION IS BEING RECEIVED.

The Digimite logic circuits reject interference when flying. However do not tune the receiver on a busy flying field where other transmitters are in operation. Any transmitter signals regardless of exact frequency result in wide variations in the receiver's sensitivity and totally confuse any attempted tuning operation.

Normally the tuning operation need only be performed once in an airplane. However, if changes are made in the antenna placement or model wiring, then tuning could be affected.

FLYING

Perform a routine control test with transmitter antenna off upon arriving at the flying field each day. Although RF activity at the field may reduce the range previously attained with antenna removed, the results of this test are indicative of whether or not a major problem exists.

A qualified proportional flyer should test fly the aircraft and trim it in the air using the trim levers. After the flight, mechanical trim adjustments should be made to the airplane linkage so that the transmitter trim levers may be returned to neutral.

Lack of sufficient charging of power supplies is one of the greater problems affecting reliability. Whenever possible, charge the power supplies for 24 hours just prior to flying.

Always extend the transmitter antenna completely, prior to taxiing out for take-off. The receiver with its R.F. overload protection allows operation within an arm's length of the transmitter with antenna fully extended.

FACTORY SERVICE

If at any time the Bonner Digimite system fails to function properly, it should be returned to the factory for service. The components should be replaced into the original shipping carton for return. A description of the problem should be included.

Circuit diagrams are not included with Digimite units. The computer-type logic network circuits of the Digimite system do not require checkout by, and are beyond the capability of, the normally skilled electronic technician. Do not open servo cases. This would void the warranty. Unless servo cases are opened with factory tools, the bearings may spring out, touch magnets and damage the sensitive circuitry. Circuit diagrams may be obtained from the factory for $2.50 a set, (transmitter, receiver, and servo circuits are in one set). Be sure to include the serial numbers of your transmitter and your receiver when ordering circuit diagrams. The serial number for each set is printed next to the 110 volt charging socket on the transmitter.

A circuit diagram of the receiver power supply is shown in Figure 5.

We reserve the right to make improvements and modifications at any time without notice or obligation.

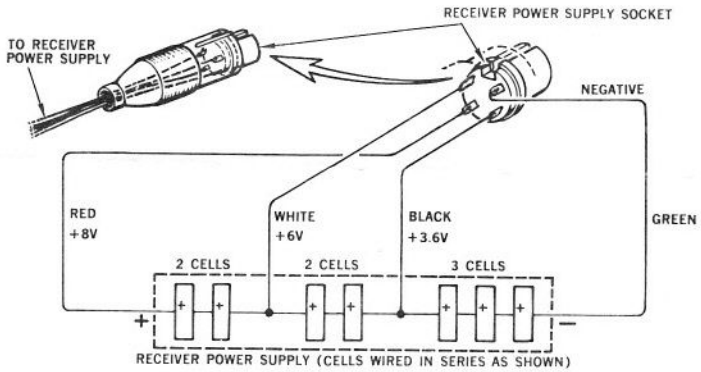


Figure 5. Schematic of Receiver Power Supply.

WARRANTY

All BONNER equipment is fully guaranteed against defective parts and workmanship for a period of ninety days from the date of purchase, subject to the following provisions: BONNER SPECIALTIES, INC. assumes no responsibility for compatibility of its equipment with that of another manufacturer; the guarantee is void if the subject equipment has been tampered with, altered, or shows evidence of abuse; transistors and crystals are not guaranteed against burnouts or breakage. If in our opinion the damage incurred is not covered by warranty a charge will be made based on a $2.50 minimum plus cost of parts replaced FOR SERVOS.

Due to the complexity of the Digimite system, a $12.00 minimum service charge will be made on systems covered by warranty. Any abuse or tampering of this set including the wiring will void the warranty. When returning equipment for repair, include the receiver batteries to enable us to determine cause of failure. All repairs are returned C.O.D. or CASH IN ADVANCE.

Because crashes can be caused by many things (pilot error, high speed stalls, etc.) WE ARE NOT RESPONSIBLE FOR ANY CRASH DAMAGE.

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