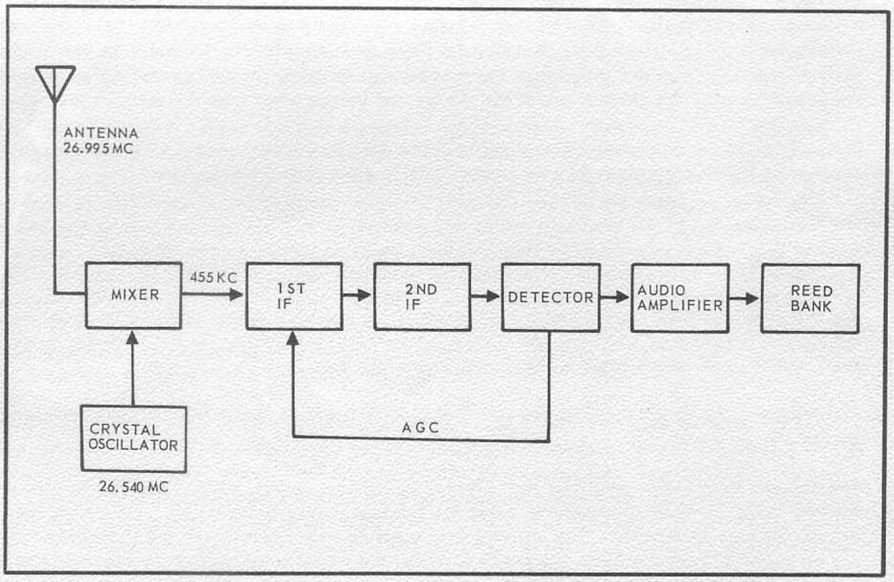
INTRODUCTION

KRAFT Superheterodyne Reed Receiver is unquestionably the finest and most reliable unit available to radio control enthusiasts. Only the finest components have been utilized to provide outstanding performance and long, trouble-free service. Its sensitivity (operating range) and stability are unequalled. Its selectivity and excellent AGC (automatic gain control) system make reliable control possible on our crowded radio control frequencies.

The receiver will reject signals 5,000 cycles per second or less away from its operating frequency. However, with your transmitter off, you may notice that your receiver can be operated by nearby transmitters which are 50 kc or more away from your receiver's frequency. This has nothing to do with the receiver's selectivity. It is caused by the square wave or other chopped form of modulation used in many radio control transmitters. This type of modulation causes a dirty transmitted signal, and it may splatter over as much as plus or minus 100 kc from the actual frequency of the transmitter. Generally, this splatter is not a problem at the low power levels used in radio control. The carrier wave signal from your transmitter will usually be sufficient to turn on the AGC system of your receiver, reducing its gain and eliminating this adjacent channel interference. However, some transmitters splatter so badly that you may be risking your aircraft to fly when they are in use. It is highly recommended that this receiver be utilized with the KRAFT Reed Transmitters.

Properly installed, your receiver will require little or no maintenance or retuning for years to come. It will function with absolute reliability at any temperature from zero to over 140° F.

SUPERHETERODYNE RECEIVER



When two signal frequencies are combined, two additional frequencies are created. One is the sum of the two combining frequencies, the other is the difference between these two frequencies. In your superheterodyne receiver the incoming frequency is combined in the mixer with the frequency generated by the crystal controlled local oscillator in the receiver. The difference between these frequencies is called the intermediate frequency, and this is amplified by the intermediate frequency amplifiers. For example, suppose the operating frequency is 26.995 Mc and our intermediate frequency amplifier is designed to work at 455 kc. The local oscillator in the receiver must operate on a frequency which is 455 kc above or below 26.995 Mc. Thus, we may use a crystal in the receiver of 26.995 minus 455 kc, which equals 26.540 Mc or 26.995 Mc plus 455 kc, which equals 27.450 Mc. In our radio control receiver, the local oscillator frequency is generally operated below the signal frequency. Therefore, for a transmitter frequency of 26.995 Mc, the receiver crystal's frequency will be 26.540 Mc. However, for ease of identification, the top of the crystal will usually be marked with the operating frequency of the receiver rather than the actual frequency of the crystal.

In receivers of this type, there is also another transmitter frequency which may operate the receiver. This is known as the image frequency and will be 910 kc (twice 455 kc) below the main frequency. Remember that the intermediate frequency is 455 kc and that our local oscillator generates a signal this amount below the operating frequency of 26.995 Mc. Naturally, it also operates 455 kc above the frequency of 26.085 Mc. This is known as the image frequency. Our mixer stage is tuned to 26.995 Mc, but at these high frequencies the tuned circuit is not sharp enough to give very much attenuation to the image frequency. Fortunately, the image frequencies do not create a problem because the part of the frequency band which they fall in is not widely used.

The reason the superheterodyne receiver is able to reject other nearby transmitter frequencies is because the high frequency is converted to a low intermediate frequency of 455 kc. The signal is then amplified through several sharp tuning stages which narrow the bandwidth of the receiver to the point where it will reject all but the desired frequency.

BATTERIES

The receiver has been designed to operate on the batteries supplying power to the model's servo actuators. Thus, no additional battery supply is required for the receiver. All of today's practical relayless servo systems require five 1.2 volt rechargeable batteries wired in series for power. Dry batteries have become obsolete for multi-channel radio control use. Therefore, the receiver is designed to operate on five scintered-plate type, nickel cadmium cells. The KRAFT KB-5 Battery Pack is recommended for use in the receiver. This pack features genuine "Ni-cad" 600 mah capacity batteries which greatly increase the usable battery life and reliability of the system. Other packs utilizing inexpensive button type cells are not recommended. The KRAFT Battery Pack is available from your dealer. The cells of the KB-5 have a fully charged voltage of 1.3 volts per cell under moderate loads. This means that the total voltage across the battery pack will be 6.5 volts initially. After a bit of use the batteries will drop to 6 volts under load (by "load" we mean the drain of the servos, as the receiver itself draws very little current). Always charge your battery pack the day before use as it will gradually lose its charge in storage.

WIRING

Careful neat wiring is a must for reliable operation of the radio control system. Always use a high quality 60-40 resin core (not acid core) solder.

The four and six channel receivers have the servo and battery pack wiring precabled. Consequently, it is only necessary to match the wire colors of the servo cables using appropriate plugs to the color coding of the wires from the servos. Follow the wiring diagram (Figure I) carefully and be sure the four wire power cable is correctly wired to the battery pack.

The ten and twelve channel receivers do not have the servo wiring precabled because the resulting large bundle of wires to the light receiver would tend to transmit vibration and could cause reed problems. There are twelve or fourteen wires coming from the receiver. The red wire is connected to the positive (plus 6 volts) side of the battery pack. The white striped green wire is connected to the negative (minus 6 volts) side. The other ten wires are from the reed bank and are divided into five color pairs, each pair corresponding to a suggested control function as follows: brown pair, rudder; orange pair, aileron; yellow pair, motor; green pair, elevator; blue pair, trim. This reed selection matches the tone selection of the KRAFT transistor transmitter. Other combinations could be used with other make transmitters, but it must be remembered that this reed bank is of a new high frequency type and other make transmitters may not only be difficult to match to it, but may not have the necessary tone frequency stability to ensure reliable operation.

The only difference between the ten and twelve channel units is in the reed bank. The twelve channel reed bank has two more reeds added, and its tone frequency spread is approximately 20 cps higher. The gray pair of wires from the twelve channel reed bank are for auxiliary use, (i.e. flaps, spoilers, twin engine control, etc.). The other colors of wire pairs are for the same functions as the ten channel reed bank.

The receiver is designed to be used with the reed relayless type servos. The over-all reliability of the installation is highly dependent on the servos used. Therefore, it is recommended that the KMS KRAFT relayless reed servo be used with this receiver. This servo features a precision industrial-type motor, which is guaranteed for 1,000 hours. It has the lowest battery drain of any servo on the market (35 - 40 milliamperes) with a static thrust of over three pounds. The over-all precision of the gear train assembly, coupled with the quality components used in the servo amplifier, make it a must for those desiring reliable, trouble-free operation. Each individual wire pair (brown, blue, yellow, green, orange and gray) from the reed bank is mated to the orange and yellow wires from each servo. To change direction of servo movement, reverse the connections of the orange and yellow wires from the servo to the color pair of wires from the receiver.

Figure II shows the suggested wiring diagram. Use No. 26 nineteen-strand wire and strip back only long enough to make connections. Always use tight fitting sleeving over connections to protect against vibration.

INSTALLATION

The receiver should be mounted with a minimum of 1/2" of foam rubber surrounding it on the sides, top and back. Three-fourths inch (3/4") minimum is desirable on the front and bottom for greatest protection. Do not pack the receiver in tightly. It should slide loosely into its foam rubber lined compartment without compressing the foam.

Mounting position is not important except that it is desirable to mount the unit vertically with the bottom of the can facing forward where practical.

The antenna installation should be kept clear of all wiring, servos, etc. We prefer to glue a length of No. 22 stranded wire from the tail forward to the receiver compartment inside the fuselage during construction. The end at the receiver compartment should be left long enough for easy attachment. The antenna wire supplied with the receiver is 24" long; but if the suggested installation is used, it may be cut off about 3" from the can. We prefer to solder the antenna connection permanently from the receiver to the model, covering the splice with a length of sleeving. However, a small tight fitting plug may also be used.

Total antenna length should be about 24", but it can be anything from 18" to 30". If the antenna is installed inside the airplane, DO NOT use a metallic finish as this could materially reduce range.

TUNING

A hole is provided in the receiver can to allow for final RF tuning. NO OTHER TUNING ADJUSTMENTS ARE NECESSARY AND THE WARRANTY IS VOID IF THE I. F. CAN TUNING SEALS ARE TAMPERED WITH.

The receiver should be installed in its compartment with all connections made to servos, switches, batteries, etc. (including aileron servo connection, if any). Slide the receiver out of its compartment just far enough to expose the tuning hole in the cover. A hex type plastic tuning wand is used to match the hex hole in the tuning slug. Remove the transmitter antenna. If a helper is available have him hold down the trim or motor switches to drive the associated servo to the end of its travel. Tuning will be easier using the trim or motor tones because the servos will not be running back and forth during tuning. Have your helper walk out a few feet until you cannot hear the reed vibrating. Insert the tuning wand into the slug and keep your body away from the wiring and receiver can as much as possible. Do not hold the receiver while tuning. Rotate the slug in or out until the reed starts vibrating again then have your helper move slowly away with the transmitter tone held on while you tune the slug to keep the reed vibrating. When your helper has reached the range limit, the slug tuning will be very sharp and in most cases you will be able to faintly hear the tone humming in the reed coil beyond the point of range where the reed stopped vibrating. Merely tune the slug for maximum tone volume.

A range of about 15 feet with the transmitter antenna removed is adequate. Occasional range checks may be made right in your shop. Establish a fixed point to place the airplane and another point of maximum range to use as checks. DO NOT vary these positions in your shop or proximity to various objects will greatly change the range to be expected. For example, with the airplane sitting on a dry asphalt runway, a range of four to ten feet may be all that can be attained. With the airplane propped on a stool over a lawn a range of 50 feet or more may be obtained. We point this out to illustrate that range will vary considerably with the transmitter's antenna removed depending on the test location.

If you desire a real range test, prop the airplane upon a stool off the ground and have your helper start walking out with the transmitter (antenna on, of course). Pull up a chair and relax as he will have a mighty long walk.

REED BANK ADJUSTMENT

The transmitter's lever switches operate two controls each. The switches close contacts connected to a capacitor. A potentiometer and capacitor across each of these capacitors provide a fine tuning adjustment to allow tuning to the receiver's reed bank.

These tuning potentiometers are located on the back of the transmitter's printed circuit board and are identified to match the control functions operated by the lever switches. Rotating the blue knobs clockwise raises the tone frequency applicable to that particular control. Rotating the control potentiometer counterclockwise lowers the tone frequency.

Transmitters purchased separately will tune to the average reed bank of the type used in our receiver. However, because reed banks vary in tone frequency range, the transmitter tone adjustments may not cover all reed banks even of the same manufacturer and may require minor tuning capacitor changes. For this reason, it is always desirable to purchase matched transmitters and receivers.

All KRAFT reed transmitters, except the four channel, are simultaneous. This means that two control functions may be obtained at the same time. The controls are arranged so that the left hand control switches may be used simultaneously with the right hand switches. However, two switches on the same side of the transmitter may not be used together.

Adjacent reeds do not operate well simultaneously. Therefore, certain simultaneous combinations will not operate smoothly. On the ten channel units, aileron and motor controls operate adjacent reeds. On the twelve channel, auxiliary and motor operate adjacent reeds, and on the six channel, motor and rudder operate adjacent reeds. These functions are not normally used in flying and this is the reason the reed selection has been made to allow good simultaneous operation of the controls which are sometimes used together.

The reed bank has metal fingers equal to the number of "channels". These together are called the reed comb. This reed comb is mounted above a coil and a magnet. When an alternating current is introduced in the coil at a frequency equal to the resonant frequency of a metal reed finger, the finger will vibrate. When it vibrates, it hits the upper adjustable screw contact acting as a vibrating switch. The magnet of the reed bank provides a magnetic bias which improves reed drive in a manner similar to the principle used in the magnetic speaker commonly found in your home radio. While it would appear that the frequency of the metal finger of the reed bank would be determined solely by its length, this is not true. The frequency of a reed is primarily determined by its length, but it is also influenced by the distance between the reed and the pole piece on which the reed coil is wound. In production of the reed bank, stresses are introduced in the metal reed fingers. As the reed bank is used, these stresses tend to relieve, and the position of the reed in relation to the reed pole piece as well as the adjustable screw contact change. The closer the reed finger is to the pole piece of the reed coil the lower its resonant frequency will be, and the harder it will drive. The further away it is, the higher its frequency and the weaker its drive. Consequently, changes in the relationship between the reed comb and the pole piece will change the frequency response of the reed bank and may necessitate retuning.

In extreme cases, the gap between the reed and reed adjusting screw may also require readjustment. It is very important to note, however, that the gap between the adjustment screw and the reed does not influence the reed's frequency. It does, however, affect the starting ability of the reed and its dwell time, and has a decided effect on operation. Minor reed adjustment may be required from time to time. The gap between the reed and reed adjustment screw should be checked with the reed vibrating to observe the distance of the reed swing. This swing will be smaller for the shorter reeds and wider for the long ones. Normal swing observed at the end of the reed will be approximately 1/32" to 3/54" for the short reeds, and 3/64" to 1/16" for the long reeds. Excessively close spacing will result in poor reed response (slow starting) and poor simultaneous operation.

With the reed spacing approximately correct, the next step is tuning the transmitter to the reeds. This is done in the following manner. If reed operation is good simultaneously, it naturally will always be correct for non-simultaneous operation. Therefore, reed tune up should be done while holding simultaneous controls. For example, hold left rudder and up elevator. Rotate the up elevator control potentiometer to the right to increase the reed frequency. Key the up elevator switch as the potentiometer is rotated until the reed does not start. Then holding the up elevator switch, rotate the control potentiometer slowly back counterclockwise, or to the left, until the up elevator reed starts again. Continue rotating to the left slightly beyond this point. Repeat this process now with the left rudder control potentiometer and with the up elevator switch held on. This tuning adjustment should be repeated for every simultaneous combination. Once the reed bank has been tuned in this manner the various controls should be actuated together simultaneously and the reed action observed carefully. There may sometimes be slight interaction during simultaneous operation of two reeds with a third reed. Slight retuning of the combination causing the interaction will be necessary to eliminate it.

During adjustment of the reed bank, servos should be disconnected. In the case of matched combinations, the reed bank has been very carefully adjusted and matched to the transmitter. Readjustment should only be attempted when changes in the reed bank indicate it. Generally speaking, once the reed bank has been used for a few hours, and then retuned, it will set in. Their readjustment will not be necessary for long periods.

Despite very careful testing at the factory, it is possible that a small piece of dirt or other matter might become imbedded under one of the reed contacts. If one of the reeds appears to be driving well but does not actuate the associated servo, the reed may be cleaned as follows: cut a small length of 0.040 piano wire and file or grind it across the width of the wire to roughen it. Very carefully rub this roughened surface of the wire across the reed contact and reed. DO NOT in any way disturb or excessively bend the reed itself. After the reeds have been operated for a short period of time it is unlikely that they will ever require further cleaning or attention.

TROUBLESHOOTING

IN CASE OF TROUBLE, inspect all wiring carefully for properly soldered joints. Most radio troubles can be traced to poor soldering. Be sure no wiring is accidentally shorted. Check your switches and plugs to be sure that they are making good contact. Both can be a source of trouble that is sometimes difficult to isolate. Check your battery voltages and inspect the battery pack. Be sure wire color coding matches with Figure I and II. If, after careful inspection, the trouble seems to be isolated to the receiver, return it to the factory with a letter outlining your difficulty. DO NOT TAMPER WITH OR ATTEMPT ANY RECEIVER ADJUSTMENT OTHER THAN SPECIFIED IN THIS INSTRUCTION MANUAL. IF YOU DO TAMPER WITH THE RECEIVER, YOUR WARRANTY IS AUTOMATICALLY VOID AND EXPENSIVE REPAIRS MAY BE NECESSARY.

CHANGING FREQUENCIES

The operating frequency of your receiver is fixed by the crystal installed in it. Should you desire to have your receiver changed to another radio control frequency, return it to the factory along with your transmitter. DO NOT attempt to change the frequency by changing crystals yourself. The transmitter and receiver crystal are ground within specific tolerances. While these tolerances are extremely close, it is entirely possible that they could be far enough off to substantially degrade the performance of the receiver. Therefore, realignment is desirable when changing the receiver from one frequency to another. When returning your transmitter and receiver to the factory for frequency change, include your check or money order for $12.50. This charge includes exchanging crystals, complete realignment, and a thorough checkout of both units together. For changing frequency of the receiver only, include your check for $7.50.

GUARANTEE

The KRAFT Custom Superheterodyne Receiver is guaranteed against defects in workmanship and material for 90 days from the date of purchase. In case of trouble, return the unit to the factory. Enclose $3.00 to cover the cost of return postage, insurance, and handling. Failure to include the handling charge will indefinitely delay the return of your unit. If the unit is judged to be defective, we will immediately repair or replace it and return it to you at no charge. If our inspection indicates that it has been tampered with or physically damaged we will send you a repair estimate. No C.O.D. shipments will be made.

We take great pride in our electronic design and workmanship and in the careful, thorough testing of every unit we manufacture. Our standard of manufacture is that we would personally use any unit which leaves our plant in our most prized model under any conditions.

If you have any comments or criticisms regarding our equipment, we would appreciate hearing from you.

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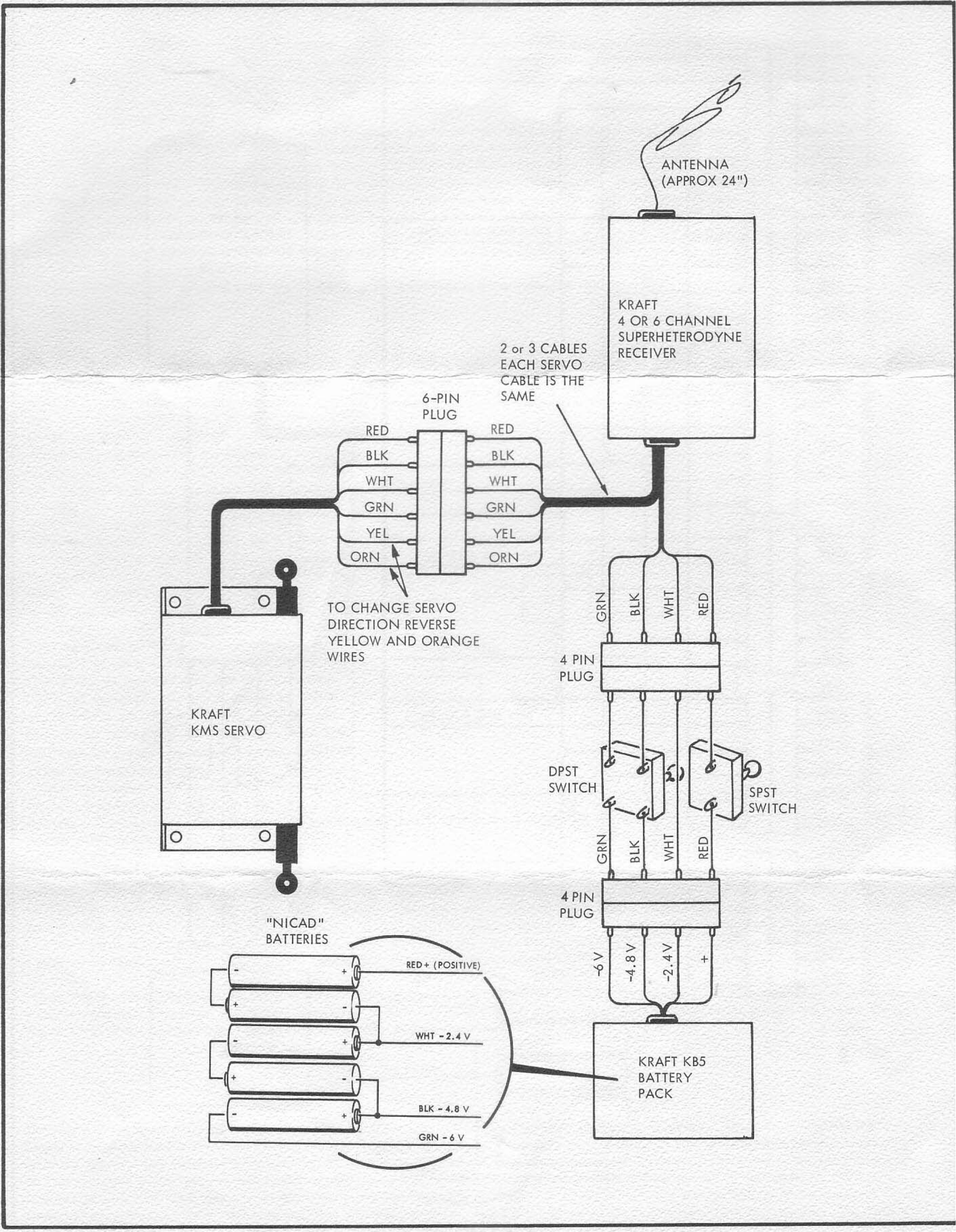

Figure 1. 4 and 6 Channel Wiring Diagram

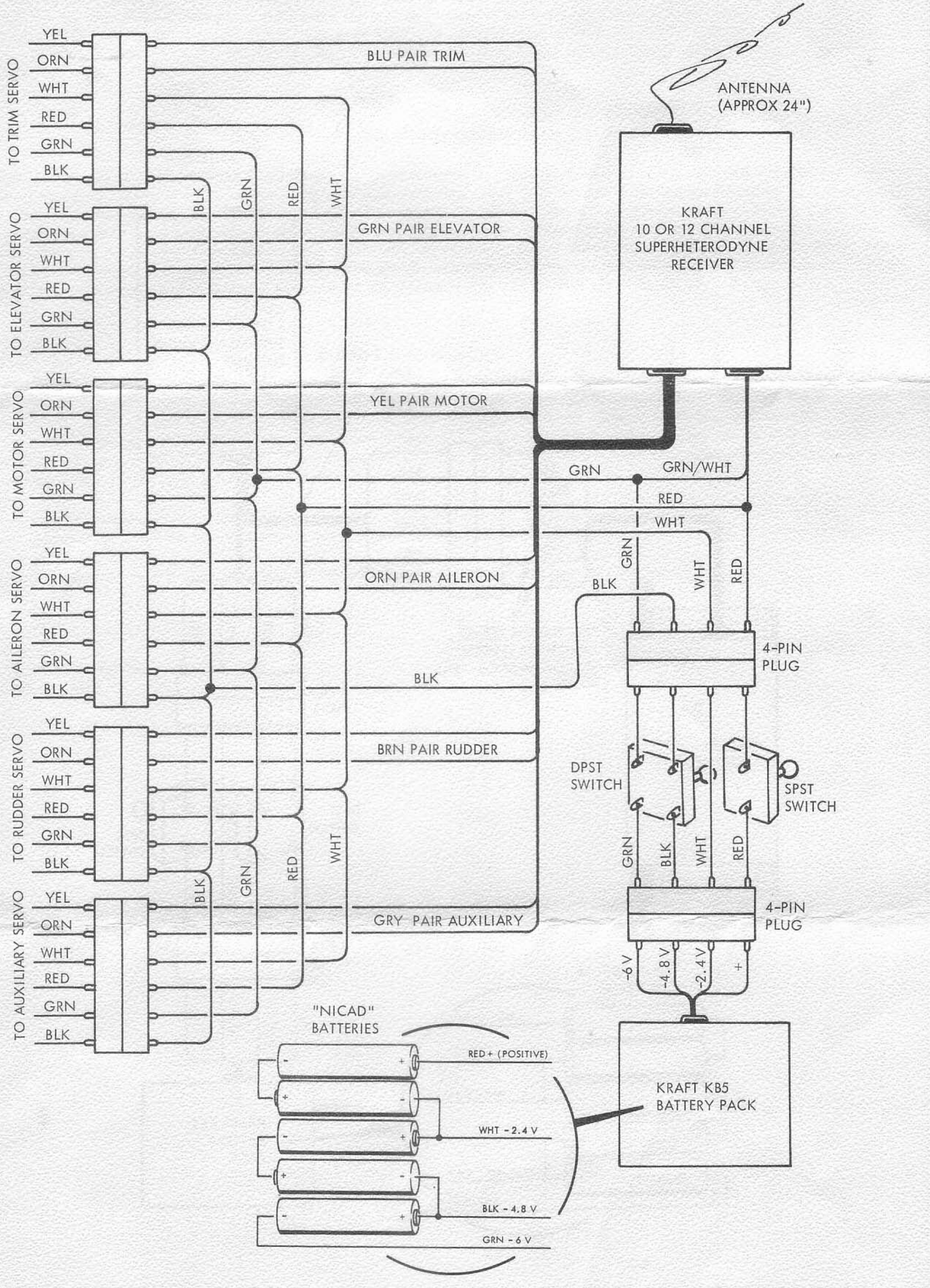

Figure 2. 10 and 12 Channel Wiring Diagram