

CT1K
ASSEMBLY MANUAL

FOR YOUR

ACE
SINGLE CHANNEL
TRANSMITTER

COMMANDER

3RD EDITION

Ace R/C, Inc.

BOX 301

HIGGINSVILLE, MISSOURI

HELPFUL KIT BUILDING INFORMATION

Your Commander Transmitter Kit uses a printed circuit base. This uses copper laminate pattern which is on an epoxi glass base. Not only is this virtually indestructible, but is less affected under high humidity and temperature conditions. The copper laminate is firmly fastened to the epoxi, but prolonged lengths of the heat application should be avoided, since it may peel away.

Generally, when a kit has to be returned to our Servicenter, it is because of two very important factors. 1. Improper component placement and/or mounting. 2. Poor soldering technique.

A general rule to follow on mounting is that all components should be mounted tightly to the board unless a step states otherwise. All leads should be kept as short as possible to minimize stray capacity in the wiring. Tubular capacitors and resistors are generally mounted on end. A study of the steps will show which hole they are to be mounted over. Bend the opposite lead easily and gently so it fits into the other hole called for. Disc capacitors will generally fit with no lead preparation, other than to make sure they are straight. Components with lugs and coil ends normally require no preparation unless they appear bent; if they are they should be straightened with a pliers.

Parts should be inserted as called for. The leads may be slightly bent outward, to lock them in place.

The method of soldering leads to a PC board is really simple. Position the tip of the soldering iron so that it firmly contacts both the PC board foil and the wire or lug to be soldered. Then the solder should be immediately placed between the iron and the joint to the solder. Remove the solder as soon as it begins to melt and flow onto the lead and foil. Keep the iron tip in place only long enough until the solder begins to flow over the foil.

Do not overheat joint to be soldered. Use of a 25 to 40 watt iron is recommended as best for PC work. Avoid use of a heavy duty solder gun.

Avoid using a lot of solder. This may increase the possibility of having solder flow between the lands or plugging some of the drilled holes which need to remain open for later connections. If you do happen to get solder across lands, clean it off by heating carefully and then wiping solder away with a soft cloth. Clear any plugged holes by pushing the lead of a resistor through the hole from the opposite side, applying heat from your iron, and then withdrawing the lead before the solder has a chance to reharden. Be careful not to force the lead of the resistor, since too much pressure before the solder has time to soften will separate the foil from the epoxi base.

Should a break occur in the copper laminate, you can rejoin it with a small piece of bare wire soldered across the gap.

Only ordinary care, reasonable neatness, and ability to follow instructions will give you a transmitter to be proud of.

INTRODUCTION

Your Ace Commander Transmitter kit is one of the finest and most powerful single channel tone Radio Control designs available. It was developed by Phil Kraft, who is responsible for such famous designs as the Custom 4, 6, 10 and 12 channel reed equipment, and the KP4 Digital Proportional System. Under license arrangement this circuit is made available to the home builder, to allow you to duplicate this well known circuitry for your channel equipment.

The Commander Transmitter utilizes silicon transistors in an MOPA (Master Oscillator, Power Amplifier) Radio Frequency circuit. This is modulated by a tone of 400 - 450 cycles per second, to provide a transmitter that will be usable with most single channel receivers available today--relay or relayless.

By using silicon transistors, you are assured of temperature stability over the wide range of temperatures you will choose to fly, with the power that you require. Not only is the Commander a powerful transmitter, with an input of 300 to 400 milliwatts, but this power is efficiently used since it has a BASE loaded antenna. This effectively radiates its power without nulls or dead spots, and puts the punch out in the air where you need it. Physically, too, the base loaded antenna will not present problems of collapsing. With the deluxe version the antenna is quickly removable if desired to make it even easier to transport. With the standard version the antenna collapses to such a small height that it presents no problem.

The Commander has a click type of keying switch that can be heard and felt as it is depressed and leaves no doubt in your mind as to when you send a command from your transmitter.

In spite of its power, the Commander is housed in a very convenient and small case. Yet, it uses the standard heavy duty size of 9 volt battery such as the Mallory M1603, Burgess D6, or Eveready 276, to assure you long economical and dependable operation.

By assembling your transmitter you can be assured of considerable savings, and yet enjoy the fun of Radio Control. Not only are step by step instructions given, but trouble shooting information is also available. We urge you to read and then re-read the helpful kit building information before beginning assembly.

CONSTRUCTION NOTES

This manual is to assist you in completing your kit with the least possible chance for error. If you follow it carefully, you will have a stable transmitter, which will operate at a high degree of dependability. It would be a good idea to keep these instructions for future reference for any maintenance that may arise.

To help you familiarize yourself with the parts, unpack your kit carefully and check each part against the parts list. The parts list contains the color codes to help you identify the resistors furnished; most of the other components are either identified, or can be identified by referring to the drawings and photographs.

In order to expedite delivery, we occasionally are forced to make a minor substitution on a part. If this is done you can rest assured the part will work as well as the original.

You may find it helpful to put parts in muffin tins, or egg cartons, or cut off the end of a corrugated box and stick resistors and capacitors in the corrugations for ease in holding and identification and use. You can write values on the cardboard next to each component.

With the parts list following, check out all of your parts and not only make sure that you have all that are required, but that you can identify each one.

PARTS LIST FOR ACE/KRAFT COMMANDER TRANSMITTER

- () 1 2N706 Transistor
- () 3 2N2712 Transistors
- () 1 Zebra Transformer ^{3/4"}
- () 1 coil 17 turns, #18, ~~1/2"~~ I.D. (L1)
- () 1 Coil 16 turns, #18, 1/2" I.D. (L2)
- () 1 Coil 5 turns, #18, 1/2" I.D. (L3)
- () 1 Coil 15 turns, #18, 3/8" I.D. (L4) NOTE: L3 is wound over L4.
- () 1 Crystal
- () 1 20 uhy RFC choke
- () 1 18 mfd axial lead Electrolytic Capacitor
- () 1 .033 mfd Mallory Capacitor
- () 1 .047 mfd Mallory Capacitor
- () 2 Arco 423 trimmer capacitors
- () 1 33 pf NPO disc capacitor (33K)
- () 1 .01 mfd capacitor
- () 2 .001 mfd disc capacitor (1K)
- () 2 270 ohm 1/4 watt resistors (red, violet, brown, silver)
- () 1 470 ohm 1/4 watt resistor (yellow, violet, brown, silver)
- () 1 2.2K 1/4 watt resistor (red, red, red, silver)
- () 2 4.7K 1/4 watt resistor (yellow, violet, red, silver)
- () 1 15K 1/4 watt resistor (brown, green, orange, silver)
- () 1 33K 1/4 watt resistor (orange, orange, orange, silver)
- () 2 47K 1/4 watt resistor (yellow, violet, orange, silver)
- () 1 68K 1/4 watt resistor (blue, grey, orange, silver)
- () 1 Set of battery connectors
- () 1 Cabinet push switch
- () 1 SPST slide switch
- () 1 Punched and screened cabinet
- () 1 PC base
- () 1 42" Domestic Antenna
- () 1 6/32 x 1/2 bolt

- () 4 2/56 x 1 1/8" bolts
- () 4 15/16 spacers
- () 4 2/56 nuts
- () 4 #4 Self taps
- () 1 Grommet
- () 2 4/40 x 1/4" bolts
- () 1 6/32 nut
- () 1 Ace decal
- () 1 Set of instructions
- () 1 Heat Sink
- () 1 Pkg. Hookup wire (4" blue and white, 11" red, 5" black)
- () 1 Length of Solder 24"
- () 1 Metal Bracket

- () 1 #6 Solder Lug
- () 1 #6 Flat Metal Washer
- () 2 #6 Extended Fiber Washer
- () 1 1" X 1" X 1/4" Foam Rubber

In this transmitter the 2N2926 and 2N2712 transistors are directly interchangeable. You may receive either one in this kit.

STEP BY STEP INSTRUCTIONS

Have all the tools on hand that you will need--long nose pliers, side cutters, wire stripping tool for stripping insulation, a 25 to 40 watt iron of the pencil type, and solder that is designed for good printed circuit work, such as Ersin Multi-core or Sav-Bit. DO NOT USE ACID CORE UNDER ANY CIRCUMSTANCES.

The following steps are in a logical 1--2--3-- order to enable you to complete your kit with the least effort. It is a good idea to read each step before you actually do the work. Also, you may want to read ahead a few numbers to familiarize yourself with the general operation. When the step has been completed, check it off in the (). This will help prevent errors if there is an interruption to your building. Some builders also like to mark each step in colored pencil on the pictorial as it is completed.

The steps directing the installation of resistors include color code to minimize error. Solder each step as it is completed unless otherwise stated. Also, it is advisable to clip off the excess component leads, using a side cutters, unless otherwise stated.

ASSEMBLY OF YOUR PRINTED CIRCUIT BOARD

For purpose of making this part of the assembly easier, orient the printed circuit base by holding the glass part of it toward you--the copper laminate away from you. If you hold it against the light you will be able to see the copper through the epoxy glass and you will have an outline which will assist you greatly as you do the following steps. Insert components from this side through the board. Solder at each step, unless otherwise instructed. Also clip excess wire leads at each step unless otherwise instructed.

- () 1. Insert the lugs of an Arco 423 Trimmer into holes 1 and 2, so that they stick through the slots and protrude slightly. Solder both. It is not necessary to clip them off.
- () 2. Insert L3 and L4 into holes 3, 4, 5 and 6. L3 is wound over L4. Only a small shifting should be necessary to get the coil leads to line up. L3 and L4 as well as L1 and L2, are not only formed, but are doped as well to keep them closewound. The leads have also been stripped and no scraping is necessary. Mount close to the PC Board. Tin the coil leads with solder before inserting into the PC Board.
- () 3. Insert the 18 mfd electrolytic capacitors into holes 7 and 8, so that it stands upright over hole 7. The negative lead goes into hole 7, with the positive lead going into hole 8.
- () 4. Insert 47K resistor (yellow, violet, orange) into holes 9 and 10, standing it upright over hole 9.
- () 5. Insert a 68K resistor (blue, grey, orange) into holes 11 and 12, standing it upright over hole 11.

- () 6. Insert .01 mfd tubular capacitor into holes 13 and 14, standing it upright over hole 13.
- () 7. Insert a 270 ohm resistor (red, violet, brown) into holes 15 and 16, standing it upright over hole 15.
- () 8. Insert a 2N2712 transistor into holes 17, 18 and 19. Make sure the emitter goes into hole 17, base into hole 18, and collector into hole 19. Do not pull tight, but have transistor stand about 1/4 inch away from PC base. Use a heat sink to prevent damage to transistor when soldering.
- () 9. Mount the Zebra transformer in holes 20, 21, 22, 23, 24 and 25. Make sure Secondary leads go into holes 20 and 21; with Primary leads going into holes 22 and 23. The tabs of the transformer go into holes 24 and 25. Use care in placing leads before soldering. Solder tabs as well as leads. The transformers have been checked for continuity, and as you get your unit it is in operating condition, careless handling may cause a break in the winding.
- () 10. Place the .033 mfd mylar capacitor into holes 28 and 29.
- () 11. Mount coil L1 (17 turns #18 1/2 inch ID) into holes 30 and 31. No scraping is required before soldering. Mount close to the PC Board. Tin coil leads with solder before inserting into PC Board.
- () 12. Insert the crystal pins into holes 32 and 33.
- () 13. Insert 4.7K resistor (yellow, violet, red) into holes 34 and 35. Stand it upright over hole 34.
- () 14. Mount a 2N2712 transistor into holes 36, 37 and 38. Emitter goes into hole 36, base into hole 37, collector into hole 38. Do not pull leads down tight; leave transistor about 1/4 inch away from base. Use a heat-sink when soldering to prevent damage to the transistor.
- () 15. Insert .001 (1K) mfd capacitor into holes 39 and 40.
- () 16. Insert 470 ohm resistor (yellow, violet, brown) in holes 41 and 42, standing it upright over hole 41.
- () 17. Insert 33K resistor (orange, orange, orange) in holes 43 and 44, standing it upright over hole 44.
- () 18. Insert 270 ohm resistor (red, violet, brown) in holes 45 and 46, standing upright over hole 45.
- () 19. Insert 4.7K resistor (yellow, violet, red) in holes 47 and 48, standing upright over hole 47.
- () 20. Install the 20 uhy RF choke in holes 49 and 50, standing it upright over hole 49.
- () 21. Insert .001 (1K) mfd capacitor in holes 51 and 52.

Before proceeding with step 22, read the special note on bottom of Page 7.

- () 22. Insert 2N706 transistor in holes 53, 54 and 55. Emitter goes into hole 53, base into hole 54, and collector into hole 55. Leave body of transistor about 1/4 inch away from base. Use a heat sink when soldering to prevent damage to transistor.

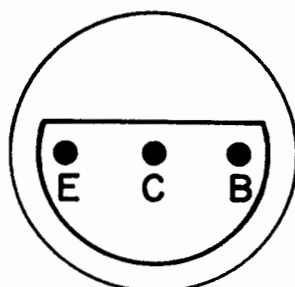
- () 23. Mount .047 mfd mylar capacitor into holes 56 and 57.
- () 24. Insert 47K resistor (yellow, violet, orange) into holes 58 and 59, standing it upright over hole 58.
- () 25. Insert 2N2712 transistor in holes 60, 61 and 62. Emitter goes into hole 60, base into hole 61, and collector into hole 62. Leave transistor about 1/4 inch away from base. Use heat sink to prevent damage.
- () 26. Insert 2.2K resistor (red, red, red) in holes 63 and 64, standing upright over hole 64.
- () 27. Insert 15K resistor (brown, green, orange) in holes 65 and 66, standing upright over hole 65.
- () 28. Insert leads of 33 (33K) pfd capacitor into holes 67 and 68.
- () 29. Mount coil L2 into holes 69 and 70, close to the PC Board. Leads do not require scraping. Tin coil leads with solder before inserting into the PC Board.
- () 30. Insert lugs of Arco 423 trimmer into holes 71 and 72 so that they stick through the slots, and protrude slightly. After soldering both, it is not necessary to clip them off.
- () 31. Strip 1/4 inch insulation from both ends of the 5" black lead, and place one end into hole 73 FROM THE COPPER LAMINATE SIDE OF THE PC BASE. Solder the negative battery snap onto the other end.
- () 32. Cut a 4 inch length of red hookup wire. Strip 1/4" insulation from one end and insert this into hole 74 FROM THE COPPER LAMINATE SIDE.
- () 33. Cut a 2 1/2 length of blue hookup wire, and strip 1/4" insulation from one end, insert this end into hole 75 FROM THE COPPER LAMINATE SIDE OF THE PC BASE.
- () 34. Strip 1/4" insulation from the length of white wire, and solder on to land "A" on the copper side.

Lay the printed circuit base aside for the time being, and begin work on the case.

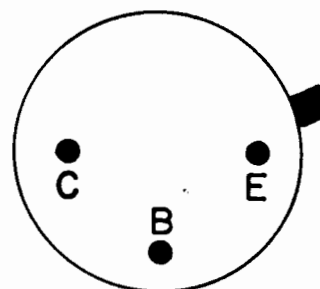
SPECIAL NOTE:

Before installing the 2N706 transistor on the P.C. board, install the wakefield heat sink on this transistor. This is done by forcing the heat sink over the transistor. DO NOT spread or stretch the heatsink out of shape. Apply several drops of glue or epoxy to bond heat sink to the transistor. Failure to mount or glue the heat sink to the transistor will result in transistor burn out.

BOTTOM VIEW



2N 2712



2N 706

ASSEMBLING THE TRANSMITTER INTO THE CASE

- () 36. Mount the cabinet push switch in the hole marked Key. Scrape lugs prior to mounting. Use the Tinnerman clip and force fit it on to the back of the switch. This is a friction fit and a combination pliers or other tool that has an appropriate diameter may be used to fit the clip onto the switch for a tight fit. See drawing.
- () 37. Mount the SPST slide switch in the hole marked OFF-ON. Use two 4/40 x 1/4" bolts. Make sure off-on switch corresponds to off-on on case.
- () * For the standard model--do steps 43 and 49 now.
- () 38. Fasten the metal bracket to the back of the transmitter case using the two #4 self tap screws. Study the drawings. The bracket mounts in the center of the case so that the lip is to the bottom.
- () 39. Cut a 4" length of red wire and strip 1/4" from each end, and solder one end to the one side of the push button switch.
- () 40. Strip 1/4" insulation from the blue wire in hole 75 of the PC board to the other side of the cabinet push switch.
- () 41. Strip 1/4" insulation from both ends of the 3" length of red wire, and solder one end to the lower lug of the SPST slide switch. Solder the positive battery snap to the other end.
- () 42. Strip 1/4" insulation from the red wire from hole 74 of the PC base, and place in the top lug of the SPST slide switch. Take the end of red wire we left dangling in step 39, and place it in the same lug of the SPST slide switch, and solder both wires.

NOW DOUBLE CHECK ALL PRECEDING STEPS TO MAKE SURE THAT ALL CONNECTIONS HAVE BEEN MADE, AND THAT ALL STEPS HAVE BEEN FOLLOWED. Remove any excess wire leads which might have been overlooked. Double check all solder connections.

ANTENNA MOUNTING

In the deluxe model we use a 5 section 42" antenna for greater output.

- () 43. Mount the rubber grommet in the large hole in the top of the transmitter case.
- () 44. Slide the #6 extruded washer on to the 6/32 x 1/2 bolt, making sure the flat side of the washer is toward the head of the bolt, with the extrusion nearest the threads. Slide the bolt through the center hole in the bracket mounted on the front of the case. Now add the #6 flat fiber washer over the bolt. Place the solder lug on the bolt and fasten with the 6/32 nut. Fasten tightly. Solder nut, bolt and solder lug together.
- () 45. Solder the white wire from the PC base to the antenna solder lug.
- () 46. Install the PC base on the front cover using the four 2/56 X 1 1/8" bolts and spacers and nuts. Mount so the PC base will have coil L2 on the top. Insert the piece of foam rubber between the PC base and push switch to prevent shorting.

You can now install antenna by placing base through the grommet at the top of the case and carefully turning until it catches on the threads of the 4/40 x 1/2 bolt on the bracket on the front of the case. Continue turning until it is screwed down as far as it will go.

Now install your battery. This should be a 9 volt of the Mallory 1603, Burgess D6, or Eveready 276. Lay battery on its side with the snaps toward the right when looking into the back of the transmitter case. It will make easy connections with the battery clips this way. Make sure the clips fasten firmly.

TUNING

NOTE: This transmitter requires a license from the Federal Communications Commission. Form 505 is available from your hobby dealer or from the Federal Communications Commission, Gettysburg, Pennsylvania. This form should be filed with the FCC, and license should be in your possession before any attempt is made to operate the transmitter.

Because of its power, this transmitter must be tuned under the direction of, or by someone holding a First or Second Class License issued by the FCC. Some units, with less than 100 milliwatts of power, do not require this. However, your Commander does.

To assist the technician in tuning, we include the necessary tuning instructions.

USING A MILLIAMETER

Insert a milliammeter of 0 to 100 or 150 milliamperè range in your B+ lead with the positive lead of the meter going to the positive connection of the battery, and the minus lead of the meter going to the positive snap on the battery connector.

With both Arco 423 padders turned down fairly snug, turn on the ON-OFF switch. With an insulated screwdriver rotate the Arco 423 trimmer in holes 1 and 2 (located below the crystal as you view the PC board from the back) in a counter clockwise direction. Rotate until a maximum reading of about 40 milliamperes is had.

Now tune the other Arco 423 for a dip. It will be slight, so watch for it carefully. Final reading will be about 38 milliamperes.

Key the push button. Your milliammeter with tone on will read about 42 or 44 milliamperes.

A field strength meter may be used for final fine tuning. The entire tuning procedure may also be carried out using a FSM. Tune the Arco 423 below the crystal first. Then tune the other one for maximum output.

A word about field strength readings are in order. Taking field strength meter readings with field strength meters of the average kind on the modellers bench, gives only relative readings. Never judge final output by field strength meter readings alone.

True Field Strength Meter readings can be had by being more than one full wave length away. Most of the simple FSM circuits in use will not reach nearly that far and therefore they cannot be used to judge transmitters relatively. There are many factors that enter into true readings of output.

After tuning, you are ready to slide on the rear cover. Either insert tape or cardboard between the battery and case side to prevent shorting battery. You will note the 2 holes are off center. Slide cover on so that matching screw holes on cover will match rear cover. Use the two #4 self taps to fasten cover in place.

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In case you experience difficulty, and you do not get a dip, double check all of your solder connections. Begin trouble shooting by checking through the circuitry. You will note voltage readings on the schematic. These were all taken with a Heath Vacuum Tube Volt Meter. In checking if you fail to get a reading at one point or the other, you have isolated your troubles; look for a poor solder joint, or improper part here. Voltages may vary plus or minus 20% due to component tolerances.

