

900 CPS

INSTRUCTION BOOK  
FOR  
BABCOCK RADIO CONTROL  
RECEIVER BCR-3  
AND  
TRANSMITTER BCT-2

CG 250-400



Price \$2.00

**Babcock Radio Engineering, Inc.**  
7942 Woodley Ave. • Van Nuys, Calif.

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## Introduction

This instruction book is in its second printing. Thousands of these units are in service today and giving their owners the enjoyment of reliable trouble free performance. We urge you to follow the instructions carefully with particular reference to bonding and careful workmanship in wiring. If you do have an accident or trouble of any kind the factory stands ready to serve you.

## Parts and Material Required

Whether you know electronics and radio or not, you will find the technical dissertation following the basic installation instructions informative. To proceed with the receiver installation, you will need:

1. A piece of #22 gauge bare tinned copper wire about 5 feet long for the antenna and common ground (for bonding bus).
2. Some flexible #22 or 24 gauge insulated wire for all connections and antenna (10 feet is more than ample). Note: Seven colors are provided in the BCR-3 Installation Kit. (May also be used for antenna).
3. A good double pole single throw switch for turning on the "A" and "B" circuits: Note: We recommend the slide switch in our installation kit. Other makes of slide switches have given vibration trouble. A good toggle switch (H & H) is satisfactory.
4. A single circuit headphone jack.
5. Snap connectors for the "B" battery.
6. Two battery boxes for medium sized flashlight cells (if desired).

7. Batteries required:  
 "A" 2 medium size flashlight cells.  
 "B" 1 Burgess K45 - 67½ volts or Eveready #457.  
 "C" 1 Burgess U10E 15 volts or Eveready #411.  
 Servo or actuator - 2 more medium flashlight cells.  
 (See Technical Data for battery drains and voltage tolerances).

This battery complement adds up for weight as follows:

"A" 2 medium cells @ 1.33 oz.	—	2.66 oz.
"B" 1 @ 6 oz.	—	6.00 oz.
"C" 1 @ .75 oz.	—	0.75 oz.
BCR-3 Receiver	—	5.30 oz.

Total Radio & Battery Weight — 14.71 oz.

Add to this:

Babcock Super Compound		
Escapement	—	0.75 oz.
2 Medium cells @ 1.33 oz.	—	2.66 oz.

Total payload — 18.12 oz.

The above is the recommended battery complement. If extreme economy in weight is desired, penlite cells may be employed in place of medium size cells. This procedure is not recommended because of short life and relatively small saving in overall weight. In case you have difficulty securing Items 1 thru 5 above, we have made life easy for you by packaging these five items along with an extra connector plug. This package is known as "Receiver BCR-3 Installation Package" and may be purchased where you got your radio for \$2.95. The batteries are available at every radio store or hobby shop and the escapements are available at either hobby shops or from their makers. Since there are no "tricks" to "learn", bench testing is a waste of time

that could be used to greater advantage in making a better installation in the ship.

## Notes on Small Aircraft

The BCR-3 has been very successfully flown in ½ A ships at a gross flying weight of 24 to 28 ounces with the following complement of equipment:

BCR-3 Receiver	—	5.5 oz.
B Battery (3 - 22½V hearing aid batteries)		
such as RCA #VS084 - 67 volts	—	3.5 oz.
A Battery - 3 pen cells	— 1½V	1.5 oz.
Escapement battery 1 pen cell	— 1½V	.5 oz.
"C" battery Eveready #504	— 15V	.5 oz.
Escapement (Babcock Super Compound)	—	.75 oz.
Installation Kit	—	.75 oz.
Airframe and engine	—	11.00 oz.

Gross flying weight — 24.0 oz.

Note: We suggest eliminating the phone jack and clipping on leads from phones for monitoring.

## Receiver Installation

Having all of the above at hand, roll up your sleeves, ignore all "valuable advice" from your neighbors, and install the receiver.

Referring to the installation diagram page 15:

1. Install the ground bus. Bond all metal parts to it as suggested, use very light flexible wire to bond the control rods to the bus - do not forget the landing gear (use #22 bare). Glue in place to prevent vibration breaking.
2. Install the antenna - this should be flexible wire and should run to the top of the fin. Keep the lead

in as far away from the battery and servo wires as possible. Use a rubber band insulator at the top of the fin to keep antenna tight.

3. Solder 7 wires to the glass plug furnished - we suggest color coded wire as furnished in the installation kit, and connect as shown in the installation diagram. Just follow the diagram and you can't miss.
4. Mount the receiver by means of rubber bands in the 4 holes provided on the case. We suggest that you use more rubber bands and less tension on them so that the receiver has the maximum vibration isolation. Shock restraining thin wall vinylite tubing on rear fitting will provide protection from practically all shocks. (Sufficient is included in BCR-3 Installation Kit).

An additional and recommended method of mounting the receiver in place is to glue a pad of  $\frac{1}{2}$ " soft sponge rubber to the bottom of the receiver and in turn glueing this to the bottom of the fuselage. Rubber cement is necessary.

5. Connect antenna, put in the power plug, turn the switch on, plug in a pair of high impedance phones (not the war surplus ones with the red plug) and listen.

You should hear what is commonly called the "characteristic super regenerative hiss". If you don't hear it, check back over your connections, and check your batteries, particularly polarity, have your tubes checked - one of these is absolutely sure to be it. The receiver's design is such that a tube tester gives accurate results. Don't go digging around inside the receiver with the case off. There isn't anything there that can give trouble.

Next:— We will assume that you have installed batteries in your transmitter. Also plugged in the antenna (see page 8).

Turn the transmitter on while listening in the headphones and tune the receiver until hiss ceases. Next press the transmitter button and a loud clear high pitched tone should be heard in the phones. At this time the escapement should actuate.

Before flying, "fine" tune the receiver at about 100 ft. distance. Remember: The BCR-3 has no "hand capacity" or other "tuning tricks". It works in the air as it works on the bench. No precautions need be taken other than those mentioned heretofore. Remember, haywire and bum connections are the enemy of every aircraft radio installation - (model or otherwise). So lets have none of it. The BCR-3 "fails safe" under any circumstances. And keep in mind that it *won't fail* at all if you keep away from haywire, keep your batteries up, and use a normally careful checkout procedure.

A word about models for Radio Control — We don't recommend any one model for use with our equipment. We however do recommend a model specifically designed for radio control. These models may either be kits or one of the many excellent designs found in Model Airplane Magazines such as "Air Trails" or "Model Airplane News". Any one of them designed to carry one pound of radio equipment (including escapement and batteries) may be used.

## Operation of Transmitter BCT-2

To place the transmitter in operation remove the 4 screws holding the cover on to the case. To install batteries compress the sides of the battery compartment, and the lid will come off in your hand. Place the transmitter face down on the table. Install the "B" batteries (2 XX45 Burgess or 467 Eveready - 67- $\frac{1}{2}$  volts) one on each side of the compartment, and snap their connectors in place. Two large flashlight cells are installed cap down in the appropriate depres-

sions in the metal strip. The cover is then snapped back into place, holding all four batteries securely. Next replace the transmitter in it's case and plug the antenna in thru the grommet in the top of the case. Turn the switch on, and remove the plug button from the panel. Use an appropriate screw driver to tune for maximum brilliance as shown on the radiation indicator. You will notice that as the screw is turned to the right from the full brilliancy condition that the light will suddenly go out. The tuning must be operated at least a half turn to the left from this position. All tuning should be done while holding the transmitter in one hand and using the screwdriver with the other. Do not tune up without holding transmitter. The antenna must be on when tuning. Transmitter will not work without antenna. Replace the plug button. Press the control switch. The radiation indicator should now get quite dim. This is O.K. and normal. The transmitter is now ready for use. *Do not use an antenna either longer or shorter than the one furnished.*

### Technical Data on BCR-3 Receiver

Referring to drawing #816 it will be noted that the receiver is composed of a super-regenerative detector, two stages of audio amplification and a relay control tube. The 3A5 tube is employed as the detector and 2nd audio amplifier. The detector circuit is unique in it's long term stability and ability to operate over a wide range of voltages. The chokes RFC L2 and L3 are self resonant at 27 Mc. R1 is inserted in the antenna lead to prevent resonant effects of the antenna affecting detector operation and has almost no effect on sensitivity. The quench frequency is primarily determined by R3 and C3 (about 85 Kc.). R2 and C5 form a low pass filter for the quench voltage. The detector is extremely stable and has no bad habits, lending itself to uniform quantity production. The overall receiver has a sensitivity of 5 microvolts (five millionths of one volt) for reliable relay

operation with a signal modulated 75% or more. No hand capacity effects are present.

The 1st audio (1U5) and 2nd audio (1/2 3A5) are conventional except for the value of the plate load resistor of the 2nd audio. This resistor has a high value to permit developing the maximum voltage into its load (M1-SR and R-10).

The relay tube (3V4) is operated with a cut off bias of 15 volts. With no carrier and no modulation the audio output is approximately 5 volts (of amplified detector hiss). This is rectified by M1-SR and appears as a  $\pm$  5 volts. However, this leaves a net of 10 volts negative on the grid of the 3V4 and it remains under cut off conditions.

Obviously, with carrier on, unmodulated, the output of the second audio is zero due to the quieting action, and the entire bias appears at the grid of the relay tube. Thus the BCR-3 is completely fail safe. With modulation applied, about 20 volts of audio appears at the rectifier and more than completely offsets the bias, thus effectively grounding the grid of the relay tube enabling it to draw all the plate current of which it is capable.

It is interesting to note that the plate voltage on the 3V4 under these conditions is only about 7 volts. Resistor R11 and Capacitor C13 serve as a filter to eliminate the audio ripple at the grid of the 3V4. Resistor R12 serves as a screen current limiting device when the 3V4 is pulling high plate current. R13 and C15 are employed as arc suppression for the relay contacts.

The relay has a 10,000 ohm coil and while the relay tube is pulling full current (5.5 to 6 Ma.) there is over 1/3 watt of power in the coil. The relay is hermetically sealed, therefore dust free, is adjusted to pull in at not over 3 Ma. and drop out at not under 1.5 Ma. With the arc suppression built in, more than 100,000 operations may be expected and in most cases will exceed one million operations. There is no

tedious relay adjusting. Relay contacts are rated at 2 amp. at 28 volts whereas the normal use in model aircraft is 1/2 amp. at 3 or 4-1/2 volts.

Typical plate current drain of the receiver is as follows: With or without carrier 1.1 Ma. This is the current consumed by the detector and audio. The relay tube plate and screen current is zero. With modulation 8 or 9 Ma. is normal and is composed of 1.1 Ma. for the 3A5 and 1U5 to which is added 6 Ma. for the 3V4 plate, the balance for the 3V4 screen.

It is not recommended that a ship be launched with less than 1.2 volts "A" battery under load *with switch on* - so make allowance on that last flight so that the battery will not get less than 1.1 during the flight duration in which case command may be lost.

The receiver will operate properly with as low as 51 volts (signal on) from the "B" battery but remember that when a 67-1/2 volt battery reaches 52 volts under load you have had good service from it and it is better to replace or charge per drawing #815 than take a chance. The "C" battery is good for shelf life but should be replaced at 12 volts. The servo battery will of course vary with the type of escapement or actuator.

*Note Carefully:* The true condition of the batteries will show up only under "load". "B" battery tests should be made only with both receiver and transmitter on and the modulation button held down. Don't let the fail safe and large voltage tolerance characteristics of the BCR-3 receiver let you get caught with low voltage in the air for if you do, your ship will surely disappear over the horizon if it gets caught in a thermal.

### Technical Data on BCT-2 Transmitter

The BCT-2 transmitter contains a 3A4 crystal controlled regenerative oscillator. The antenna is capacitively coupled

to the plate end of the tank coil by C1. This method provides a good impedance match for the short (36") 1/12 wavelength) antenna. Effectively, the plate of the oscillator is tapped down on the tank coil.

The effective radiated power, under modulated conditions, is about 1/10 watt. The sensitivity of the receiver is such that more power than this is unnecessary. Unmodulated, the radiated power is about 2/5 watt. The 3V4 tube is connected as a clamp tube modulator. The screen is returned to B+ so as to enable modulation percentage to be high (about 85%) and linear. An NE2 neon bulb is connected to serve as a relaxation audio oscillator to drive the grid of the modulator, frequency is 900 cps.

When the control button is up the carrier is on full strength. When it is pressed the modulator draws full plate current on negative modulation peaks and no current on positive peaks. Hence the positive modulation peaks are the equal of the unmodulated carrier (button up).

The radiation indicator dims with modulation because it indicates *average* carrier under modulation. The full carrier is transmitted without modulation to permit the maximum quieting in the receiver and to secure the most resistance to interference. Total "B" current drain is 15-17 Ma. either with or without modulation. The radiation indicator is adjusted to absorb about 1/12 watt.

The range of the system is such that with the model just a speck in the distance, the transmitter has been turned upside down with the *tip* of the antenna 3 inches off the ground and reliable operation has been maintained. "A" battery drain of the BCT-2 transmitter is 320 Ma. at 1-1/2 volts. When the end voltage of the "B" battery of the transmitter becomes less than 110 volts under load, it is a good time to change it.

The "A" battery should not be used with an end voltage of less than 1.1. The same precautions apply here as in the case of the receiver. As noted above, the radiation indicator

dims with modulation. If it goes out completely, it is probable that the oscillator is not operating due to insufficient plate voltage. This can readily be checked with a pair of headphones plugged into the receiver, in which case no tone will be heard, merely the silence caused by radiation of the transmitter carrier.

### Possible Troubles

The ground bus is one of the most important of all installation considerations. Every case of trouble during early experimental flights was traced to improper or inadequate bonding. This cannot be overemphasized. The need for bonding should not be construed as a weakness of design. It is necessary only because of receiver sensitivity which is far greater than any other available receiver which accounts for the great range of this equipment with a low powered transmitter.

To check for the adequacy of bonding, follow steps below:

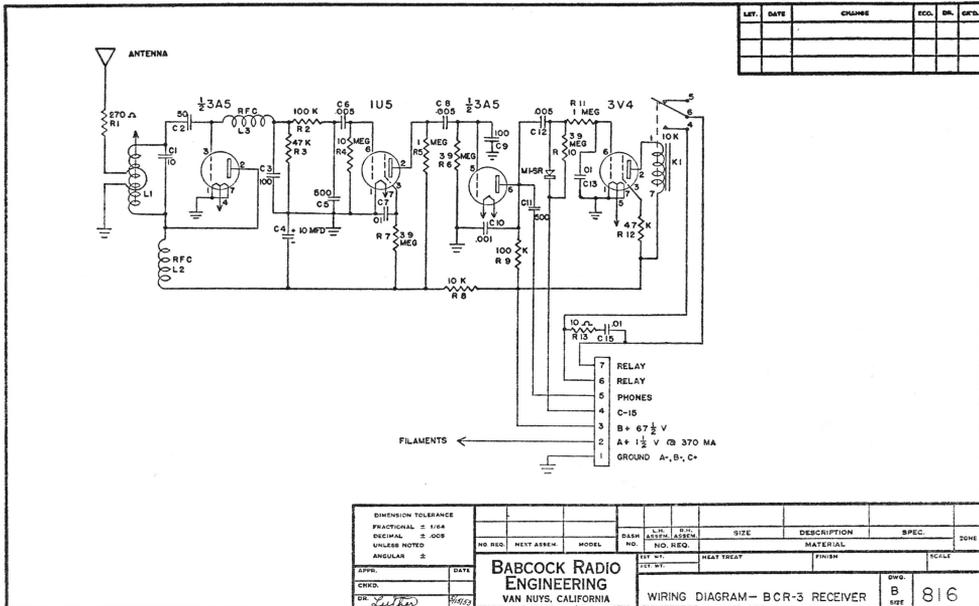
1. Turn receiver and transmitter on, plug in 'phones.
2. Tune for the silent condition of the receiver.
3. Bounce the model up and down, pound on the sides, top and bottom of the fuselage. If any scratching sound is heard in the headphones, look for metal pieces of any kind which are rubbing causing the noise and bond them.
4. Start engine and observe effects of vibration with transmitter both on and off. Escapement should not actuate except by pulse of transmitter being turned on and off.
5. It's now O.K. to fly.

**GUARANTEE** — The equipment as described in this book is guaranteed for a period of 90 days from date of purchase except for tubes. After 90 days a service of \$2.00 plus materials will be made.

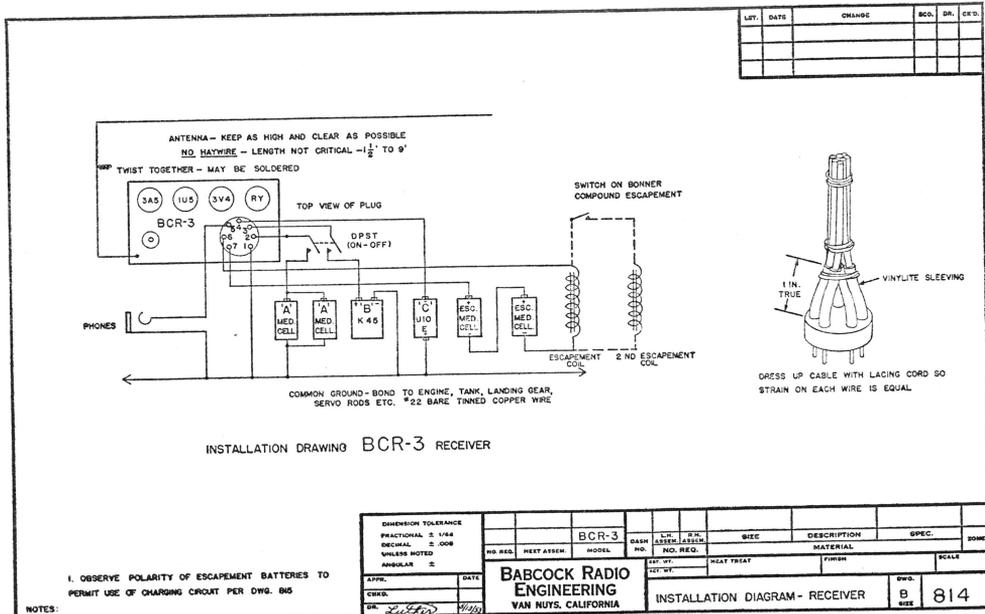


### Price List

BCR-3 Radio Control Receiver . . . . .	\$29.95
BCT-2 Radio Control Transmitter . . . . .	39.95
BCR-3 Receiver Installation Package . . . . .	2.95
Babcock Super Compound Escapement . . . . .	7.95

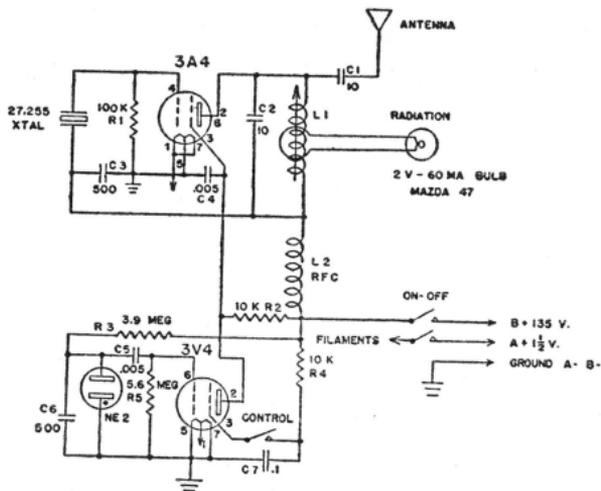


WIRING DIAGRAM - BCR-3 RECEIVER



INSTALLATION DIAGRAM - RECEIVER

LET.	DATE	CHANGE	REQ.	DR.	CHK'D.



DIMENSION TOLERANCE		NO. REQ.		MKT. ASSEM.		MODEL		DASH NO.		L.C. ASS'Y. NO.		S.H. ASS'Y. NO.		SIZE		DESCRIPTION		SPEC.		ZONE	
FRACTIONAL $\pm 1/64$																					
DECIMAL $\pm .005$																					
UNLESS NOTED																					
ANGULAR $\pm$																					
APPR.	DATE	EST. WT.		HEAT TREAT		FINISH		SCALE		MATERIAL											
CHKD.		20% WT.																			
DR.																					
<b>BABCOCK RADIO ENGINEERING</b> VAN NUYS, CALIFORNIA										WIRING DIAGRAM - BCT-2 TRANSMITTER DWG. B 818 SIZE											

WIRING DIAGRAM - BCT-2 TRANSMITTER