Operating Instructions

for

Bliley CCO ... Model [redacted] 1C

Bliley

CRYSTAL CONTROLLED OSCILLATOR

CRYSTAL CONTROLLED OSCILLATOR

for

RADIO SERVICE TECHNICIANS

CAUTION
USE ONLY
110 VOLTS
AC OR DC

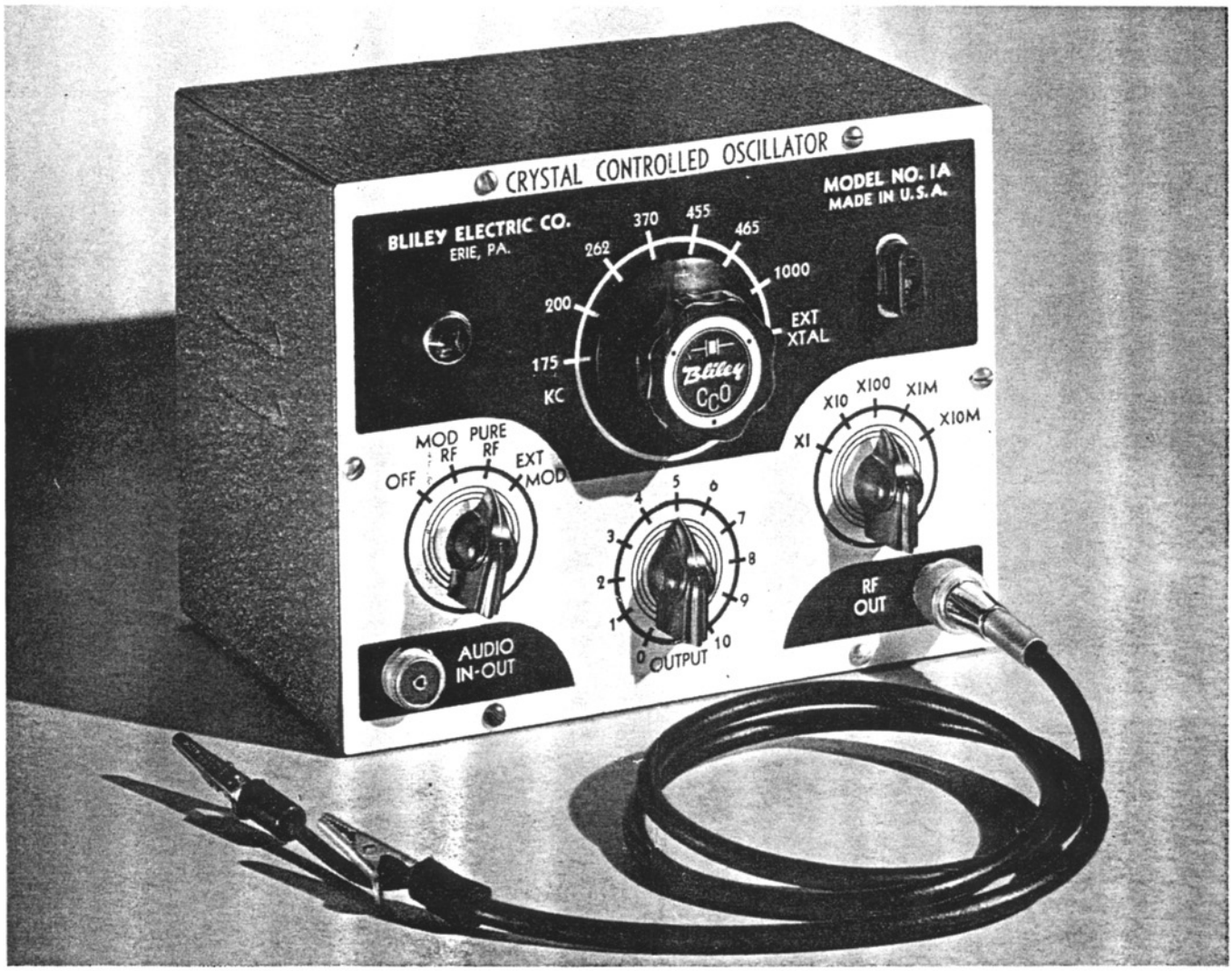
BLILEY ELECTRIC CO. ERIE, PA. U. S. A.

Form PF91-2M-11-46

Printed in U. S. A.

Blank Page

BLILEY CCO . . . CRYSTAL CONTROLLED OSCILLATOR



MODEL 1A

GENERAL DESCRIPTION

The Bliley CCO . . . Model 1A, is designed to provide the radio technician with a highly stable source of radio frequency voltage at the most commonly used frequencies. These frequencies are controlled directly by quartz oscillating crystals. Factors such as temperature change, humidity change, aging, vibration, and dust, which cause ordinary self excited oscillators to deviate from their calibration, have little or no effect on the crystals.

IF CHANNELS

The oscillator provides five Intermediate frequencies selected with a knob on the front panel. These five frequencies: 175, 262, 370, 455, and 465 Kc. are the most commonly used IF's in standard broadcast receivers. The serviceman can therefore handle at least 95% of his IF alignment with crystal controlled accuracy.

RF CHANNELS

Two frequencies are incorporated for use in aligning the radio frequency stages in receivers. They are 200 Kc. and 1000 Kc. The 200 Kc. crystal produces strong harmonics up as high as 10,000 Kc. although its primary usefulness lies in the harmonics which fall in the broadcast band. These

are 600, 800 1000, 1200, 1400, and 1600 Kc. The 600 and 1400 Kc. frequencies are used in padding the low and high frequency ends of the receiver dial, while the other frequencies are useful in checking the dial calibration.

The 1000 Kc. signal is also for use in aligning the short wave bands of receivers. Its harmonics are useful up to 20,000 Kc. on broadcast type receivers and up to 50,000 Kc. on the more sensitive receivers, such as the types used for communications.

FM RECEIVERS

The Bliley CCO may also be used in the alignment of FM receivers. To do this it is necessary to purchase two additional crystals which plug into the external crystal socket on the front panel. One of these crystals is for IF alignment and must be at one half the standard FM intermediate frequency, or 5.35 megacycles. The other crystal is for RF alignment and should be at 5 megacycles in order to provide harmonics every 5 Mc. through the FM band. Thus, there will be signals at 90, 95, 100, and 105 megacycles in the FM band.

OUTPUT CONTROL

The Bliley CCO incorporates a five step output attenuator with a vernier control at each step. This affords smooth control of the RF output all the way from minute voltages up to the high output of which the oscillator is capable, approximately 15 volts across an impedance of 150,000 ohms. Although such high output is not essential in most instances, it is advantageous in cases of extreme misalignment.

MODULATION CONTROL

The modulation switch on the panel provides for choice of pure RF, internally modulated RF, or externally modulated RF output. An audio oscillator produces a 400 cycle tone on the internal modulation. This tone modulates the oscillator about 50% on all channels except the 1000 Kc. On the 1000 Kc. channel modulation is close to 100% in order to produce good tone strength at the high harmonics. Crystals with frequencies between 1000 and 7000 Kc. inserted in the external socket will also be modulated 100%.

When the selector switch is in "PURE RF" position no modulation appears on the RF output. Instead, the internal 400 cycle tone appears at the audio jack on the left side of the panel. By coupling to this jack with the output cable, the audio may be used in tracing through audio circuits. The 400 cycle tone has an RMS value of about 7½ volts.

In "EXT MOD" position, the oscillator may be modulated by an external signal with a frequency from 30 to 10,000 cycles. An RMS value of 7½ volts will modulate the 1000 Kc. channel 100%, while about 15 volts is necessary for full modulation of the lower frequency channels. One of the uses to which the external modulation feature may be put is the testing of phono pick-ups. By coupling the pick-up to the audio jack, setting the switch to "EXT MOD" and tuning in one of the RF channels on a receiver, the pick-up can be quickly checked for performance. Since modulation of the crystal oscillator does not produce excessive frequency swing, or carrier shift, fidelity will be excellent.

CIRCUIT DISCUSSION

In Figure #1 is shown a schematic diagram of the Bliley CCO circuit. There are two tubes used, a 12SK7 oscillator, and a 35Z5GT rectifier. In addition, a ¼ watt neon bulb serves as the audio oscillator.

The 12SK7 oscillator circuit is designed to operate over a range from 150 to 7000 Kc. In order to secure isolation of the oscillator from the output circuits, the screen grid of the 12SK7 serves as oscillator anode, and electron coupling to the plate provides the necessary transfer of RF energy to the output. Thus there is no danger of fracturing the crystals by accidental application of voltage to the output cable.

Modulation of the oscillator is accomplished by the suppressor grid. The modulating signal being supplied by a simple neon tube relaxation type oscillator operating at about 400 cycles.

Output controls incorporate a five step attenuator switch and a continuously variable potentiometer. The potentiometer couples the output of the 12SK7 plate circuit to the attenuator network, which is designed to produce approximate multiples of ten between steps. Output across the shielded cable may be varied from zero to approximately 15 volts with the attenuator switch and potentiometer. Due to the strong signal produced by the crystal oscillator, there may be in-

stances where the signal cannot be reduced to zero in the receiver when attenuator controls are set to zero. This is caused by slight radiation from the oscillator cabinet, which is transmitted along the output cable even though no signal appears from the inner conductor to the shield. This difficulty will be encountered only when the output cable is coupled tightly to the receiver. Grounding the oscillator externally will reduce this radiation. For these reasons it is recommended that the oscillator be coupled loosely except in cases where misalignment or loss of sensitivity in the receiver call for a strong input signal.

Direct current to the oscillator is furnished by the 35Z5GT rectifier. The circuit being a conventional AC-DC type with the common negative bus floating above the chassis. This allows the chassis and cabinet to be grounded externally, eliminating the danger of shocks so commonly associated with AC-DC circuits. The heaters are connected in series across the line with an internal bleeder resistor dropping the current to specified limits.

MAINTENANCE

Due to the simplicity of design and construction, and since all components are operated at reduced ratings to insure long life no trouble should be experienced with the Bliley CCO. In the event of failure, standard test procedure may be used on the chassis to determine the cause. The pilot light on the instrument is shunted by a fixed resistor so that failure of the lamp will not interrupt operation.

If it is necessary to remove any crystals due to failure, this can be accomplished by detaching the backing plate after which the crystals can be removed from their sockets. A defective crystal may be returned through your Bliley distributor or direct to the factory for repair.

DO NOT ATTEMPT TO OPEN CRYSTAL UNITS. WARRANTY WILL BE VOID IF CRYSTAL SHOWS EVIDENCE OF TAMPERING.

Warranty

Your Bliley CCO has been carefully tested and is warranted free from all electrical and mechanical defects on date of purchase. Performance in accordance with the operating and instruction manual is warranted for six months after purchase, and free replacement or repair of any component or the entire unit will be made in the event of failure due to faulty manufacture.

This warranty does not apply to any CCO which shall have been repaired or altered outside of our plant in any way so as, in judgment, to affect its stability or reliability, nor which has been subject to misuse, negligence or accident.

The Manufacturer reserves the right to make changes in design or add improvements to the instruments manufactured at any time without incurring any obligation to install same in instruments previously purchased.

All instruments returned under this warranty should be sent to the Manufacturer with charges prepaid. After repairs have been completed the instrument will be returned all charges prepaid by the Manufacturer.

Bliley CCO . . . Crystal Controlled Oscillator

OPERATING INSTRUCTIONS

PRELIMINARY

1. The Bliley CCO operates on 110 volts AC or DC. Its power consumption is approximately 17 watts. The modulation control also serves as power switch with the "OFF" position breaking the 110 volt line.

2. The tube heaters are supplied with current through a series resistor which is mounted within the cabinet. There is no resistance included in the line cord.

3. The pilot lamp serves as an indicator that power is on. However, it is shunted by a resistance so that failure of the lamp will not interrupt operation of the CCO.

4. To place the unit into operation, plug the line cord into a 110 volt receptacle, and turn the modulation control to the desired position. The oscillator does not require a warm up period any longer than the tubes take to begin functioning. It may be turned off after each period of use if desired.

5. In some installations there may be an objectionable amount of AC "hum" present on the signal from the oscillator. This can be eliminated by simply reversing the 110 volt plug from the oscillator.

6. The crystals included in the Bliley CCO are not subject to any deterioration through use. They will last indefinitely, whether they are oscillating continuously, or not being used at all.

IF ALIGNMENT

1. Disconnect the antenna from the receiver, set the tuning dial to the high frequency end, and turn the volume control up to maximum.

2. Set the modulation control of the Bliley CCO to "MOD RF" and the channel selector to the intermediate frequency of the particular receiver being aligned. If the receiver is listed at 456 Kc. use the 455 channel, or if it is listed at 260 Kc. use the 262 channel. In the few instances where odd IF's are listed, they may be aligned at the nearest channel. For example, 460 or 470 Kc. IF's may be aligned with the 465 channel. As mentioned previously, this difficulty will be encountered in only five per cent of the receivers. Although using a channel 5 Kc. away from the one recommended by the manufacturer will result in deviation from perfect tracking and dial calibration, it will not be serious. A difference of more that 5 Kc. should be avoided.

3. Place the output cable from the Bliley CCO near the antenna lead or post of the receiver, and advance the attenuator controls until the 400 cycle tone is heard faintly. If it cannot be heard with the controls set at maximum, clip the red output lead to the antenna lead or post. If the tone strength is too great, reduce the CCO output until the tone is just audible. Always leave the receiver volume on full.

4. With the tone just audible, adjust the IF trimmers for maximum tone strength. As the strength builds up, continue to back down on the attenuator controls. If the output lead is clipped directly to the antenna lead, it may be necessary to remove it during final IF adjustment.
   It is important that the tone be very faint during final adjustment. The attenuator control should be backed down until the tone is only about as loud as the "rush" or background noise in the receiver.

5. A convenient method of coupling the Bliley CCO to receivers is to use a short length of wire running along the bench as a radiator. By clipping the oscillator output to this wire, it will be possible to align practically all receivers on the bench without additional coupling.
   Caution: The length of the wire should not be more than three or four feet. One longer than this will radiate sufficient energy to cause interference.

RF ALIGNMENT

A—Broadcast Band

1. Set the channel selector of the Bliley CCO to 1000 Kc., the modulation control to "MOD RF", the attentuator switch to "X100" and the vernier to maximum.

2. Turn the receiver volume control to maximum, and tune the dial to the vicinity of 1000 Kc. until the 400 cycle tone is heard. If it does not come in, advance the attenuator control until it does. Then back the output vernier down until the tone is about medium volume. Leave the receiver volume control on full at all times.

3. Now switch the CCO over to the 200 Kc. channel. With the receiver dial left at the same point where the 1000 Kc. comes in, the 200 Kc. channel will also be heard. This is the fifth harmonic of 200 Kc.

4. By tuning the receiver dial up toward the high frequency end, another point will be found where a tone is heard. This point is the 200 Kc. sixth harmonic at 1200 Kc. Continue to tune higher until the next signal is found. This one is the seventh harmonic at 1400 Kc. The chart of Figure #2 illustrates these harmonics. The upper scale shows the 1000 Kc. channel's fundamental and second harmonic respectively, while the lower scale shows the 200 Kc. channel's fundamental and its harmonics up through the tenth at 2000 Kc. It can be seen that the fifth harmonic of the 200 Kc. coincides with the 1000 Kc. channel, and its tenth harmonic coincides with the second harmonic of the 1000 Kc. at 2000 Kc.

5. Previously we located the 1000 Kc. point on the receiver dial and followed the 200 Kc. harmonics up to the 1400 Kc. point. This signal should come in at the 1400 Kc. mark on the dial. If it does not, adjust the high frequency padder until it does.

6. With 1400 Kc. signal now coming in at the 1400 Kc. mark on the dial, adjust the antenna and RF trimmers for maximum signal. If the tone comes up to very great strength, back the attenuator controls of the CCO down until the tone is weak. Then re-adjust the antenna and RF trimmers for maximum signal strength.

7. Now follow the 200 Kc. harmonics down the dial, counting off the 1200, 1000, 800, and 600 Kc. points. The 600 Kc. signal should come in at the 600 Kc. mark. To bring it to this point, adjust the low frequency padder.

8. Return the receiver dial to the 1400 Kc. signal and check its setting. If the low frequency padder had to be changed much, it may be necessary to reset the high frequency padder.

9. When the 600 and 1400 Kc. points have thus been adjusted with crystal controlled accuracy, outside stations will fall into their correct dial positions, and the receiver's sensitivity will be uniform throughout the range, provided that IF channel has been aligned properly.

RF ALIGNMENT

B—Shortwave Bands

1. The exact procedure to be followed in the alignment of short wave bands will be determined largely by the frequency coverage of the bands, and the manufacturer's instructions for alignment. The 1000 Kc. channel of the Bliley CCO will prove most useful. It produces harmonics up to 20,000 Kc. on broadcast type receivers, and up to 50,000 Kc. on the more sensitive types, such as those used in communications. On the new VHF receivers harmonics can be detected up to 150 Mc. although, since they are only 1 Mc. apart, their usefulness is limited. In special applications it may be desirable to use external crystals in short wave alignment. These may be inserted in the socket provided on the panel of the CCO. Crystals up as high as 7000 Kc. may be used. As an example, if a 5000 Kc. crystal is inserted in the external socket, and the channel selector set to "EXT XTAL", then harmonics will occur every 5 Mc. and may be detected up as high as 200 Mc. For information on the alignment of FM receivers see, "FM Alignment" on page 8.

2. On a medium shortwave band, one which tunes from about 1700 to 5000 Kc., there should not be any difficulty in identifying the 1000 Kc. signals. Starting from the low frequency end, the first signal will naturally be the second harmonic, or 2000 Kc. and from this point up to the high frequency end there will be a signal every 1000 Kc. or one at 3000, 4000, and 5000 Kc. These 1000 Kc points may be used for adjustment of the high frequency

padder, and also the low frequency padder, if one is provided. With a range of 1700 to 5000 Kc. the 4000 Kc. signal should be used for adjustment of the high frequency padder, and the 2000 Kc. point for adjustment of the low frequency padder. In general, whatever the range may be, the 1000 Kc. points which occur about one-fourth of the way in from each end of the dial should be used for the padder adjustments. This is illustrated by the chart of Figure #3. Ordinarily there is no padder for the low end of the short wave bands. In this case only padding of the high end is required, and this is done at the point illustrated.

3. On the high frequency band there will be a need for identifying the 1000 Kc. harmonics. If the receiver adjustments are very far off, it is possible that the 7 Mc. signal, for example will be close to the 6 or 8 Mc. mark on the dial. In order to make a check, the 175 Kc. channel may be used as follows:

   Locate the 1000 Kc. harmonic which comes closest to the 7 Mc. mark on the dial. Then switch over to the 175 Kc. channel on the Bliley CCO. If the tone from the CCO comes in at the same setting of the dial, then this signal is at 7 Mc. The tone will be a little weaker, but it will be at exactly the same place as the harmonic of the 1000 Kc. channel. If no tone appears when the CCO is switched to 175 Kc. then the harmonic is not 7 Mc. It is probably either 6 or 8 Mc. Tune to an adjacent harmonic of the 1000 Kc. channel and repeat the check with the 175 Kc. signal, until the point is found where the 1000 Kc. and 175 Kc. channels both produce a signal on exactly the same dial position. This position is 7 Mc. Once the 7 Mc. position is located, then all the other integral megacycle positions can be located by counting 1 Mc. harmonics up or down from the 7 Mc. signal.

   The method described above may also be used for locating the 14 Mc. position. At 14 Mc. a signal will be heard from either the 1000 Kc. or the 175 Kc. channel at exactly the same dial reading. Once either the 7 or the 14 Mc. position is determined, the padding frequency can be located and adjustment made to bring the dial into calibration. In the example of Band C in Figure #3, this padding frequency is 14 Mc. so when the 14 Mc. signal from the CCO has been found, the padder should be adjusted until the signal comes in at the 14 Mc. calibration on the dial.

4. When the padder for the high frequency end of the band has been adjusted, that is, when the 1 Mc. harmonics are coming in at the correct dial positions, then the antenna and RF trimmers should be adjusted for maximum signal. This should be done at the same frequency used for the high end padding. In the example of Figure #3, on Band B the antenna and RF trimmers will be adjusted at 4 Mc. and on Band C at 14 Mc. As in the case of broadcast band alignment, the receiver volume should be on full, and the CCO output set to produce just a faint signal.

FM ALIGNMENT

A—IF Channel

1. A 5.35 Mc. crystal is required to align the standard 10.7 Mc. IF stages of an FM receiver. Actually its second harmonic is the signal frequency. The crystal is inserted in the socket on the panel of the CCO, and the channel selector is set to "EXT XTAL".

2. Using the signal from this crystal, align the receiver IF's according to manufacturer's instructions. Coupling from the oscillator to the receiver may be done in the same way as for standard broadcast alignment.

B—RF Alignment

1. A 5 Mc. crystal is necessary to align the RF stages of any FM receiver tuning in the range 88—108 Mc. This crystal is inserted in the socket on the panel of the CCO and the channel selector is set to "EXT XTAL".

2. Harmonics of the 5 Mc. crystal will occur at 90, 95, 100 and 105 Mc. all within the band. Since there are just four harmonics in the band there will not be any difficulty in identifying them.

3. These harmonics may be used in aligning the RF stages according to the manufacturer's instructions.

AUDIO SIGNAL TRACING

1. The internal audio tone of 400 cycles supplied by the Bliley CCO may be used in tracing through the audio circuits of a receiver or audio amplifier. When the modulation control is set to "PURE RF" the internal audio

appears at the audio jack on the left side of the panel. The audio output has an amplitude of approximately 7½ volts at an impedance of about 500,000 ohms.

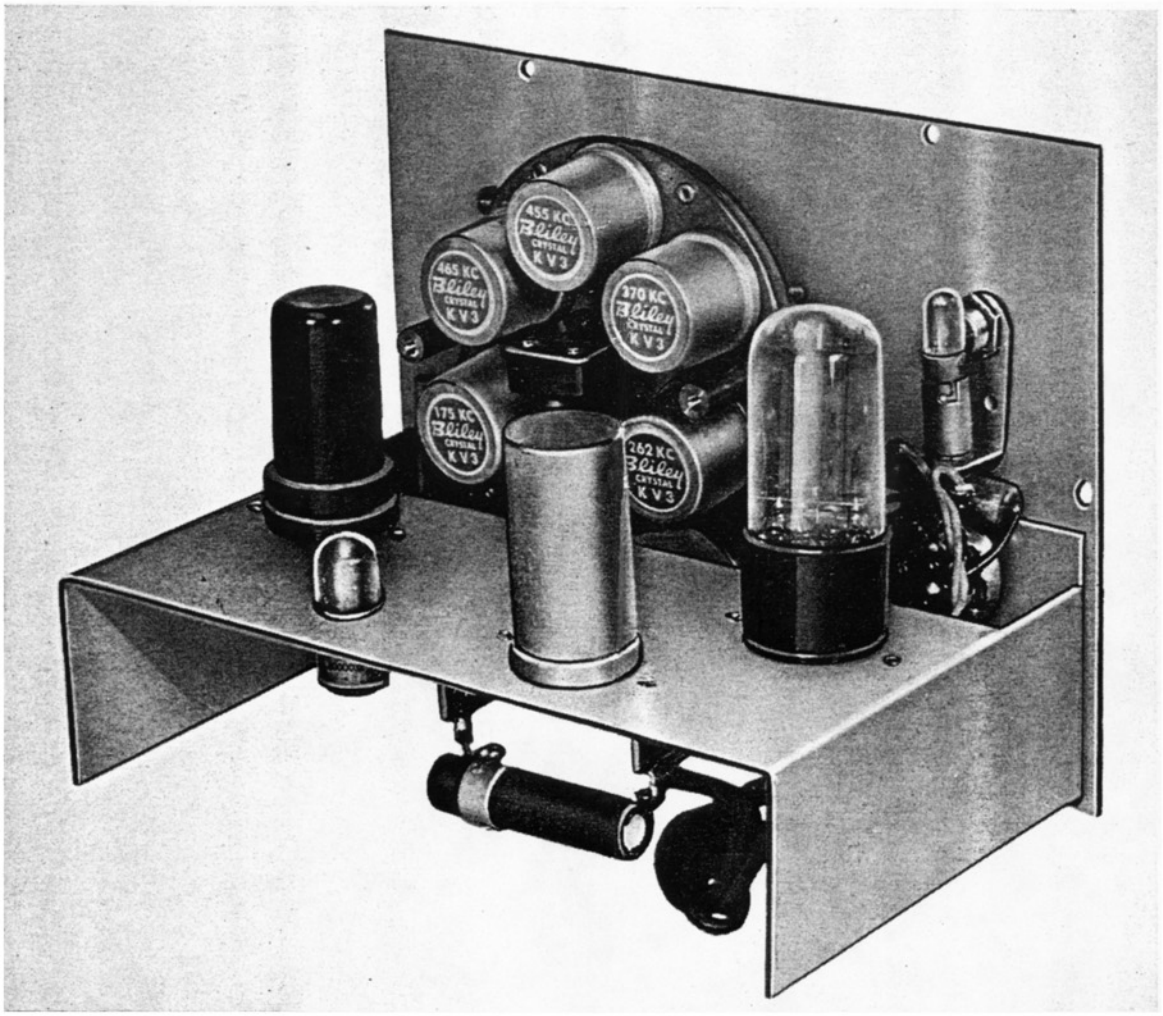
2. To check the audio circuits, set the modulation control to "PURE RF" connect the output cable to the audio jack attach the black clip of the cable to the chassis or common negative terminal of the circuits to be tested, and use the red clip as a probe.

EXTERNAL MODULATION

1. Provision is made for modulating the crystal controlled oscillator with an external audio voltage. This voltage is coupled into the audio jack on the panel, with the modulation control set to "EXT MOD". An RMS voltage of about 7½ is required for 100 per cent modulation of the 1000 Kc. channel. However, values as low as 2 volts will produce good modulation with excellent fidelity.

2. Phono pick-ups of the high impedance type may be tested quickly by using the external modulation position. Simply connect the pick-up to the audio jack, either with the cable supplied with the oscillator, or an extra adapter, and monitor the oscillator output in a receiver. The 1000 Kc. channel will be found most convenient for this work, although any of the others will function. The fidelity of reproduction will be dependent on the quality of the receiver used for the monitor. Therefore, it is best to use a good receiver in checking pick-ups.

3. Low impedance pick-ups may be tested by inserting a matching transformer between the pick-up and the audio jack. Since most pick-ups are of the high impedance type, there will be little call for such a transformer.



Rear View Bliley . . . CCO with Cabinet Removed

BLILEY CRYSTAL CONTROLLED OSCILLATOR

12SK7

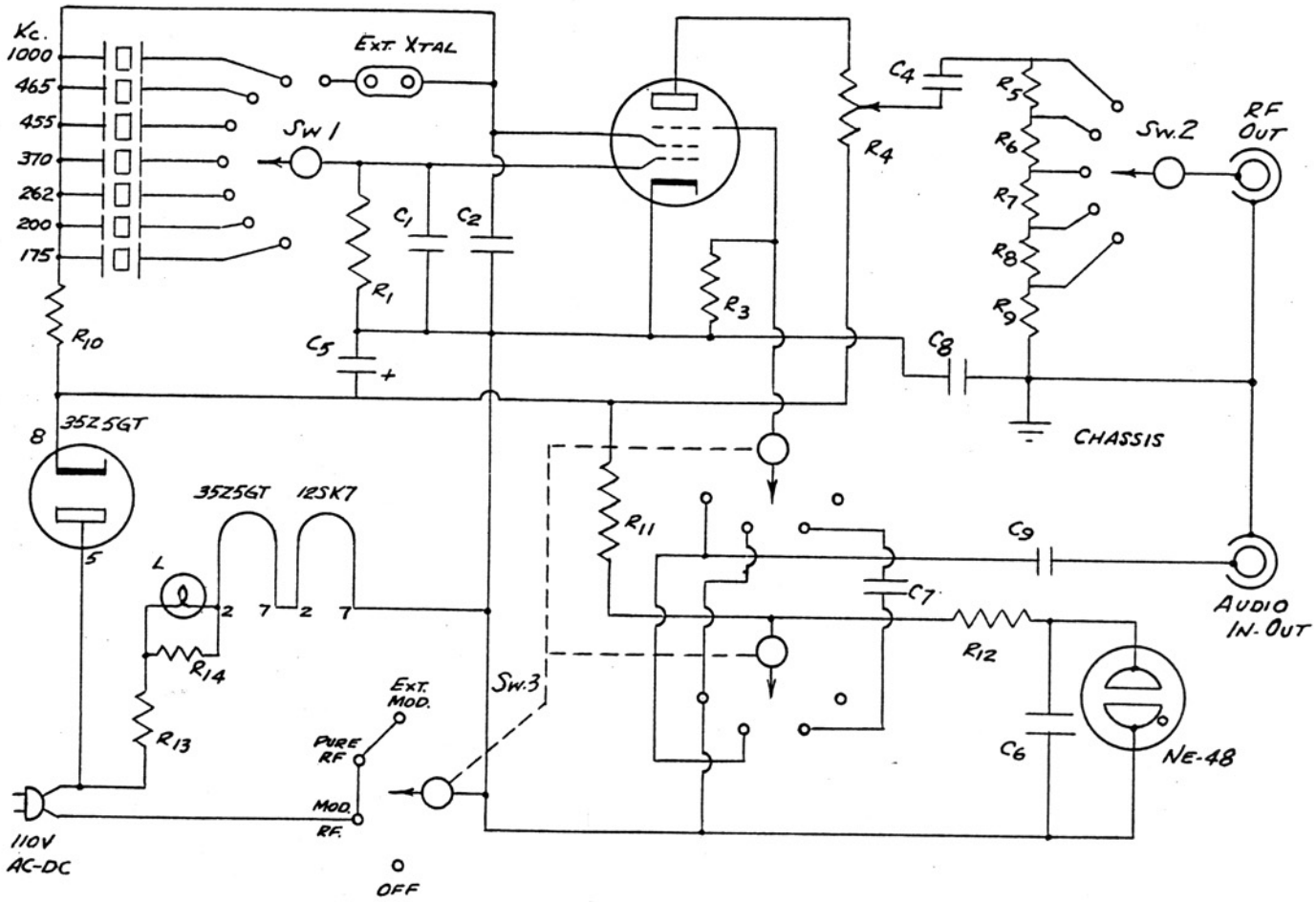


Figure #1—Schematic Diagram

			(all 20% tolerance)
R_1	220 M ohms ½ W.	C_1	50 mmf. mica 10%
R_3	470 M ohms ½ W.	C_2	100 mmf. mica 10%
R_4	25 M ohms Potentiometer	C_4	.002 mfd. mica 20%
R_5	100 M ohms ½ W.	C_5	16.0 mfd. 250 v. Electrolytic
R_6	47 M ohms ½ W.	C_6	.002 mfd. mica 20 %
R_7	1000 ohms ½ W.	C_7	.02 mfd. 400 v. 20%
R_8	100 ohms ½ W.	C_8	.1 mf. 400 v. 20%
R_9	4.7 ohms ½ W.	C_9	.02 mfd. 400 v. 20%
R_{10}	33 M ohms 1 W.	Sw. 1	1 Circuit 8 Positions
R_{11}	1 megohm ½ W.	Sw. 2	1 Circuit 5 Positions
R_{12}	1 megohm ½ W.	Sw. 3	3 Circuits 4 Positions
R_{13}	500 ohms 20 W.	L	6.3 v. .15 amp. Lamp
R_{14}	100 ohms 1 W.		

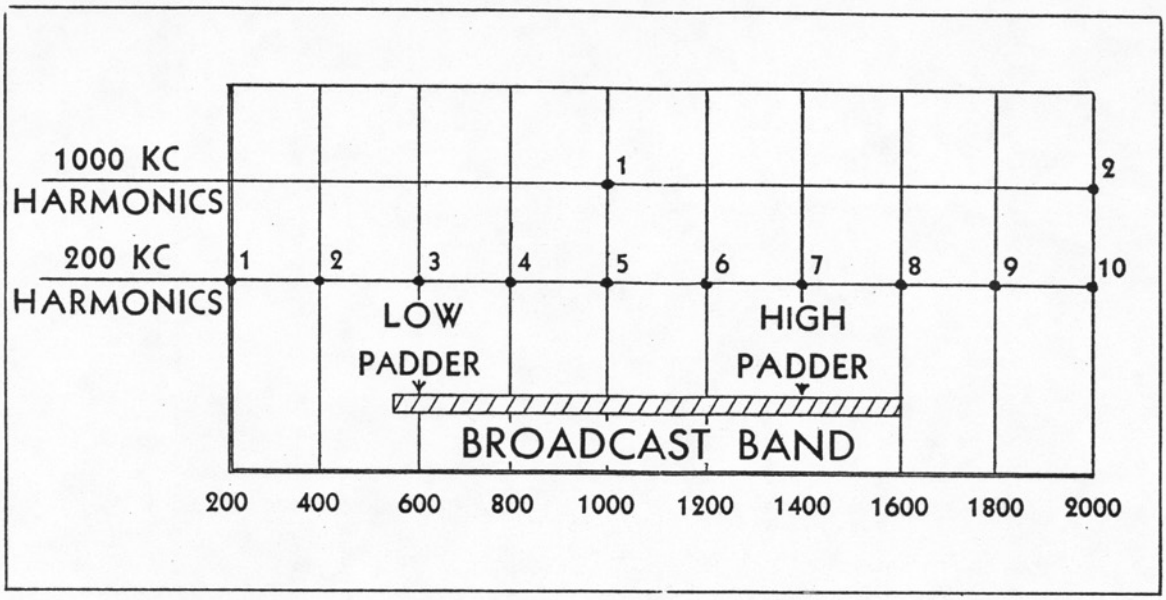


Figure #2—Illustrating the relationship between the broadcast band, and harmonics of the 200 Kc. and 1000 Kc. channels.

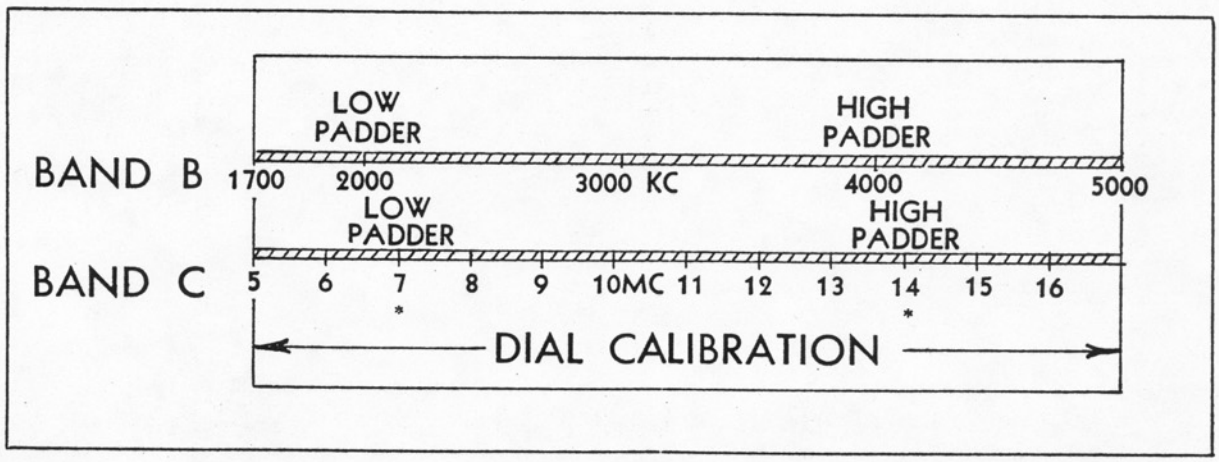


Figure #3—A typical example of dial calibration on medium and short wave bands, showing where the high and low frequency padder adjustments should be made.

**These are the points where harmonics from the 175 and 1000 Kc. channels coincide.*

April 25, 1947

ERRATA SHEET

OPERATING INSTRUCTIONS
for
BLILEY CCO .....MODEL 1 C

All references to Model 1-A should be changed to Model 1-C.

Page 4 -----"Output Control", Paragraph #1, Line #6.

Change voltage from 15 volts to 7 volts.

Page 4 -----"Modulation Control", Paragraph #2, Line #8.

Change RMS voltage from 7-1/2 volts to 75 volts.

Paragraph #3 changed to read:

In "EXT MOD" position, the oscillator may be modulated by an external signal with a frequency from 50 to 5000 cycles. An RMS value of 1-1/2 volts will modulate the RF output about 50%, while 3 volts is necessary to modulate 100%. One of the uses to which the external modulation feature may be put is the testing of phono pick-ups. (Remainder of paragraph is as printed)

Page 4 -----"Circuit Discussion", Paragraph #1 changed to read:

In Figure #1 is shown a schematic diagram of the Bliley CCO circuit. There are two tubes used, a 12SK7 oscillator, and a 12SL7GT combination rectifier and audio oscillator.

Paragraph #3 changed to read:

Modulation of the oscillator is accomplished by Heising coupling to the plate circuit. Internal modulation of 400 cycles is supplied by an audio oscillator using one half of the 12SL7GT twin triode tube.

Paragraph #4, Line #8.

Change voltage from 15 volts to 7 volts.

Page 5 ----- "Circuit Discussion", Change Paragraph #6 to read:

Direct current to the oscillator is furnished by one half of the 12SL7GT tube. The circuit is a conventional AC-DC type with a common negative bus floating above the chassis. This allows the chassis to be grounded externally. The heaters are connected in series across the line with an internal bleeder resistor dropping the current to specified limits. An RF line filter reduces the feedback of RF from the oscillator back through the power line to a negligible value.

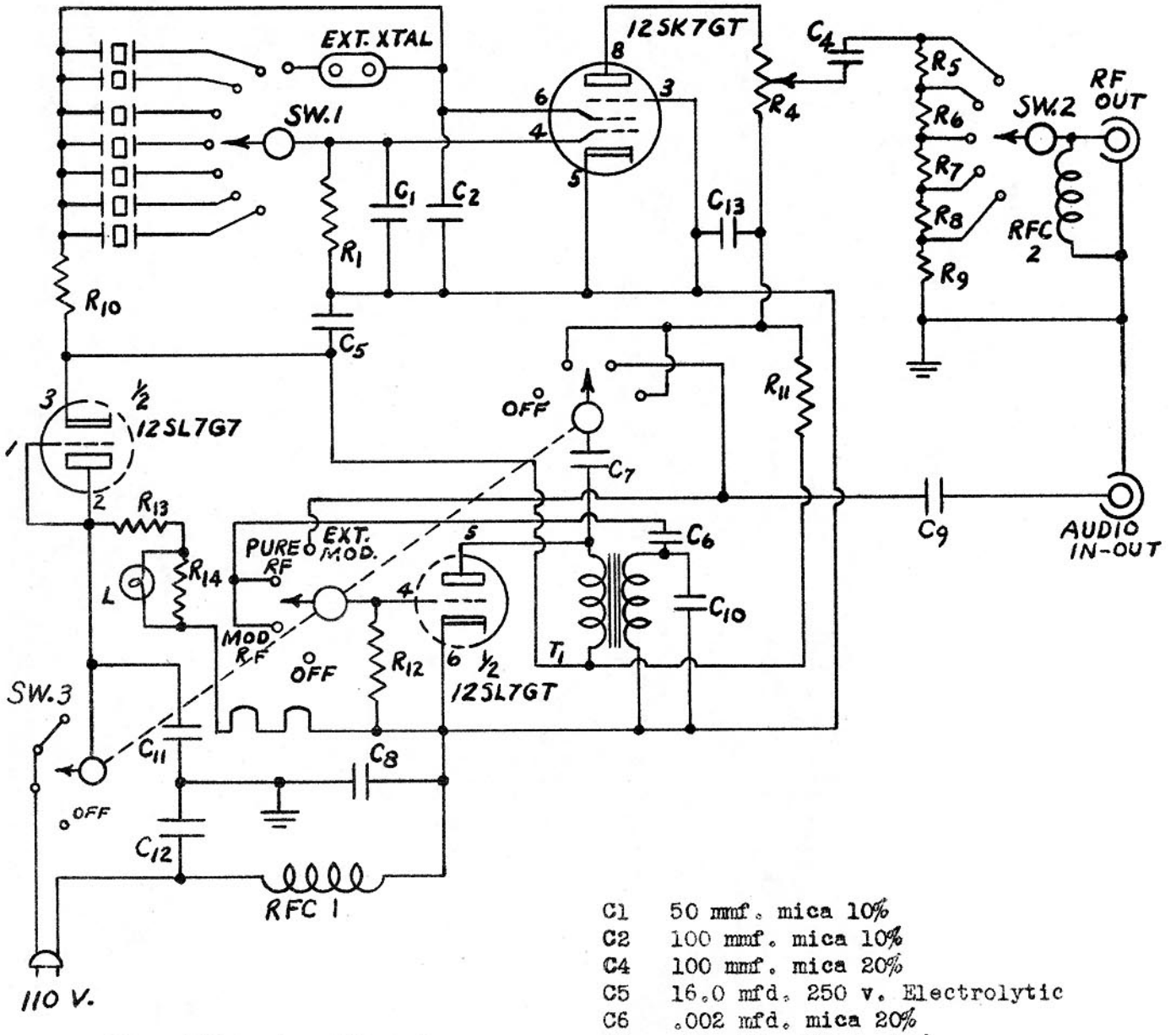
Page 9 -----"Audio Signal Tracing", Paragraph #1, Line #8.

Change voltage from 7-1/2 volts to 75 volts.

Page 9 -----"External Modulation", Paragraph #1, Line #6.

Change voltage from 7-1/2 volts to 3 volts.

BLILEY CRYSTAL CONTROLLED OSCILLATOR
MODEL IC



R1	220 M ohms 1/2 watt
R4	25 M ohms Potentiometer
R5	100 M ohms 1/2 watt
R6	47 M ohms 1/2 watt
R7	1000 ohms 1/2 watt
R8	100 ohms 1/2 watt
R9	4.7 ohms 1/2 watt
R10	33 M ohms 1 watt
R11	68 M ohms 1/2 watt
R12	220 M ohms 1/2 watt
R13	500 ohms 20 watt
R14	100 ohms 1 watt

(all 20% tolerances)

RFC1 8 mh. Choke
RFC2 2.1 mh. Choke

C1	50 mmf. mica 10%
C2	100 mmf. mica 10%
C4	100 mmf. mica 20%
C5	16.0 mfd. 250 v. Electrolytic
C6	.002 mfd. mica 20%
C7	.02 mfd. 400 v. 20%
C8	.1 mfd. 400 v. 20%
C9	.02 mfd. 400 v. 20%
C10	.02 mfd. 400 v. 20%
C11	.1 mfd. 400 v. 20%
C12	.1 mfd. 400 v. 20%
C13	.02 mfd. 400 v. 20%

T1 1: 1.5 Audio Transformer

Sw. 1. 1 Circuit 8 Positions
Sw. 2 1 Circuit 5 Positions
Sw. 3 3 Circuits 4 Positions

L 6.3 v; .15 amp. Lamp