

# E-200D ALIGNMENT

**NOTE:** This is not an official B&K alignment procedure. This procedure was created by experimenting with an E-200D. However when this procedure is followed, the resulting calibration should be very close.

See the end of the procedure for the location of the calibration points.

## EQUIPMENT REQUIRED

- Frequency counter
- Oscilloscope
- RF millivoltmeter
- Plastic hex-shaped alignment tool (see text)

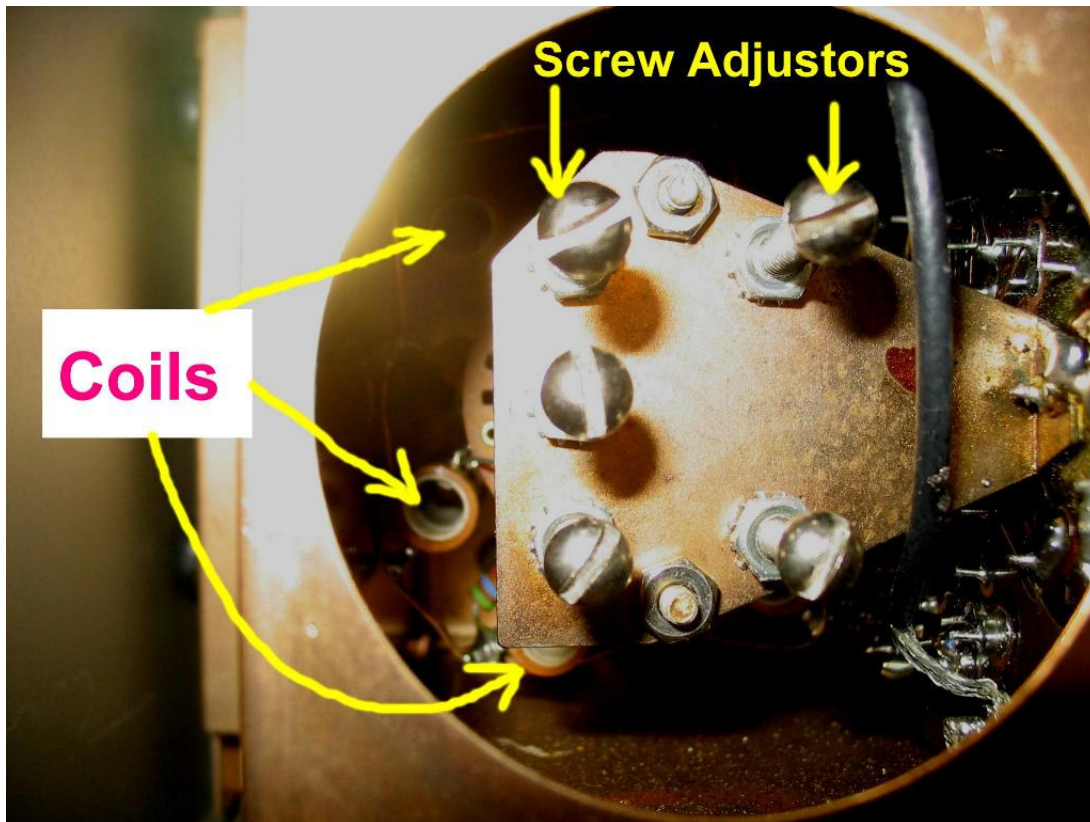
## PRELIMINARY

1. Remove the cover from the generator.
2. With generator off, adjust the mechanical zero of the meter.
3. Turn on the generator, allow a 15 minute warm-up.

## FREQUENCY ADJUSTMENT

1. Connect a frequency counter to the generator output.
2. Set controls as follows:
  - XTAL CALIBRATOR set to OFF
  - MODULATION set to CW
  - 6db attenuator switch IN, all others OUT
  - METER set to CARRIER
  - Adjust the FINE ATTENUATOR so the meter reads 0db
  - There is an "offset knob" at the top of the frequency dial, which adjusts the cursor left and right. Adjust this knob to the center position (the mark should be at the 12:00 position).
3. Pry off the large silver plug to expose the frequency adjustments. Just inside you will see 5 screw adjustors. These are trimmer capacitors. On older units the screw adjustors look like machine screws, and on newer units they are traditional ceramic trimmer capacitors. Farther in back you will see 5 coil adjustors. Refer to the diagram. A plastic hex-shaped alignment tool is needed to adjust the coils, available from electronic suppliers. You could use a metal hex wrench, but you must withdraw the wrench to observe the results of your adjustment.

The adjustors for band A are in the upper-right corner (both the screw adjustor and the coil). Bands B through E are in sequence, going counter-clockwise.



The frequency for each band is adjusted in the same manner, using the corresponding screw and coil for each band. Start with band A and continue through band E. The coil is for adjusting the low end of the band, and the screw is for adjusting the high end of the band. Repeat steps a-g for each band as listed below:

- Set the Range switch to the desired band.
- Set the frequency dial to the coil adjustment frequency.
- Adjust the coil for the proper reading on the frequency counter.
- Set the frequency dial to the screw adjustment frequency.
- Adjust the screw for the proper reading on the frequency counter.
- The coil and screw adjustments will interact. If you adjust one, be sure to re-check the other. You may need to go back-and-forth several times.
- Check a couple frequencies throughout the range. You may need to readjust the coil and screw to get the best dial accuracy throughout the range. The specification for dial accuracy is  $\pm 1.5\%$  of the full-scale frequency, but you can probably get within  $\pm 1\%$ .

<b><u>Band</u></b>	<b><u>Coil Adjustment</u></b>	<b><u>Screw Adjustment</u></b>	<b><u><math>\pm 1.5\%</math> Dial Accuracy</u></b>	<b><u><math>\pm 1\%</math> Dial Accuracy</u></b>
A	105KHz	360KHz	$\pm 6\text{KHz}$	$\pm 3.7\text{KHz}$
B	380KHz	1350KHz	$\pm 21\text{KHz}$	$\pm 14\text{KHz}$
C	1.44MHz	4.9MHz	$\pm 77\text{KHz}$	$\pm 51\text{KHz}$
D	5.2MHz	15.5MHz	$\pm 240\text{KHz}$	$\pm 160\text{KHz}$
E	15.4MHz	52MHz	$\pm 810\text{KHz}$	$\pm 540\text{KHz}$

## RF METER ADJUSTMENTS

The RF meter is calibrated by R48 and R50. R50 adjusts the low end of the scale and R48 adjusts the high end.

When looking at the back of the signal generator, there will be 3 small holes along the bottom of the shielded box. R50 is located in the middle hole. R48 is located in the right-hand hole.

1. Set controls as follows:
  - XTAL CALIBRATOR set to OFF
  - MODULATION set to CW
  - METER set to CARRIER
  - One 20db attenuator switched IN, all others OUT
2. Connect an RF millivoltmeter to the generator output. Make sure that the RF millivoltmeter provides a 50 ohm load to the E-200D (this is very important).
3. Adjust the FINE ATTENUATOR for a signal level of 3.16mV on the RF millivoltmeter.
4. Adjust R50 until the meter on the generator reads -10db.
5. Adjust the FINE ATTENUATOR for a signal level of 10mV on the RF millivoltmeter.
6. Adjust R48 until the meter on the generator reads 0db.
7. Double-check both adjustments since there may be some interaction.
8. Try checking the accuracy at other settings per the chart at the end of this document.

### NOTE

An oscilloscope can be used instead of an RF millivoltmeter. The calibration won't be as good, but if done carefully it will be reasonably close. Here is how to do it:

- a. The RF meter on the E-200D is accurate only when the generator is connected to a 50 ohm load. When using an oscilloscope, be sure to terminate the generator with a 50 ohm non-inductive load. During calibration connect the scope across the load (but not yet).
- b. Using a variable DC voltage source and an accurate DMM, connect the scope to exactly 89 millivolts and then to 283 millivolts. Take note as to the accuracy of your scope. When adjusting the generator, set it to the same amplitude you observed with the DC voltage source.

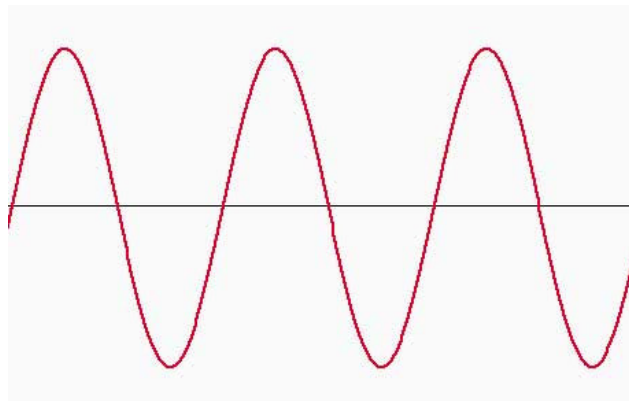
In order to get voltages that low, you will probably need to use a couple of resistors as a voltage divider. For a 0-12V or 0-15V adjustable supply, try using a 10K resistor in series with a 330 $\Omega$  resistor. Then take the voltage off the 330 $\Omega$  resistor. You can change the resistor values as needed to get the proper voltages.

- c. Set the generator to approximately 500KHz.
- d. Set the time base of the scope to 0.2mS and do not try to trigger on the generator output.
- e. Use the settings in step #1 above, except have all attenuator switches OUT.
- f. Adjust the FINE ATTENUATOR for a signal level of 89 millivolts peak-to-peak on the scope.
- g. Adjust R50 until the meter on the generator reads -10db.
- h. Adjust the FINE ATTENUATOR for a signal level of 283 millivolts peak-to-peak on the scope.
- i. Adjust R48 until the meter on the generator reads 0db.
- j. Double-check both adjustments since there may be some interaction.

## AUDIO OSCILLATOR ADJUSTMENT

R42 is for adjusting the 400Hz audio oscillator. When viewing the back of the generator, R42 is located under the shielded box along the right-hand edge. There are 2 controls along the right-hand edge, R42 is the one towards the front of the generator. R42 is adjusted to ensure reliable oscillation.

1. Set the MODULATION control to 400HZ OUT.
2. Connect an oscilloscope to the EXT MOD jacks. Set the time base on the scope to 1mS.
3. Adjust R42 until the 400Hz output is a good-looking, reliable sine wave as shown below. The peaks should be rounded as shown, not cut off (no clipping).



## MODULATION METER ADJUSTMENT

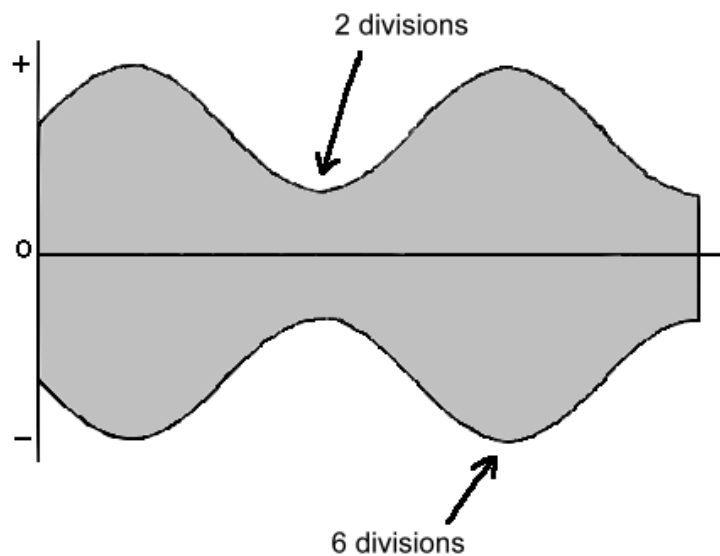
R54 is for adjusting the modulation meter. When viewing the back of the generator, R54 is located under the shielded box along the right-hand edge. There are 2 controls along the right-hand edge, R54 is the one towards the back of the generator.

1. Set controls as follows:
  - Generator frequency to approximately 500KHz
  - XTAL CALIBRATOR set to OFF
  - MODULATION set to INT
  - MOD LEVEL to mid range
  - METER set to CARRIER
  - 6db attenuator switch IN, all others OUT
  - Adjust FINE ATTENUATOR so the meter reads 0db, then switch the METER to % MOD
2. Connect an oscilloscope to the generator output.

3. Set the time base on the oscilloscope to 0.5mS. Adjust the oscilloscope for a stable trigger. You should see a modulated waveform (refer to the diagram).
4. Adjust the volts/div on the oscilloscope just until the display exceeds 6 divisions.
5. Turn the variable control (usually located on the volts/div knob) until the peak-to-peak display is exactly 6 divisions.
6. R54 interacts with the MOD LEVEL control. You will need to adjust both of these to get the desired display. The desired display is 6 divisions peak-to-peak at the highest point, and 2 divisions peak-to-peak at the lowest point. Refer to the diagram. You must play with R58 and MOD LEVEL until you get the desired display AND the meter reads 50% modulation. You may need to readjust the variable control on the oscilloscope to maintain a peak-to-peak of 6 divisions.
7. When you have simultaneously achieved a 50% modulated signal on the oscilloscope **and** a meter reading of 50% modulation, you are done.

Try adjusting MOD LEVEL until the meter reads 30% modulation. The signal on the oscilloscope should now show 6 divisions peak-to-peak at the highest point, and about 3.2 divisions peak-to-peak at the lowest point.

### Modulation Meter Adjustment



50% Modulated Waveform

## **MIXER ADJUSTMENT**

The mixer adjustment seems to balance the volume between the 1MHz and 100KHz markers. If the control is turned too far either way, one of the markers will be faint and hard to hear. R28 is the adjustment for the mixer. When looking at the back of the signal generator, there will be 3 small holes along the bottom of the shielded box. R28 is located in the far left hole.

1. Set controls as follows:
  - RANGE set to Band B
  - Frequency dial set to 600KHz
  - XTAL CALIBRATOR set to 100KHz
  - MODULATION set to CW
  - One 20db attenuator switched IN, all others switched OUT
  - METER set to CARRIER
  - Adjust the FINE ATTENUATOR so the meter reads 0db
2. Fine-tune the frequency dial for a zero-beat, taking note of the volume level.
3. Switch the range to Band D and adjust the frequency dial to 10MHz.
4. Set the XTAL CALIBRATOR to 1MHz.
5. Fine-tune the frequency dial for a zero-beat, taking note of the volume level.
6. Repeat steps 1-5, adjusting R28 until you achieve a suitable volume level at both check points.

## **100KHz MARKER ADJUSTMENT**

The 100KHz marker is not crystal controlled, it is an L-C oscillator. As such, it can drift over time. The 100KHz oscillator coil is located through a hole in the bottom of the generator. A plastic hex-shaped alignment tool is needed to adjust the coils, available from electronic suppliers. You could use a metal hex wrench, but you must withdraw the wrench to observe the results of your adjustment.

1. Set the controls as follows:
  - RANGE set to Band B
  - Frequency dial set to 600KHz
  - XTAL CALIBRATOR set to 1MHz
  - MODULATION set to CW
2. Slowly adjust the frequency dial until an exact zero beat is obtained.
3. Switch the XTAL CALIBRATOR to 100KHz.
4. Adjust the 100KHz oscillator coil for an exact zero beat.
5. Switch the XTAL CALIBRATOR between 1MHz and 100KHz to verify that they are both at zero beat. Fine tune as needed.

This completes the alignment.

Location of calibration points:



## E-200D Attenuator Setting to Microvolts

Attenuator	Microvolts	Attenuator	Microvolts	Attenuator	Microvolts	Attenuator	Microvolts
-100	1.0	-75	18	-50	316	-25	5,623
-99	1.1	-74	20	-49	355	-24	6,310
-98	1.3	-73	22	-48	398	-23	7,079
-97	1.4	-72	25	-47	447	-22	7,943
-96	1.6	-71	28	-46	501	-21	8,913
-95	1.8	-70	32	-45	562	-20	10,000
-94	2.0	-69	35	-44	631	-19	11,220
-93	2.2	-68	40	-43	708	-18	12,589
-92	2.5	-67	45	-42	794	-17	14,125
-91	2.8	-66	50	-41	891	-16	15,849
-90	3.2	-65	56	-40	1,000	-15	17,783
-89	3.5	-64	63	-39	1,122	-14	19,953
-88	4.0	-63	71	-38	1,259	-13	22,387
-87	4.5	-62	79	-37	1,413	-12	25,119
-86	5.0	-61	89	-36	1,585	-11	28,184
-85	5.6	-60	100	-35	1,778	-10	31,623
-84	6.3	-59	112	-34	1,995	-9	35,481
-83	7.1	-58	126	-33	2,239	-8	39,811
-82	7.9	-57	141	-32	2,512	-7	44,668
-81	8.9	-56	158	-31	2,818	-6	50,119
-80	10.0	-55	178	-30	3,162	-5	56,234
-79	11.2	-54	200	-29	3,548	-4	63,096
-78	12.6	-53	224	-28	3,981	-3	70,795
-77	14.1	-52	251	-27	4,467	-2	79,433
-76	15.8	-51	282	-26	5,012	-1	89,125

With an attenuator setting of 0db, the output will be 100,000 microvolts