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# Service Manual

# OB-Xa

## Polyphonic Synthesizer

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# PRELIMINARY

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For UNITS WITH SERIAL NUMBERS

820817 AND BELOW.

(820818 → Version 3)

First Edition  
June 1981

## OB-Xa TEST PROCEDURE [FIELD SERVICE]

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This procedure will enable the technician to calibrate the following functions:

1. Power Supply
2. Modulation Assembly
3. Control/Processor board
4. Voice Cards
5. Mother board

### Equipment required:

Digital Voltmeter (4 1/2 digit minimum)  
Strobe tuner (optional)  
Audio amplifier with speakers or headphones  
Oscilloscope

### POWER SUPPLY TEST

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#### CMOS MEMORY CURRENT DRAIN

BEFORE APPLYING AC POWER, the current drain of the CMOS memory (6514's) is measured.

[It is important no power has been applied to the unit for a minimum of 5 minutes before making this measurement.]

Check for any ground connections to the DVM common input other than the one ground lead used for the measurement.

Locate the 10K resistor to the right of the battery on the upper control board.

Measure the voltage across the 10k resistor. It should be less than 50 mV. This corresponds to a current drain of 5uA.

#### POWER SUPPLY CALIBRATION and VERIFICATION

Two voltages are adjustable, the -5V and +15V supplies.

Locate the trimmer next to the leftmost 723 voltage regulator; it is labeled "-5". Locate the trimmer next to the rightmost 723 voltage regulator; it is labeled "+15".

Attach the DVM ground lead to pin 4 of connector C (on the lower control board).

#### +15V ADJUSTMENT

Attach the DVM positive lead to pin 6 of connector K (upper control board). Monitor this voltage; adjust the +15V trimmer for +15.000V +/-20mV.

#### -5V ADJUSTMENT

Attach the DVM positive lead to pin 10 of connector C (upper mother board). Monitor this voltage; adjust the -5V trimmer for -5.0000V +/-20mV.

VOLTAGE VERIFICATION

All voltages are D.C. unless specified otherwise.

Refer to the chart below:

CONTROL BOARD, upper and lower, connectors K & A, respectively:

PIN#	VOLTAGE	TOLERANCE
1	~5.5Vac	+/-2V
2	+5.0V	+/-250mV
3	+5.0V	+/-250mV
4	key	
5	+15.0V	+/-20mV
6	+15.0V	+/-20mV
7	gnd	
8	gnd	
9	-15.0V	+/-750mV
10	-15.0V	+/-750mV

MOTHER BOARD, upper and lower, connector D:

PIN#	VOLTAGE	TOLERANCE
1	-15.0V	+/-750mV
2	key	
3	+15.0V	+/-20mV
4	+15.0V	+/-20mV
5	gnd	
6	gnd	
7	gnd	
8	gnd	
9	-5.0V	+/-20mV
10	-5.0V	+/-20mV

UPPER CONTROL BOARD VOLTAGE VERIFICATION

Verify the +5.6V supply at pin 16 of I.C.#145 (4051), tolerance is +/-200mV.

Verify the -10V supply at pin 7 of I.C.#149 (4053), tolerance is +/-1V.

LOWER CONTROL BOARD VOLTAGE VERIFICATION

Verify the +5.6V supply at pin 16 of I.C.#45 (4051), tolerance is +/-200mV.

Verify the -10V supply at pin 7 of I.C.#13 (4053), tolerance is +/-1V.

POT BOARD VOLTAGE VERIFICATION

Two voltages are developed on the pot board, +5.6V and -5.0V.

Verify the 5.6V supply at pin 16 of I.C.#5 on the pot board. Tolerance is +/-350mV.

Verify the -5.0V supply at pin 7 of I.C.#5. Tolerance is +/-500mV

## MODULATION ASSEMBLY CALIBRATION

Two types of modulation assemblies are installed in the OBXa. The first type, (referred to as model 1), is installed in OBXa's with serial number 810820 and before. The second type, (referred to as model 2) is installed in OBXa's with serial number 810821 and later. The calibration procedure is different between the two assemblies. Be certain of the type of modulation assembly before calibrating.

## MODEL 1 CALIBRATION

Refer to the "Modulation Assembly Trimmer Location" diagram for trimmer locations.

Locate the trimmers which are accessible thru the holes on the top of the bend assembly. The "LFO Offset" trimmer is located inside near IC#8.

All switches on the bend assembly- off (LED out), except the "down transpose" and "lower & upper" switches.

## 1- Center Bend Lever Adjustment;

This adjustment needs to be performed if the following occurs; 1- "Up or Down Bend" cannot be brought into range; IE: will not bend an octave. 2- there is excessive beating between the two oscillators when "OSC 2 Only" is pressed.

If the problem is due to offsets in the bend assembly, problem 2 described above, do the following:

Hold note C5, press "Auto-Tune", be certain the oscillators are beatless (less than 1 beat per second), press "OSC2 Only" switch, (LED on). Adjust the "Center Lever" trimmer until the beating is less than 1 per second.

If IC#5 has been replaced the following calibration method is used:

Measure the voltage at pin 1 of IC#5. Adjust the "Center Bend" trimmer for 0.000V +/-10mV.

Measure the voltage at pin 9 of connector C. This voltage, which should be 0.000V +/-20mV, is the Bend circuit offset voltage. This voltage must be added to (or subtracted from) the voltages stated for the following three adjustments;

## 2- Up Bend Adjustment;

Move the bend lever fully towards the front of the unit, monitor the voltage at pin 9 of connector C (lower control board). Adjust the "Up Bend" trimmer until the voltage is -1.000V +/- 2mV (+/- offset).

## 3- Down Bend Adjustment;

Move the bend lever fully towards the back of the unit, monitor the voltage at pin 9 of connector C. Adjust the "Down Bend" trimmer until the voltage is +1.000V +/-2mV (+/- offset).

## 4- Narrow Bend Adjustment;

Press the "Narrow" switch, (LED on). Move the bend lever fully towards the front of the unit, monitor the voltage at pin 9 of connector C. Adjust the "Narrow Bend" trimmer until the voltage is -0.167V +/-2mV (+/- offset).

## 5- Center Transpose Adjustment;

Measure the voltage at pin 5 on connector C. Press the "Down Transpose" switch, (LED out). Adjust the "Center Transpose" trimmer until the voltage is +1.000 +/-2mV more than the voltage measured in the down transpose position.

6- Up Transpose Adjustment;

Press the "up transpose" switch, (LED on). Adjust the "Up Transpose" trimmer until the voltage is  $+2.000V \pm 2mV$  more than the voltage measured in the down transpose position.

7- LFO Offset Adjustment;

This adjustment needs be performed only if there is excessive beating between VCO1 & VCO2 when the "MOD" assign switches (on the bend assembly) are on and the "Depth" is off (knob down).

Press "OSC1 MOD" switch, adjust the "LFO Offset" trimmer until the beating is less than 1 per second. The "LFO Offset" trimmer is inside the bend assembly.

If IC #14 has been replaced following procedure is used:

Measure the voltage at pin 1 of IC#14. Adjust the "LFO Offset" trimmer for  $0.000V \pm 5mV$ .

8- Saw Symmetry Adjustment;

With an oscilloscope monitor the sawtooth waveform at pin 14 of IC#9. Adjust the "Saw Symmetry" trimmer for minimum distortion of the waveform. Note, turning the trimmer full clockwise will provide a symmetrical waveform but the amplitude will be half the required value. The required amplitude is 2 to 3V peak to peak.

MODEL 2 CALIBRATION

The following method is used for calibrating modulation assemblies installed in OBXa's with serial number 810821 and later. Refer to the "Trimmer Location Diagram" for locations.

Locate the trimmers which are accessible thru the holes on the top of the bend assembly. The saw symmetry trimmer is located inside near IC#5. Units shipped after May 1981 have this trimmer on the top of the assembly.

All switches on the bend assembly- off (LED out), except the "Down Transpose" and "Lower & Upper" switches.

1- Center lever adjustment

The "Center Lever" adjustment needs to be performed only if the "Up or Down Bend" cannot be brought into range, IE: will not bend an octave.

Measure the voltage at pin 1 of IC#8. Adjust the "Center Lever" trimmer for  $0.000V \pm 25mV$

2-Bend Offset Adjustment

The bend offset adjustment needs to be performed only if there is excessive beating between the two oscillators when "OSC 2 Only" is pressed. Do the following:

Hold note C5, press "Auto-Tune", be certain the oscillators are beatless (less than 1 beat per second), press "OSC2 only" switch, (LED on). Adjust the "Bend Offset" trimmer until the beating is less than 1 per second.

If IC#8 has been replaced the following calibration method is used:

Measure the voltage at pin 1 of IC#8. Adjust the "Center Bend" trimmer for  $0.000V \pm 25mV$ .

Measure the voltage at pin 7 of IC#8. Adjust the "Bend Offset" trimmer for  $0.000V \pm 2mV$ .

Measure the voltage at pin 9 of connector C. This voltage, which should be  $0.000V \pm 20mV$ , is the bend circuit offset voltage. This voltage must be added to (or subtracted from) the voltages stated for the following three adjustments:

3- Up Bend Adjustment;

Move the bend lever fully towards the front of the unit. Monitor the voltage at pin 9 of connector C (lower control board). Adjust the "Up Bend" trimmer until the voltage is  $-1.000V \pm 2mV$  ( $\pm$  offset).

4- Down Bend Adjustment;

Move the bend lever fully towards the back of the unit, monitor the voltage at pin 9 of connector C. Adjust the "Down Bend" trimmer until the voltage is  $+1.000V \pm 2mV$  ( $\pm$  offset).

5- Narrow Bend Adjustment:

Press the "Narrow" switch, (LED on) and move the bend lever fully towards the front of the unit. Monitor the voltage at pin 9 of connector C. Adjust the "Narrow Bend" trimmer until the voltage is  $-0.167V \pm 2mV$  ( $\pm$  offset).

6- Up Transpose Adjustment;

Measure the voltage at pin 5 of connector C.

Press the "Up Transpose" switch, (LED on). Adjust the "Up Transpose" trimmer until the voltage is  $+2.000V \pm 2mV$  more than the voltage measured in the "Down Transpose" position.

7- LFO Offset Adjustment;

This adjustment need be performed only if there is excessive beating between VCO1 & VCO2 when the "MOD" assign switches on the bend assembly are on and the "Depth" is off (knob down).

Press "OSC1 MOD" switch. Adjust the "LFO Offset" trimmer until the beating is less than 1 per second.

If IC #7 has been replaced the following calibration method is used:

Measure the voltage at pin 7 of IC#7. Adjust the "LFO Offset" trimmer for  $0.000V \pm 5mV$ .

8- Saw Symmetry Adjustment;

With an oscilloscope monitor the sawtooth waveform at pin 8 of IC#6. Adjust the "Saw Symmetry" trimmer for minimum distortion of the waveform. Note, turning the trimmer full clockwise will provide a symmetrical waveform but the amplitude will be half the required value. The required amplitude is 2 to 3V peak to peak. Note, this trimmer is inside on some units.

## UPPER AND LOWER CONTROL BOARD CALIBRATION

This calibration procedure makes reference to notes C0 through C5. C0 is low C on the keyboard, and C5 is high C.

There are 6 trimmers for calibration on the upper and lower control boards. They are described below:

- : DAC Offset
- : DAC Scale
- : Lower LFO
- : Upper LFO
- : Lower Portamento
- : Upper Portamento

## DAC OFFSET ADJUSTMENT

Press the "Unison" switch. Press low C (C0). Measure the voltage at pin 7 of IC#64 and adjust trimmer T6 (near IC#35), for 0.000V +/-2mV.

## DAC FULL SCALE ADJUSTMENT

Press high C (C5). Measure the voltage at pin 7 of IC#64 and adjust trimmer T9 for 5.000V +/-2mV

## DAC LINEARITY VERIFICATION

While monitoring the voltage at pin 7 of IC#64:  
 Press key C1, this voltage equals 1.000V +/-2mV.  
 Press key C2, this voltage equals 2.000V +/-2mV.  
 Press key C3, this voltage equals 3.000V +/-2mV.  
 Press key C4, this voltage equals 4.000V +/-2mV.

## UPPER AND LOWER LFO CALIBRATION

The OBXa has two LFO's on the main control boards. One is on the top board, the other is on the bottom. The bottom LFO is the master LFO (modulates all voices) when the unit is in any mode except "Split or Double". When in "Split or Double" the top LFO modulates the upper voice tray and the bottom LFO modulates the lower voice tray.

To perform this adjustment the technician will be required to write a patch setting into A1 and A2. Be certain to save the patches onto cassette tape before proceeding with this adjustment.

Put the unit into the "Manual" mode. Set the controls as follows:

All pots down (Full CCW) except the following:

Filter Frequency	-Full CW
Frequency Modulation Depth	-Full CW
LFO Rate	-12 O'Clock
VCA and VCF sustain	-Full CW

All switches off, except the following:

OSC1	-On
OSC1 Frequency Modulation	-On
LFO Waveform	-Square

Write the above patch into memory at A1 and A2; see OBXa owners manual. (page 5), for description of this procedure.

Press the "Split Switch". The keyboard is split at note C2. Program A1 is the bottom half of the keyboard and program A2 is on the top half of the board.

Hold note C1 and while listening to the oscillator being modulated, adjust trimmer T5 (lower board) for a LFO rate of 2-4 Hz.

Hold note C2 and while listening to the oscillator being modulated, adjust the trimmer on the top board, (near IC#148), for a LFO rate of 2-4 Hz.

#### DIP SWITCH FUNCTION

On the pot board inside the OBXa is a 8 position DIP switch. This switch is used for voice selection, it is labeled "VOICES". If the switch is down (the open position) that voice is off. Position 1 is for voice one, position 2 is for voice two, and so on.

#### PORTAMENTO CALIBRATION

Put unit into manual. Set the front panel controls as follows:

Pots all full CCW except the following;	
Filter frequency	-Full CW
VCA and VCF sustain	-Full CW

All switches off except the following:  
OSC1 -On

With the voice selection DIP switch turn voices 5 through 8 off.

Press note C0 4 times then turn the "Portamento" pot full CW.

Press note C1 4 times (3 times for a 6 voice) while listening for the amount of portamento on each voice; i.e., the amount of time it takes the oscillators to change from one pitch to the next. Repeat this procedure of listening to the amount of portamento at each octave (C2, C3, C4, C5) while adjusting trimmer T8 until the amount of portamento is approximately 3 to 5 seconds per octave.

Using The DIP switch turn voices 1 through 4 off and voices 5 through 8 on. Next repeat the above procedure for the upper tray, using trimmer T7 to adjust the amount of portamento.

The following equipment is required for calibrating the voice cards in the OBXa:

- Audio amplifier with speakers or headphones
- Mini to Mini jumper clip
- Oscilloscope (optional)

There are 15 trimmers on the OBXa voice card for calibration, they are:

- : Pulse width (VCO1 & VCO2)
- : Initial frequency (VCO1 & VCO2)
- : VPO (VCO1 & VCO2)
- : Hi-track (VCO1 & VCO2)
- : Resonance (2pole filter)
- : Initial frequency (both filters)
- : VPO (2 pole filter)
- : Initial frequency (4 pole filter)
- : VPO (4 pole)
- : VCA offset
- : ENVMOD (envelope modulation)

Next to the DIP switch you will find two large slide switches labeled TEST 1 and TEST 2. The TEST 2 switch is not functional and has no effect on the unit. TEST 1, when in the Off (down) position, forces all the Fine Tune voltages to the voice cards to mid scale, thus disabling the effect of Auto-Tune.

#### OSCILLATOR TUNING (VCO's)

Set the front panel controls as follows:

Put the unit into the "Manual" mode.

All pot's down (full CCW) unless specified otherwise.

The pot settings follow:

"Filter Frequency" [VCFF]	-full CW
"Filter Modulation" [VCFM]	-full CW
"VCA & VCF Sustain" [VCAS] [VCFS]	-full CW
"Master Tune"	-center (dead zone)
"VCO2 Detune"	-center (LED out)

All switch parameters off, unless specified otherwise.

The switch settings follow:

"VCO1"	-on
"Waveform"	-pulse
"Track"	-on
"Transpose" (on bend assy)	-down octave
"Test1"	-down (Auto-Tune disabled)
"Unison"	-on

Using the voice selection DIP switch, turn the voice to be calibrated and a good voice, to be used as a reference, ON.

VOLT PER OCTAVE/INITIAL FREQUENCY ADJUSTMENT

VCO1  
Holding note C1 listen to the oscillators "beat". Turn the "Initial Frequency" trimmer until no beats are heard.

Holding note C2 turn the "VPO" trimmer until no beats are heard.  
Holding note C1 readjust the "Initial Frequency" trimmer.

Holding note C3 turn the "VPO" trimmer until no beats are heard.  
Holding note C1 readjust the "Initial Frequency" trimmer.

Holding note C4 turn the "VPO" trimmer until no beats are heard.  
Holding note C1 readjust the "Initial Frequency" trimmer.

Holding note C5 turn the "VPO" trimmer until no beats are heard.  
Holding note C1 readjust the "Initial Frequency" trimmer.

It will be necessary to repeat the above procedure a few times until proper tracking of the oscillator to the keyboard is obtained.

HI-TRACK ADJUSTMENT

"Octave" switch (on bend assy.) -up octave

Verify the "Transpose" circuit is within specification (see section on "Modulation Assembly Calibration).

All other switches and pots remain the same.

Holding note C5 turn the "Hi-Track" trimmer until no beats are heard.

USING A STROBE TUNER FOR OSCILLATOR CALIBRATION

To use the strobe tuner for measuring the pitch of the oscillator follow the above procedure, turning only the voice card being calibrated on. Plug the strobe tuner into the audio output (use the mono output).

C1 on the keyboard will make the first octave scale appear stationary on the strobe tuner. C2 the second octave scale stops, and so on.

PULSE WIDTH CALIBRATION

With the DIP switch turn only the voice to be calibrated on. Press note C3 and adjust the "Pulse Width" trimmer for the most "hollow" sound.

If an oscilloscope is being used, monitor the output of the voice card at pin 2 of connector G. Adjust the "Pulse Width" trimmer for a 50% duty cycle.

Repeat the above VCO calibration for VCO2, turn VCO1 -off, and turn VCO2 -on.

### ENVELOPE MODULATION CALIBRATION

The front panel settings remain the same as the VCO calibration settings with exception of the following:

Filter Modulation pot	-Full CW
F-ENV switch	-ON
OSC 1 and OSC 2	-ON

Using the DIP switch turn only the voice to be calibrated on.

Listening to both oscillators, adjust the "F-ENV" trimmer until VCO 2 is 1 octave higher than VCO 1.

### FILTER CALIBRATION

Using the voice selection DIP switch turn the voice to be calibrated and a voice to be used as a reference, ON.

### 2 POLE CALBRATION

Set the front panel controls as follows:

Mode; Manual

Switches; All, off, except the following:

"Track"	-ON
"Noise"	-ON

Pots; All down (full CCW) except the following:

"Resonace"	-full CW
"VCA & VCF Sustain"	-full CW
"Master Tune"	-centered (dead zone)
"Transpose"	-center octave

### INITIAL FREQUENCY CALIBRATION

Playing note C3 alternate between the reference voice and the voice to be calibrated. Adjust the "Filter Initial Frequency" trimmer until the new voice is the same pitch as the reference.

### VOLT PER OCTAVE CALIBRATION (VPO)

Playing note C2, again alternate between the reference card and the card to be calibrated. Adjust the "Filter VPO" trimmer until the card is the same pitch as the reference.

Recheck the "Initial Frequency" adjustment.

Playing note C4 again, alternate between the reference card and the card to be calibrated. Adjust the "Filter VPO" trimmer until the card is the same pitch as the reference.

Recheck the "Initial Frequency" adjustment.

## 2 POLE RESONANCE CALIBRATION

Set the front panel controls as follows:

Mode; Manual

Switches; All, OFF, except the following:

Track	-ON
Transpose switch	-Center octave

Pots; All down (full CCW), except the following:

Resonance	-full CW
VCA and VCF Sustain	-full CW
Master Tune	-center (dead zone)

Hold note C3 and listen to the voice card being calibrated. Listen for a low frequency oscillation (appx. 500Hz sine wave). If there is an objectionable amount, turn the "Resonance" trimmer until the point the oscillation stops, do not turn the trimmer any further.

If the above test is questionable as to whether there is oscillation, monitor the output of the voice at connector G2 with an oscilloscope. Look for any oscillation with an amplitude greater than 10mV.

## 4 POLE FILTER CALIBRATION

Press the 4 pole switch.

Repeat the procedure used for the 2 pole filter, except use the "4 Pole Initial" for initial frequency calibration and the "4 Pole VFO" trimmer for VFO calibration.

There is not a "Resonance" adjustment for the 4 pole filter.

## VCA OFFSET CALIBRATION

Set the front controls as follows:

Mode;; Manual

Switches; All, OFF.

Pots; all, OFF, except the "VCA Sustain" which is full CW.

Press key C3

Install a jumper on the card to be calibrated; see "VCA Offset" diagram.

Turn "VCA Offset" trimmer until a minimum amplitude of the tone is heard.

MOTHER BOARD CALIBRATION

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Calibrating consists of adjusting two distortion trimmers.  
Turn the front panel volume control to 3 o'clock.

Do not press any keys.

Plug the amplifier into the right output jack only. Locate the two 100k trimmers on the right end of the mother board. Hold the "Auto-Tune" switch down and adjust the trimmer labeled "R" for minimum loudness of the thump.

Plug the amplifier into the left output jack only. Hold down the "Auto-Tune" switch and adjust the trimmer labeled "L" for a minimum loudness of the thump.

Repeat the above procedure for the other mother board.

CAUTION: BE CAREFUL TO PREVENT EXCESSIVE D.C. FROM REACHING THE SPEAKERS WHEN PERFORMING THE ABOVE PROCEDURE.