# XOXBOX

## BASS LINE SYNTHESIZER

USER MANUAL (IN PROGRESS)
APRIL 30, 2005

**For more information about x0xb0x please visit:**
**http://www.ladyada.net/make/x0xb0x**

# INTRODUCTION

At this point, you should have successfully built your x0xb0x and performed basic tests to verify its functionality. This manual is intended to teach you the various functions of the synthesizer.

The manual is divided up into 3 sections. The first section describes all of the buttons, switches and ports individually. You should at least skim this section first so you know what we mean when we refer to the 'bank knob.' The second section is divided up by function and describes each function in detail and also provides examples for how to peform common tasks. The third section describes how to use the optional control software.

Since the x0xb0x is a 'living project,' there may be new versions of this document describing new functions. Be sure to check that this manual corresponds to the hardware, firmware and software version you have. The hardware version is written on the mainboard PCB. The firmware and software version can be verified through the computer control software.

This manual is written for:

x0xb0x 1.0 Hardware
x0xb0x 1.0 Firmware
x0xb0x 1.0 Software

No manual is perfect, but we can strive for completeness. If you feel like there's something amiss (whether it be poor spelling, obfuscated language, or confusing pictures) send your suggestions and corrections to the forums at http://www.ladyada.net/forums . Chances are, you're not the only one.

We hope you enjoy using your x0xb0x to make hardcore acid tracks.

# QUICK OVERVIEW

## XOXBOX CAPABILITIES

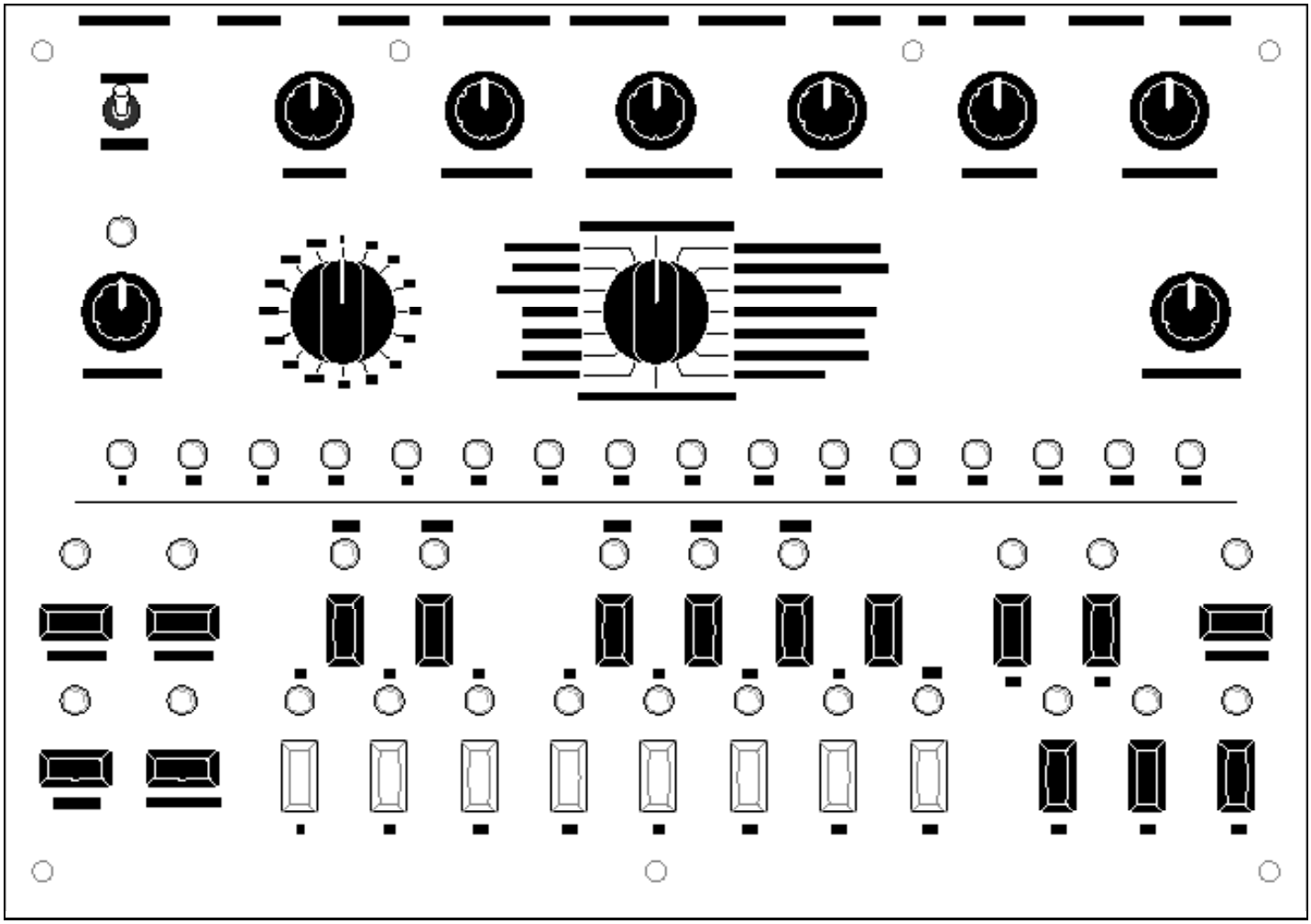
Sequencer capabilites:

- Up to 128 patterns of up to 16 notes each
- Up to 64 tracks of up to 16 patterns each
- Input sync via DINSYNC or MIDI Clock sync
- Output sync via DINSYNC and MIDI Clock sync
- Can act as a MIDI-controlled synthesizer
- Can act as a MIDI-out keyboard
- Easy-to-use sequencer allows for quick pattern & track entry and editing
- Intuitive track and pattern play with 2 octaves of pitch shift, rest, accent and slide override, as well dynamic chaining of up to 16 patterns or tracks
- Built in “random pattern” generator
- Precision tempo (20BPM to 200BPM) can be set via computer or with tap-tempo

Synthesizer capabilites:

- Monophonic, 4 octave VCO

# SECTION I
## SWITCHES, KNOBS, AND I/O

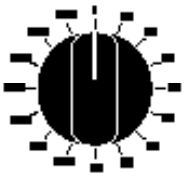


# SEQUENCER CONTROLS

The great thing about the x0xb0x is that it's not just a synthesizer, it also has a sequencer. Almost all of the buttons and controls are used to control and run the sequencer which is programmed into the microcontroller processor. Some of the controls have multiple uses, depending on the mode of operation. Note that the sequencer controls operate completely independantly of the analog controls. That means, for example, that you cannot change (or 'save') the frequency cutoff via the sequencer. Note that new firmware revisions may add or change the capabilites of the controls: they're all just buttons or LEDs and be easily reassigned new meaning.

## FUNCTION KNOB

The **function knob** sets the mode of the synthesizer. It's functionality is the same in every mode: the x0xb0x is in the mode indicated by the knob. If the knob is changed, the current mode will be exited and all modifications (such as unsaved patterns or tracks, chains, pitch shifts, etc.) will be discarded. The only exception to this rule is *Bootload Mode* which is only active if the x0xb0x is powered on with the **function knob** in this position.
Each mode is described in detail in section II.



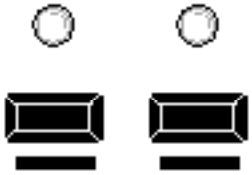
## BANK KNOB

The **bank knob** is has many uses. Its primary use is to select between banks of memory when writing or reading patterns and tracks. When addressing patterns, there are 16 banks and so all positions address a seperate bank. When addressing tracks, however, there are 8 banks. Therefore, bank position 9-16 are equivalent to positions 1-8 (respectively). Another use of the **bank knob** is to change the MIDI address of the device in *MIDI Play* or *Keyboard* mode.

# TEMPO KNOB & LED

The tempo knob is a rotary encoder, not a potentiometer. This means that tempo is adjusted by turning it left (down) or right (up) but that the particular location of the knob is irrelevant. (That is, turning the knob while the x0xb0x is powered off will not affect the tempo.)
The tempo is stored in internal memory on the microcontroller and can be precisely set using the x0xb0x control software.
The tempo is incremented or decremented one BPM per detent. The minimum tempo is 20BPM, the maximum is 300BPM. The current tempo is indicated by the tempo LED which sits above the tempo knob.
The tempo knob is not functional when syncing with external signals such as DINSYNC or MIDI Sync. However, the tempo LED will always indicate the current tempo, even when sync'd to an external signal.

# PREV/NEXT KEYS & LEDS



The **next key** and **prev key** are used in the *track edit* and *pattern edit* modes to index through patterns and tracks.
In addition, the next key is used to start step-write editing method in both *pattern edit* and *track edit* in which case the **next LED** will be lit

# RUN/STOP KEY & LED

The **run/stop key** is used to start and stop the sequencer. In *pattern edit* and *track edit* modes, pressing **run/stop** will start or stop either run or run-edit. In *pattern play* and *track play* with sync out, it will start or stop playing the selected patterns and tracks. The **R/S LED** indicates when the sequencer is running.
In *pattern play* and *track play* modes with external sync (such as MIDI clock or DINSYNC), the button doesn't do anything, but the **R/S LED** will still light up when the sequencer receives the proper external start command.

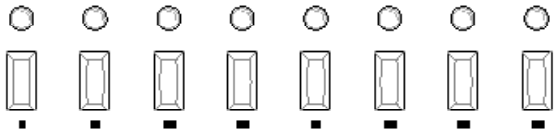
# CHAIN KEY & LED

The **chain key** is primarily used to create pattern and track chains in *pattern play* and *track play*: the button is held down while the desired chain is entered.
It is also used to create random patterns in *pattern edit* mode.

# BANK LEDS

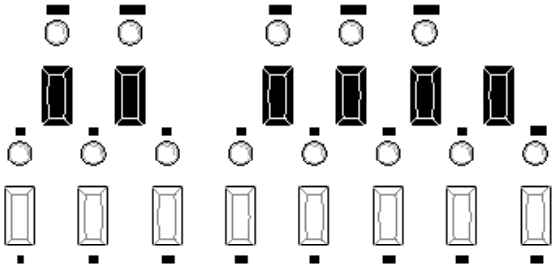
The strip of 16 numbered LEDs is used as visual feedback in many of the different x0xb0x modes. In general, it is used to indicate the currently selected bank or the current position in a pattern or track.

In *MIDI Play* and *Keyboard* mode, it indicates the current MIDI address.



# NUMBERED KEYS AND LEDS

The 8 white keys as a group are sometimes referred to as the **numbered keys**. (These keys are also used and referred to as as **note keys** when used as a one-octave keyboard.)
The numbered keys are used to address patterns and tracks in a bank while playing and editing.
The LEDs indicate the current pattern or track selected. In pattern play and track play modes, a blinking LED indicates the currently playing pattern or track and lit LEDs indicate patterns and tracks "waiting to be played."

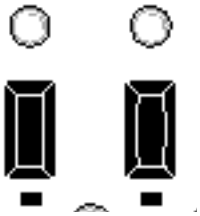


# NOTE KEYS AND LEDS

These 13 keys as a group are referred to as the **note keys**. They are also sometimes individually referred to by their label (i.e. "press the **C'** key"). The note keys are used to enter musical information.
In *pattern edit* mode, they are used to edit notes in a pattern.
In *track edit* and *track/pattern play* mode, they are also used to enter in the desired pitch shift.
In *keyboard mode*, they are used as a one octave keyboard.
In some case the octave can be changed with the **Up** and **Down** keys.

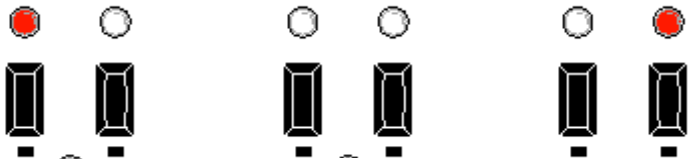
## DONE KEY & LED

The **done key** is essentially used to save tracks and patterns in *pattern edit* and *track edit* mode. It is also used as the *tap-tempo* button in *pattern play* and *track play* modes.
The **done LED** often indicates the end of a pattern or track (in *pattern edit* and *track edit* mode) or that a pattern or track is empty (in *pattern play* and *track play* modes)



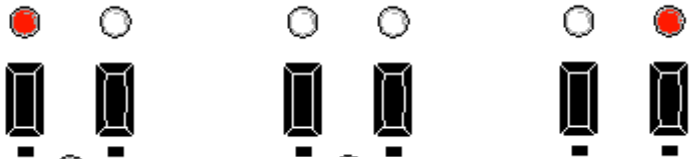
## DOWN/UP KEYS & LEDS

The **up key** and **down key** are used to extend the range of the single-octave keyboard. In *pattern edit* and *keyboard* mode, pressing the **down key** will lower the octave (no lower than the lowest octave) and pressing the **up key** will raise the octave (no higher than the 3rd octave). The LEDs will also indicate which octave is in use.

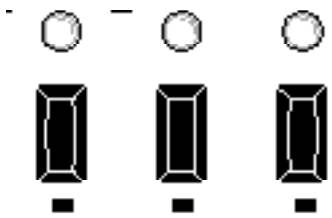


*lowest octave* *second octave* *third octave*

In *track edit* and *track play* mode, the **up/down keys** are used to transpose patterns and tracks. Patterns can be transposed either up (one octave) or down (one octave). Pressing the relavent button will display the amount of transpose in that direction on the **note keys**. the LEDs will also indicate if the pattern/track is transposed and in which direction.



*transposed down* *no transpose* *transposed up*



# REST/ACCENT/SLIDE KEYS & LEDS

The **rest key**, **accent key**, and **slide key** (and leds) are used to apply and indicate mute, accenting and portamento. Since they are often used as a group, they are sometimes referred to as the **RAS** keys and leds. While they have different effects in each mode, the overall meaning of their use is the same:

In *pattern edit* mode, they are use to create rest notes, accented notes and slides between notes. In *track edit* mode, they are used to mute patterns, accent entire patterns, and portamento entire patterns.

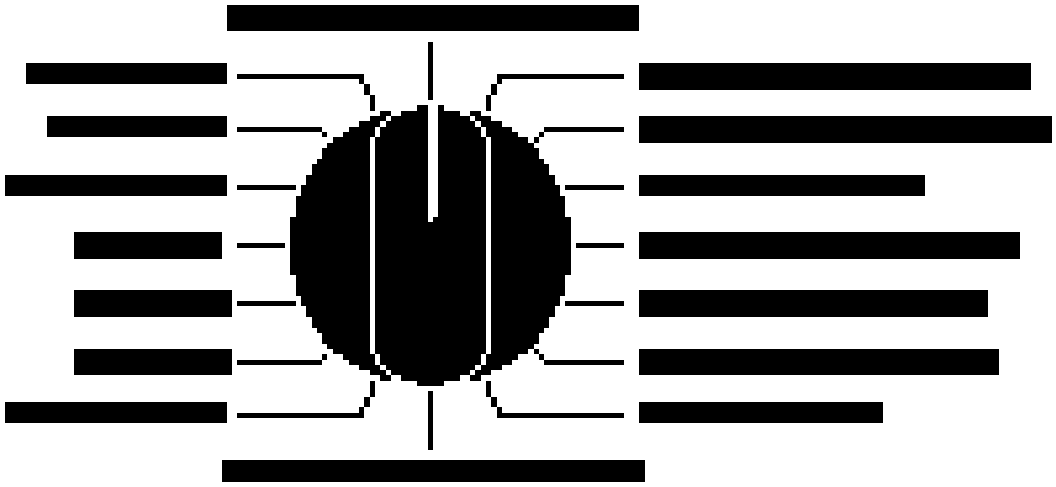
In *pattern play* and *track play* mode, they provide 'instantanous'/temporary over-riding mute, accent and slide.

In *keyboard mode*, only accent is used (sliding between notes occurs automatically when multiple keys are pressed).

Lit **RAS LEDs** indicate that the effect is currently active.

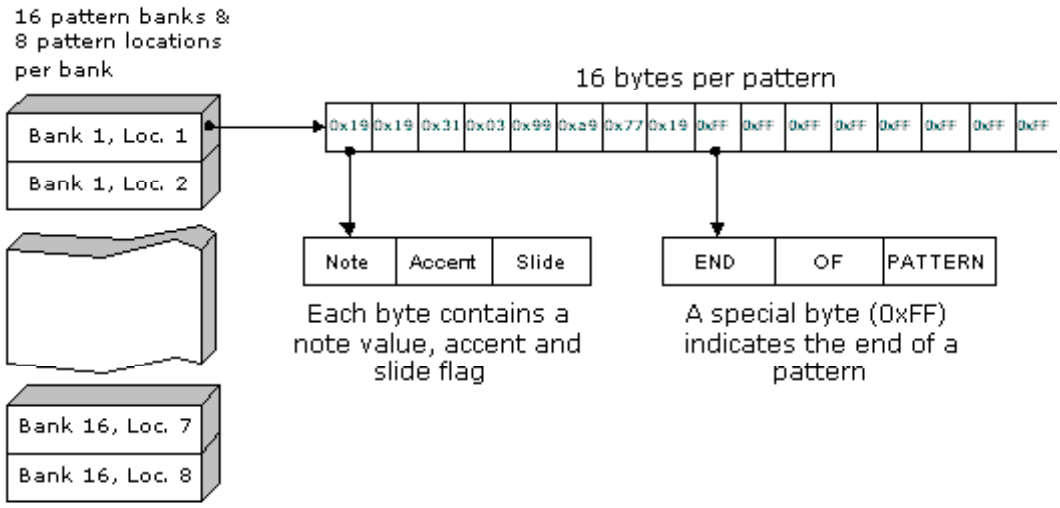
# SECTION II

## METHODS OF OPERATION



# PATTERN EDIT

Patterns are discrete sequences of notes (up to 16) used as building blocks for tracks. Every note in a pattern is considered to be a 1/16th note. Therefore, a pattern can be as long as a 4/4 measure. Unless computer control mode is used, this is the main method by which the x0xb0x sequencer is programmed.




## Pattern Memory Structure

Before delving into the pattern edit method, it is a good idea to understand how patterns are structured in memory. As mentioned before, each pattern can be as long as 16 notes. Each note in a pattern is stored in one byte of memory which actually contains 3 pieces of information: the note pitch, whether there is accent and whether there is slide/portamento. There are two notes that are particularly important. One is the 'rest' note (which is stored as the value 0 - the lowest value stored in a byte) and one is the 'end of pattern' indicator (which is stored as the value 255 - the highest value stored in a byte).

By placing the end of pattern indicator in a pattern, one can create patterns shorter than 16 notes. In the image above, for example, the pattern is 8

notes long.

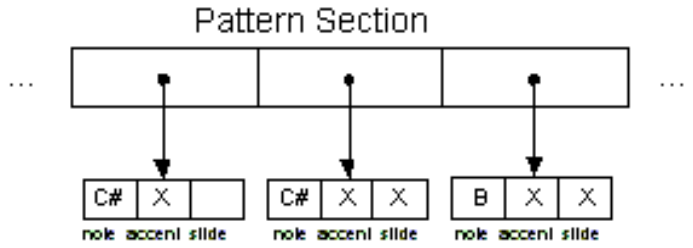
There are 128 unique pattern locations in the x0xb0x. These locations are divided up into banks and locations: 16 banks and 8 locations in each bank. To access (or 'address') a particular pattern, the bank is selected using the **bank knob**, the location is selected using the **numbered keys**.

One really important thing to note here is that in *pattern play* mode, its a lot easier to move between patterns that are in the same bank, and you can only chain patterns that are in the same bank. So you might want to group your patterns accordingly.

The original TB-303 saved patterns in battery-backed RAM. In the x0xb0x, patterns are saved on an EEPROM chip which does not require battery back-up. This chip is also socketed so that you can swap out new EEPROM chips (they're cheap and easy to buy online).

## Creating 1/8th notes, 1/4 notes, etc.

The Roland TB-303 also used a strange method of programming which required entering notes and time-bases seperately, which sometimes would lead to "interesting patterns" appearing in memory. This technique is not used, although you are free to drink heavily before programming the x0xb0x, which may also elict "interesting patterns."




Since there is no seperate time-base editing for a pattern, 1/8th notes, quarter notes, etc. are created by placing multiple identical 1/16th notes in a row and then sliding between them. (Essentially, this is how the original TB-303 did it.) For example, in the image above, a C# 1/8th note is created by sliding from one 1/16th note to another. The slide is placed on the first note.

## Scratch Pads

In the x0xb0x,
The basic method by which one programs patterns is:

1. Select which bank/location to edit, this loads the pattern from memory into a 'scratch pad'

2. Use either step-write (go though each note one at a time, adding or changing notes) or run-write (play the pattern repeatedly and change notes as buttons are pressed) mode to modify the scratch pad

3. Save the scratch pad back into the original bank/location. Alternately, the scratch pad can be tossed out.

To enter pattern edit mode, turn the function knob to Pattern Edit.