REAL WORLD INTERFACES

User Manual for the 32 Bank Memory System for the Devil Fish modified TB-303 (and for the TR-606 and TR-808)

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Contents

0 - Overall description

This is an additional modification I can install in a ***Devil Fish*** modified TB-303 or in a TR-606. A similar system can be installed in the TR-808, with the switches aligned vertically on the left side of the machine, with their toggles moving left-to-right.

This manual describes the 32 Bank Memory System as I have been installing it since April 1999. From the early 1980s I also installed memory systems with 4, 16, 21 or 32 banks, with completely different controls.

Starting in February 2014, I am able to install a variant of this 32 Bank system which enables **Dynamic Bank/Channel Switching (DBCS)**. This involves the potential inversion of address bits 3 and 2 (as described below) by detector circuits, with +1.1 volt thresholds, working from two Audio or CV input signals which arrive in two 3.5mm sockets on the left side of the machine, with the inversion signalled by a LED above each of the top left two switches. Please see the Devil Fish page for a **separate manual** for this. This can be done for the TR-606 and for the TR-808 as well, with potentially four input channels for the TR-808. In the case of the Devil Fish TB-303 with MIDI In and Out, it is also possible for this dynamic switching to be both controlled by MIDI In Note and Control Change messages on Channel 15 or 16 and for the dynamic switching to change the reception channel for Notes between four contiguous MIDI In channels.

This manual is primarily for the TB-303 – with or without the Devil Fish mods – with notes about the TR-606 and TR-808 in brackets.

The 32 Bank Memory system provides 32 times the normal memory of the TB-303 or TR-606 – with the ability to switch from one bank to another *while* a pattern is playing by operating toggleswitches and/or a pushbutton switch. This enables changes to the notes played by the Internal Sequencer on a note-by-note basis, in the middle of a pattern, in contrast to the usual arrangement by which the Internal Sequencer finishes one pattern before starting the next.

In the discussion which follows, the term "bank" refers to the total memory of a TB-303:

- Four Pattern Groups (I, II, III, IV) each of 16 patterns, 1A - 8A, 1B - 8B. This is a total of 64 patterns.
- 7 Tracks (songs) numbered 1 to 7. (Actually 7 starting points in the long track memory.)

(In the TR-606, a "bank" of memory consists of 32 patterns and 8 tracks. The TR-808 has 12 tracks and 16 patterns. Each TR-808 pattern has an A and a B section, with each section being initially 16 beats long in its first part and 0 beats long in its second part, with the total length of the two parts being 1 to 32 beats.)

The system selects between the 32 banks with the position of five toggleswitches. There are 32 combinations of these five switches being either up or down. Four of the switches are in a horizontal row. The fifth is below them, and is associated with a pushbutton switch which reverses its function. The purpose of the pushbutton switch is to provide a convenient and instantaneous means of switching banks.

The switches are not labelled. There is no particular numbering system for the banks. Using a binary number system, the 32 banks could be numbered as follows.

'▼' and '▲' refer to down and up states of the five toggleswitches. We interpret these states as binary bits `0` and `1` respectively. For instance the photograph above shows the toggleswitches set for bank 4.

Switches 4 3210	Bank number	Switches 4 3210	Bank number
▼ ▼▼▼▼	0	▲ ▼▼▼▼	16
▼ ▼▼▼▲	1	▲ ▼▼▼▲	17
▼ ▼▼▲▼	2	▲ ▼▼▲▼	18
▼ ▼▼▲▲	3	▲ ▼▼▲▲	19
▼ ▼▲▼▼	4	▲ ▼▲▼▼	20
▼ ▼▲▼▲	5	▲ ▼▲▼▲	21
▼ ▼▲▲▼	6	▲ ▼▲▲▼	22
▼ ▼▲▲▲	7	▲ ▼▲▲▲	23
▼ ▲▼▼▼	8	▲ ▲▼▼▼	24
▼ ▲▼▼▲	9	▲ ▲▼▼▲	25
▼ ▲▼▲▼	10	▲ ▲▼▲▼	26
▼ ▲▼▲▲	11	▲ ▲▼▲▲	27
▼ ▲▲▼▼	12	▲ ▲▲▼▼	28
▼ ▲▲▼▲	13	▲ ▲▲▼▲	29
▼ ▲▲▲▼	14	▲ ▲▲▲▼	30
▼ ▲▲▲▲	15	▲ ▲▲▲▲	31

For the fifth toggleswitch (labelled 4 in the table above), the state '▲' is achieved with either:

1 - The toggleswitch up and the button not pressed.

or

2 - The toggleswitch down and the button pressed.

1 - Use in Pattern Play Mode

If there is no need to switch banks while a pattern is playing, then operation is straightforward. Simply select the desired memory bank with the toggleswitches and use the machine normally.

Switching banks *while* the sequencer is playing patterns enables the creation in real-time of novel combinations of notes. For instance the first half of a pattern in Bank 8:

 **8**

could be played, and then by moving the right switch to the up position, the rest of the notes in that bar of music will come from a pattern in Bank 9:

 **9**

Each pattern contains the following information:

- The **length** of the pattern in steps. This can be between 1 and 16, or 1 to 15 for triplet mode. After clearing the pattern, hold down the Function button and press the "Step" button "9" (the same as Transpose Down) once for each note you want in the pattern.
- The "**pre-scale**", which is typically for 16 notes per 96 clock bar, but can be in triplet mode for 12 notes per 96 clock bar. After clearing the pattern, it is in 1/16th note mode, but by holding Function and pressing "0" the pattern is forever set to triplet mode.
- 16 **notes**, each of which contains:
  - Pitch.
  - Accent on/off.
  - Slide on/off.

(For the TR-606, each pattern has 1 to 16 beats, each of which can have each drum sound and accent programmed on or off. Likewise the TR-808, where the A part or the B section of a pattern can have 1 to 16 beats in its 1st part and 0 to 16 beats in its 2nd part.)

The Internal Sequencer is a single-chip microcontroller (for convenience referred to here as the “CPU”) connected to what is normally a single bank of memory. With the 32 bank modification, there are actually 32 banks of memory, and the CPU accesses whichever bank is currently selected by the toggleswitches and pushbutton. (The switches are de-bounced, so there are no messy transitions between banks due to mechanical bouncing of switch contacts.)

When the machine starts playing a pattern, the Internal Sequencer firmware (which is permanently built into the CPU) reads the length and pre-scale and stores these values in the CPU's internal RAM. When it comes to play each note (for the TR-606 and TR-808, each beat), the Internal Sequencer firmware causes the CPU to reads the external memory to retrieve the note, Accent and Slide information for that note. (For the TR-606 and TR-808, the CPU reads which drums are to be triggered, and whether Accent is to be set from external memory just before playing each beat.)

Therefore, by using the five toggleswitches and/or the pushbutton switch to select another bank of memory in the middle of a pattern, the Internal Sequencer will play subsequent notes from the new memory bank. Switching will not change the note currently being played, but affects all subsequent notes.

Here is a concrete example for the TB-303. The memory switches are set to:

▲ ▼ ▼ ▲ ▼ **Bank 18**

The Internal Sequencer is started and is playing Pattern 5B in Pattern Group III. Let's call this "Pattern III-5B". The Internal Sequencer plays this pattern several times and then in the middle of the pattern, while note 4 is playing, either the fifth toggleswitch ("4" in the above chart) is lowered, or the pushbutton is pressed. Either action has the same effect of making the fifth switch function (address bit 4) as a "low". So the bank select address bits are now

▼ ▼ ▼ ▲ ▼ **Bank 2**

As the CPU prepares to play the fifth note, it reads from memory, but instead of reading Note 5 of Bank 18's Pattern III-5B, it reads Note 5 of Bank 2's Pattern III-5B. So the pitch, Accent and Slide will vary as the banks are switched, but the CPU will take no notice of the lengths and pre-scales of Bank 2's Pattern III-5B.

Switching banks whilst in Pattern Write, Track Write or Track Play modes will surely lead to confusion of both the Internal Sequencer firmware and the user!

2 - Use in Track Play Mode

When I first began modifying TB-303s, TR-606s and TR-808s in 1981/82 , it was to install multiple memory banks. The purpose was to store more patterns and tracks so the users could use the machines to accompany them on guitar, vocals, keyboards etc. Some of these musicians had repertoires of hundreds of songs. In those systems I used pushbutton switches, counters LEDs and/or 7 segment figure-8 LED displays to control and display the current bank number. These memory systems were designed to reset the CPU whenever the bank was changed. Therefore changing from bank 23 to bank 13 was like turning off one drum-machine or TB-303 and turning on another. This was necessary, since there were certain items of data in the Track memory which was only read when the CPU ran its initialisation routines after being reset. (In the case of the TR-808, I made this reset circuit disableable to allow for live switching between banks in Pattern Play mode.)

Without this automatic reset circuit, there was a grave danger of the user changing banks whilst the CPU was running, and so causing it to become confused – particularly in regard to the starting and ending points of tracks and the prescales and lengths of patterns.

Now that the primary use of the TB-303 / ***Devil Fish*** (and the TR-606 and TR-808) is real-time manipulation rather than playing songs reliably, I have changed the memory control system. The new system has no automatic reset circuitry at all.

This toggleswitch and pushbutton arrangement is simple, flexible and reliable. However, if you are using Track Play mode and you switch banks whilst the machine is turned on, then it is quite likely that the CPU's firmware will generate unexpected and undesirable results.

If you are using Track Play Mode, do not change banks while the machine is turned on. If you accidentally do so, turn the machine off and on again so that the CPU reads in crucial data from the current bank.

Unless you want to create unpredictable scrambles in the track memory, be sure to turn the machine on and not change its memory bank at all, before using Track Write mode!

3 - Data retention and other details

This modification involves removing the existing memory chips and installing a much larger capacity memory system. Therefore it is *not* possible to retain the machine's memory data. Apart from a few test patterns I write into it, the newly modified machine will contain random data (the result of how each memory cell's flip-flop powers up in the 0 or 1 state), so be sure to clear each track before you start writing.

I have observed the TB-303's sequencer do some strange things, apparently with errant data in the memory. I don't recall exactly what these things are, how to create the situation or how to resolve it. Such strange states of data in certain patterns cannot be ruled out in any TB-303, whether or not it has extra memory banks.

In early 2015 I changed the arrangements for battery backup of memory systems. Before this, starting in 1996 with the V2.x Devil Fishes, I always used a large capacity cylindrical 1/2AA lithium battery soldered to the main Devil Fish circuit board. In all cases where I did extra memory for the TR-606 or TR-808, I used the same kind of battery, again soldered in.

In early 2015, due to air-freight restrictions on lithium batteries, it became apparent that we could only ship machines overseas, with insurance, if there was no lithium battery installed. So machines going overseas have an internal lithium battery holder, and no lithium battery, while machines being shipped to customers in Australia go by road and have a lithium battery installed. These batteries should last 10 years at least, and are user-replaceable, once the machine is partly disassembled.

Please see the separate manuals for the Devil Fish TB-303, TR-606 and TR-808 respectively regarding the battery arrangements for memory backup.

4 - Document history

2010-01-03	First PDF version of the manual, replacing what was previously a web page.
2014-02-15	Minor updates, and used this as the basis for the User Manual for the 32 Bank Memory system with Dynamic Bank/Channel Switching.
2015-02-07	New battery arrangements for memory, so referred to the separate manual for these.