REAL WORLD INTERFACES

Devil Fish modified TB-303 with the Quicksilver 303

Robin Whittle 24 July 2014   http://www.firstpr.com.au/rwi/dfish/

This Devil Fish has a Quicksilver 303 CPU replacement upgrade. For full details of this, please see the Social Entropy site for the Quicksilver 303 User Manual and for instructions on updating its firmware via USB.

>   http://socialentropy.com/quicksilver/

The differences from the normal Devil Fish modifications are:

- It is not possible to have the 32 Bank Memory system or the Devil Fish MIDI In system.

- There is no need for the TB-303's memory chips, or for C-cell batteries to power these or for the Devil Fish's usual battery backup approach which is an internal lithium battery. The Quicksilver 303's memory is contained on its CPU (more correctly, its "microcontroller") chip, and does not require backup power. (It is a form of EEPROM or FLASH reprogrammable non-volatile memory.)

- There is no TB-303 CPU. All internal sequencer functions are performed by the Quicksilver 303.

- The power requirements are not significantly different from those of the Devil Fish, however the system is more sensitive to the battery voltage being low than a Devil Fish with its original CPU. Therefore, the battery life may be shorter.

- The drive to most of the TB-303 front panel LEDs is different than with the original CPU. The duty cycle of the drive (the average time the LED is turned on as a fraction of the total time of the front panel scanning cycle) is lower. This is a function of the Quicksilver 303 firmware. While this can be adjusted (see the LED Dimming section of the Quicksilver 303 User Guide) the brightest possible setting is still significantly dimmer than with the standard CPU. The LEDs are still perfectly visible in dim and moderate lighting but are harder to use in bright ambient light.

The Quicksilver 303 performs all sequencing and the TB-303 (non-Devil Fish) front panel LED and tact-switch operations. It also provides MIDI In and Out via DIN (5 pin serial) connections and via USB. Please see the Quicksilver 303 documentation for the various modes by which MIDI inputs and outputs of the DIN and USB types can be used.

The differences between this installation and that of a standard Quicksilver 303 are:

- DIN MIDI In is via the Sync Socket. Since the Quicksilver 303 does not produce DIN Sync when receiving MIDI (as the Devil Fish MIDI In system does), it is not possible (as it is with the Devil Fish MIDI In system) to use the Sync Lead to drive DIN Sync to other devices. (The Sync Socket still receives DIN Sync, when not being used for MIDI In, according to the Quicksilver 303's functions for this.)

Since the Sync Socket has a 22 ohm resistor between its centre pin (2) and the ground of the TB-303, this does not match the usual MIDI In specification in which only pins 4 and 5 are connected, via an opto-isolator, with no ground connection at all. Therefore, in principle, there may by some ground coupled noise via this connection, such as from a computer which is driving the MIDI Out.

However, 22 ohms is a relatively high resistance compared to the likely resistance of the TB-303's connection to the ground of the audio mixing system, so it is unlikely that this will be a problem. If there are any such problems, please use a modified MIDI lead without its centre pin at the TB-303 end.

Plugging a MIDI lead into the Sync socket opens up the two pole switch which disconnects the internal Run/Stop and Tempo clock system (controlled by the Run/Stop button and Tempo knob) from the from pins 1 and 3 respectively of the Sync Socket (these are the outside pins - pin 2 is in the middle, pin 4 is between pins 1 and 2 and pin 5 is between pins 2 and 3). This means that when a MIDI lead is inserted into the Sync socket you will not be able to start, run and stop the Quicksilver 303's internal sequencer with the Run/Stop button and Tempo pot. If you want to be able to do this, you will need to make a modified MIDI lead which has a section of the shell cut away around the location slot. This will enable you to plug it in and make connections via pins 4 and 5 (the only ones needed for MIDI In) without pressing the white rod inside the location slot part of the Sync socket. It is the pressing of this rod which opens the two-pole switch. This white rod can be seen in the location slot part of the socket – the top of the socket.

- The Quicksilver 303 is wired up to drive the Filter Frequency. This is an optional part of the standard Quicksilver 303 installation instructions but it is always done when I install a Quicksilver 303 in a Devil Fish. This enables MIDI In control of Filter Frequency as well as the Quicksilver 303's "Filter Bump" function.

  To set the Quicksilver 303 to receive on Controller 1 (Mod Wheel, which is the default in the Devil Fish MIDI In and MIDI In and Out systems), please refer to the Filter Controller Number section of the Quicksilver 303 User Guide. In short: Select Config Mode; press the TB-303 front panel labelled "Accent" and "A" (not the Red Devil Fish Accent button) and then use the Back and Tap buttons until the Low C and the C# LEDs are illuminated. This is the number 1, according the system described in the Displaying Numeric Values section of the Quicksilver 303 User Guide.

- MIDI Out is via a 3.5mm stereo socket located between the Sync Socket and the Tuning knob. This is provided with a short adaptor lead consisting of a 3.5mm plug with 5 pin DIN socket. The connections are:

  Shield = ground = Pin 2 (centre pin).
  Ring = MIDI Out active low, pulled down to ground via 220 ohm resistor = Pin 5.
  Tip = MIDI Out pullup to 5V via 220 ohm resistor = Pin 4.

  If would be fine to create a single lead to replace this, of the desired length, with a 5 pin DIN plug on the other end, rather than use this short adaptor lead and a conventional MIDI lead.

  Normally the Quicksilver 303's microcontroller drives the output signal (pin 5) directly. For the Devil Fish installation, I use a buffer chip, with the intention that any excessive voltages on this socket will not harm the Quicksilver 303's microcontroller.

- The USB connection is via a Mini USB connector located between the Audio Out and the old Headphone socket. Normally, the Quicksilver 303's USB connection is tied to the ground of the TB-303. For all Devil Fish installations, I install an internal USB isolator. So this Mini USB socket is electrically isolated from the TB-303 / Devil Fish.

  The isolation is performed by a remarkable Analog Devices chip, the ADuM4160. This provides 5000 volts of isolation, by use of tiny transformers to couple data in both directions. Without this novel, highly integrated, transformer approach, the only other technique would be multiple opto-isolators, which would be considerably bulkier.

  The first purpose of this isolation is not to enable high voltages such as 5000 volts between devices, but to avoid any ground connections between the TB-303 / Devil Fish and the computer or other device which is driving the USB cable. Such devices are highly likely to have noisy grounds and it is important not to allow such noisy grounds to have any connection with the ground of the audio equipment.

  The other reason for providing this isolation is to protect the Quicksilver 303 from damage by excessive voltages being applied to its USB port.

  One source of such voltages is static electricity - a person's body can easily develop 10,000 volts or more due to the triboelectric effect, such as by friction or contact between cotton and synthetic fabrics, or from plastic-soled shoes on carpets and other types of floor.

  Another cause of excessive voltage is the way devices can be connected to the mains, either directly or via power adaptors, without being grounded to the mains ground in any way. Then, their ground is typically capacitively coupled to both the active and neutral wires, which are the only external connections, unless there is some other connection to grounded equipment. (Ethernet cables do not achieve this.) This is bad enough in 120 volt countries, where the device could float to 60 volts AC or in principle as much as 120 volts AC. It is worse still in 230-240 countries.

  Such "mains coupled, ungrounded" devices may be:

  - The Devil-Fish / TB-303 itself, running from a power adaptor, which are invariably ungrounded, and either without any connection to the presumably grounded audio system, or with a connection to some other ungrounded audio equipment.

  - Similarly, the Devil Fish / TB-303 running from batteries, without a power adaptor (which would normally be fine) but which is connected by one or more audio or CV leads to some other equipment which itself is ungrounded and so may be floating at some indeterminate voltage or being driven capacitively by the mains due to one or more of these audio devices also being connected to the mains without grounds.

  - A computer. Laptops typically use ungrounded power adaptors, so the laptop's ground may be capacitively coupled to the mains. Desktop computers typically have their grounds tied to the mains ground, assuming they are using a 3 pin lead into a properly grounded power outlet.

  The excessive voltage problem is relative. A mains-coupled but otherwise floating TB-303 / Devil Fish may have an excessive voltage with respect to a floating computer or a grounded computer. A floating computer may have an excessive voltage with respect to the TB-303 / Devil Fish whether it is floating or grounded.

The isolator should prevent any damage to the Quicksilver 303. The isolator's socket (on the rear panel of the Devil Fish) should also be immune to damage by static electricity or other sources of excess voltage, as mentioned above.

A potential problem with this isolated USB arrangement is that the USB driving device may be floating, capacitively coupled to the mains. This float voltage could be 120 volts AC or more. Since the USB socket's wires go inside the Devil Fish, it is possible that such a floating connection may introduce hum or other noise into the Devil Fish's output. (This assumes the Devil Fish is grounded, and not floating, however it is possible that such problems will occur if either or both the computer and the Devil Fish are floating.) If so, you will need to ground both the computer and the Devil Fish, or, if this can't be achieved, remove the mains connections to one of both devices, so they operate from batteries. Such problems might be reduced by installing a resistor between the isolated socket's ground and the Devil Fish socket's ground, but I believe this would increase the risk of damage to the USB isolator.

Update history

- 2012-09-10: Initial version.

- 2013-02-03: Added note on MIDI In cable disconnecting the internal Run/Stop and Clock system from Sync Socket pins 1 and 3, and how to overcome this with a MIDI In lead with a modified shell.

- 2014-07-24: Added notes about dimmer LEDs; reduced battery life due to greater sensitivity to low battery voltages and how to configure MIDI reception of Filter Frequency.