Macintosh Music: part 1: Hardware.

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I'll start with a few definitions we'll be using:

MIDI: Musical Instrument Digital Interface.

Polyphony/Synthesiser voices: Ability to play more than one note at a time, i.e. chords.

Sampler: Instrument into which you can record short segments of real sounds, e.g. violins, trombones, real vocals.

SMPTE: Society of Motion Picture Engineers. Usually refers to a synchronisation code which 'locks' a music computer to a tape machine.

Sequencer: Software which acts like a digital tape-machine (described fully next article)

If you've become bored with the capabilities of your Mac's on-board sound facilities there's a huge range of peripheral equipment which can give you often startling quality of sounds in your home, but like most things, you get what you pay for.

The extra hardware you buy depends on what kind of music you'll be using your computer for. Once you start using MIDI equipment the minimum requirement to go with your Mac is a Midi interface. This often sits under the the Mac and connects to either the modem, printer port, or both. Prices range from for a single midi in and midi out system, to x for a two Midi ins and six midi outs.

For Classical musicians, extra hardware could be a relatively simple synthesiser e.g. Yamaha DX100 (x voices, x dollars) and two midi leads (x dollars) this system could enable you to play a piano part, or simple string arrangement, or a four-part baroque piece.

We should now discuss the differences between recording with a tape machine and with a computer. If we had a four track tape-machine ('portastudio', x dollars) and an acoustic guitar, we could record four tracks of simultaneous chords (each chord using up to six strings each)for the length of time of the cassette. You could think of this process giving you 6x4=24 simultaneous 'voices' of guitar able to play together at any one instant of time. However, a computer doesn't record the actual notes played from your synthesiser, but simply remembers each note as an 'event'. This means that the playback of your computer recorded music depends on the total number of 'voices' you have available from outboard synthesisers to play simultaneous midi events. A multi-timbral synthesiser such as the Roland D-110 (x dollars) contains eight synthesiser modules and a drum module, enabling you in theory to play 8 synthesisers and a drum kit all together. Although this module is a 32 voice machine, many complex synthesiser sounds may use up to 4 voices for each note played. In Practise this means you can only realistically expect to have a drum kit, bass synth, and maybe two keyboard parts (playing three or four note chords) all playing back simultaneously. A keyboard such as the Casio xx (x dollars) may only give you four simultaneous voices, so all you may achieve here is one four-note chord part, or maybe four separate single note keyboard parts.

All this brings us to the conclusion that if you wish to computer-record complex music you will need more than one synthesiser, which leads us up into the professional end of the music market.

However a compromise much favoured by writers and musicians with home studios, is to combine conventional tape-recording with computer sequencing. With an appropiate synchronising box (anything from x to x dollars) it is possible to record a synchronising tone (often a SMPTE code) onto one track of your four- or eight-track tape-recorder.

This allows multiple tape-tracks to be recorded in succession whilst the computer runs 'locked' to the tape machine. An end result of this process is that maybe half of a song may end up on the tape machine, whilst the other half stays on the computer sequencer. In practise, the tape-machine tracks could be used for 'live' guitar or vocal tracks (plus one track for the SMPTE code) whilst the computer plays back drum kit, synth bass guitar, and several keyboard parts. With the right kind of equipment and attention to detail, a small reasonably-priced (by professional standards) computer studio can achieve very high quality recording. A home system is perfectly adequate for recording tv work and jingles, as well as high quality 'demos'.

MIDI INTERFACE- HARDWARE

The Mac is not capable of transmitting at the speed that Midi Requires so a suitable interface is required to provide the external clock reference and the Midi In and outs.

Such an interface is easily built using a handful of components. If you put one or two of these boards in a small box you will be able to start an adventure with Midi (but be warned it is like programming and extermely infectious). Now with Hyper Card and Hyper Midi it is easy to write professional looking Midi programs that have the look and feel of professional

a stable 4 Meg clock to the divider (74LS93). The divider can be configured to divide by 2; 4 or 8 to give a 2 ; 1 and 500kHz clock signals to the Mac. Most Mac programs allow you to choose which of these clock rates you use, however, on some older programs this is not the case you you can select (either with jumpers or a switch) which clock rate you use.

The Midi In is fed to the 6N138 optocouplers (I have found that this opto is more reliable than others that I have used, but it is more expensive and harder to get hold of.) The Diode across the input protcts against destructive reverse voltages and the two inverters on the output provide the bi-phase signals.

The signals from the Mac are buffered by 2 gates left in the 74LS04 and sent to the Midi out. The whole circuit uses only 3 chips and a handful of passive components. To keep the chip count down I have not included an indicators to show Midi In or Out activity, but it is a simple matter to add another IC and connect Leds to do this. As well you can add switches that allow the Modem and printer to be used without having to remove the plugs. You can also add a second Midi In and Out for the printer port. To do this you need only duplicate the In and Out circuit and connect the clock from the first board to the HSK pin on the connector of the other port.

Construction

The construction is very straight forward since everything is on the one board, be careful to orientate all the components as per the attached diagram. (The IC's, and the electrolytics.) If you have a Mac 512 you won't need to build the Power supply section as the +5 volt line comes from the Mac. There are 2 different connectors for the Mac. The D-12 for the 512 and the Mini Din-8 for the Plus, SE and the II. Consult the diagram for the connection legend. Note that the +5 Volt supply is not connected for anything except the 512 version. Place jumpers across the tracks to select the desired frequency of operation. I have found that 1 Meg has become the Defacto standard.

If you decide to build two units so that you can have 2 Midi ins and outs then it is a simple matter of building two boards but only one clock section and connecting the clock output to the second board (at the 0.1µF cap) You can also add more Outs simply by adding more buffers before gate #4 on the diagram and adding extra 220 Ω resistors to pin 4 of each Midi Out as per the diagram.

Leds can also be added to show Midi In and Out status by adding buffers at the junctions of gate #1&2 (for the Midi in) and #3 & 4 for the Midi Outs. (the leds will need to be taken low via a limiting resistor of about 200 Ω or so)

The Whole unit fits snugly into a small diecast box with the connecting cable coming out of one end and the Plug pack Supply (if you need it) connected at the other end . To make the unit conform to the Mac Interface you will need to spray it off white (or platinum) depending on the age of your Mac.

Testing

There are no adjustments to be made it either works or it doesent. If you have a frequency counter then you can confirm that the unit is infact operating at the correct frequency. To really test the unit you will need to have some Mac Midi software. There are Sequencers, Patch Librarians, Effects editors, and even Third party Microsoft Basic extensions that enable you program your own Midi Software.

I have a rather nice Midi Test Program that is Public domain from Ralph Muha from Kurzweil in America that is ideal for testing the interface and for those of you that want to get a start in Midi. The program shows all incoming bytes and will also allow you send Midi over both Modem and Printer ports.

If you want a copy of the program I will be happy to provide it to those of you that want it. Send a 3.5 Inch Floppy and a return envelope and stamps to Simon Leadley C/- MidiSoft 9 Edgecliff rd Bondi Junction 2022. The disk contains all the documentation and feel free to distribute it to interested parties. (as per the public Domain Notice) Thanks to Ralph at Kurzweil Music Systems for such a valuable program.

I have included a short Basic program using Microsoft Basic and Midi-Basic to illustrate how you can easily write routines. The program asks for a program number between 1 & 128 and transmits it on a selected Midi Channel. I have also given a comprehensive list of the Midi Codes as per the Midi Spec.

Parts List

Semiconductors

1 ..... 6N138 Optocoupler
1 ..... 74LS04
1 ..... 74LS93
1 ..... 7805 Regulator (Mac Plus SE)
3 ..... 1N914 Diodes

Passive Components

4 ..... 220 Ω Resistors
4 ..... 1kΩ Resistors
1 ..... 4 Meg Xtal
1 ..... 0.1 µF Cap
1 ..... 0.01 µF Cap
3 ..... Decoupling caps (0.1µF)
1 ..... 1000 µF Electro
2 ..... 5 Pin Din Plugs
~~1 ..... 9 Pin D Connector (512k (1))~~ Don't Need.
1 ..... 9 Pin Mini Din (Mac Plus SE)
1 ..... Die Cast Box
1 ..... PC Board
1 ..... 6 Core Cable
1 ..... Plug Pack (Mac Plus, SE)

..... continued Next Month