Construction project:

MIDI interface for the Macintosh

We've had MIDI interfaces for the IBM and the Apple II series – now it's time for the Macintosh. This simple project will allow Mac users (and possibly //GS users) to connect a MIDI instrument to their computer. The unit is compatible with existing software, and includes MIDI-in and out. Best of all, it's cheap.

by SIMON LEADLEY

The Macintosh has become one of the most popular choices for the professional musician. This is in part due to the famous Mac software interface, which allows anyone to become computer literate without months of training. And also because of the large amount of music-related software that has been written for the Mac.

Put this together in a reasonably portable box and it is easy to see why this has happened. But the Mac isn't cheap, nor are the peripherals that you need to do anything really useful. The new Apple MIDI interface costs around $190, and has only one IN and one OUT port, with no switching of the printer or modem ports. If you own an older Mac, then you will also have to buy the cable to adapt the interface to the older style DB9 outlet used as a serial port, rather than the currently used mini-DIN socket.

But enter the *EA* Macintosh MIDI interface. This neat little unit can be built for under $50, and fits into a small metal or plastic box. If you wish, you can add your own switching to allow selection of a modem or printer. The device will operate on the Mac 512k, 512k E, the plus and the Mac 2. It also has selectable clock speeds to allow it to run with a variety of programs. You could even build two and have dual MIDI in and out, by using both serial ports.

The unit is built on a small PCB that contains everything, including an onboard 5V regulator to allow the circuit to be powered by an external power pack if a 5V supply is not available from the computer.

Although not tested on a //GS, because the serial ports for this computer and the Mac are the same, it is probable it would also work on the GS. In this case, use the 1MHz clock setting, and power the unit from the games port, which has a 5V supply at pin 2 (5V) and pin 3 (ground).

MIDI specs

MIDI (Musical Instruments Digital Interface) is a serial asynchronous communications protocol, that operates at a speed of 31.25kHz. To alleviate any problems with hum loops and to give a degree of protection to the devices connected via MIDI, the standard uses a current loop with high speed optocouplers.

The Macintosh require an external clock reference and bi-phase data signals for the input, and some buffering for the outputs. The design presented here takes care of all of this.

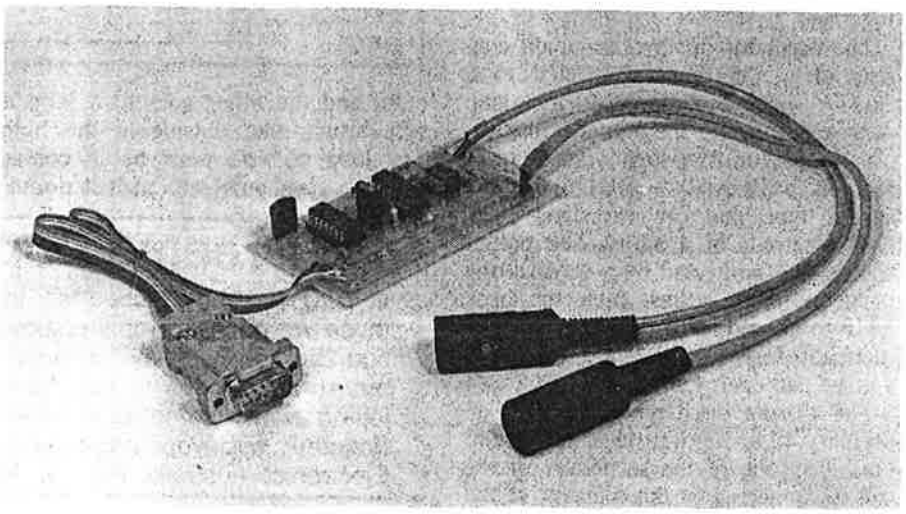
The MIDI specs have been established for some time, and a complete article describing these, and MIDI in general can be found in the article 'Inside MIDI', *EA* January 1988.

The design

The circuit uses a conventional crystal oscillator to provide a stable 4MHz clock, which is then divided by the 74LS93 counter. The divider can be configured to divide by 2, 4 or 8 to give a 2MHz, 1MHz or 500kHz signal respectively, which is then applied to the handshaking input (HSK) input at the Mac's serial port.

Most Mac programs allow you to chose which of these clock rates you want, although some older programs require a fixed clock rate. This rate can be set with a jumper on the PCB to suit.

The MIDI input signal is fed to a 6N138 optocoupler. This device is more

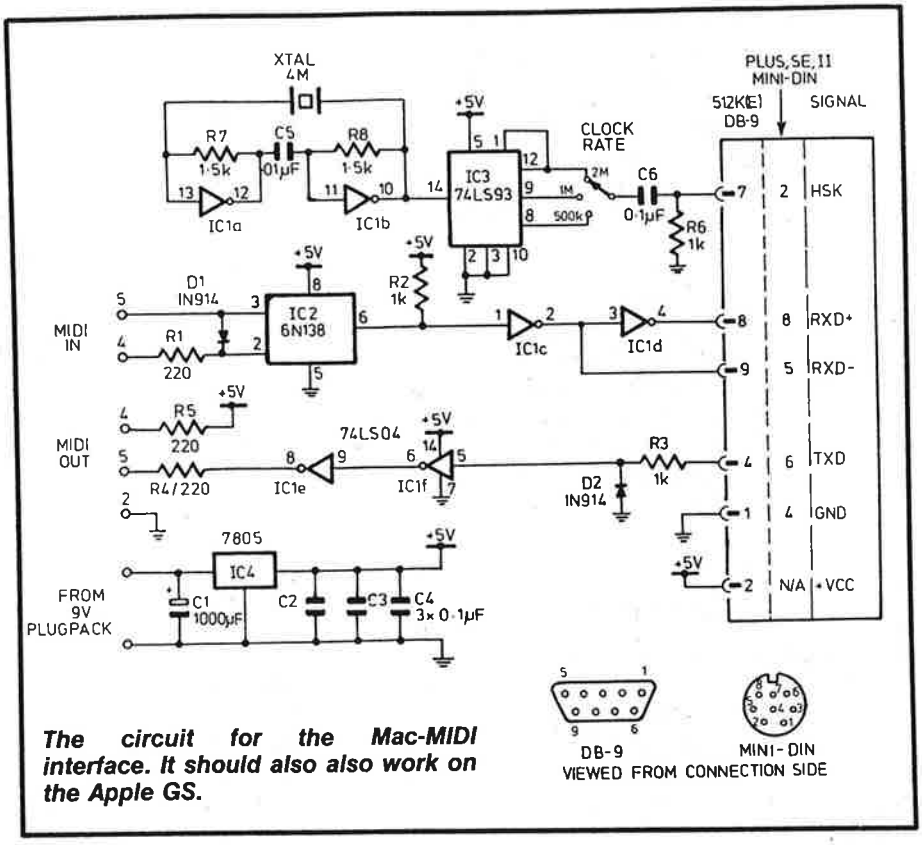


expensive and somewhat harder to get than other, slower, optos, but is recommended for best reliability. The diode D1 across the inputs protects the opto against reverse voltages. Resistor R2 is the collector load for the optocoupler, and converts the current change in the internal photo-sensitive transistor to a voltage change. The two inverters IC1(c) and IC1(d) provide the bi-phase signals needed by the Mac.

The output signals from the Mac are buffered by IC1(e) and (f), and then sent to the MIDI out. Resistors R4 and R5 are standard values for a MIDI interface, to limit the current flowing in the current loop.

The whole circuit has only three ICs and a few passive components. To keep things simple, I have not included any indicators to show MIDI activity, although constructors could add this if required. As well, you could add switches to allow a modem and a printer to be used without having to swap plugs.

You might like to have a duplicate MIDI interface connected to the other serial port. In this case, you need only duplicate the MIDI in and out sections, as the clock from the first unit can connect to the HSK pin on the other port.



The circuit for the Mac-MIDI interface. It should also also work on the Apple GS.

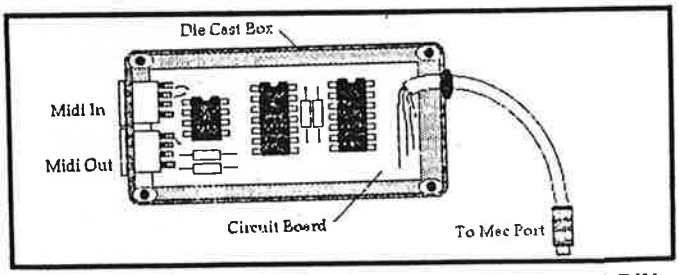
Construction

The construction is very straightforward, since everything is on the one board. Just be very careful to orientate all the components correctly. If you have a Mac 512, you won't need to build the power supply section, as power can be derived from the DB-9 socket (pin 2).

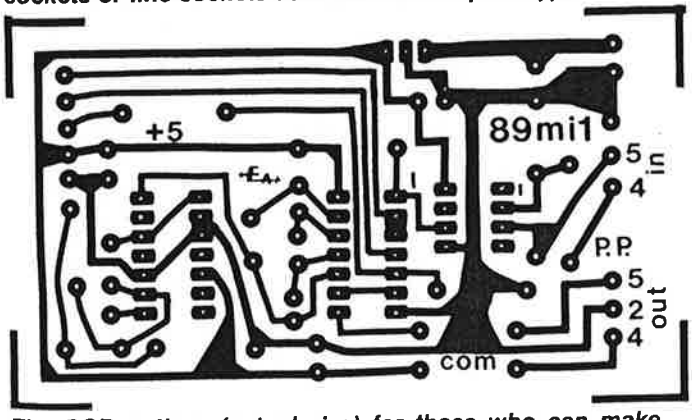
Otherwise, if you cannot derive a 5V supply from anywhere else, install the 5V regulator IC4, C1 and C2, and connect a 9V DC plug-pack to the board.

Refer to the circuit diagram for the pin connections for the two types of connectors used in the different Mac models. Note that no 5V supply is available from the mini-DIN connector used on the Plus, SE and II.

Select the clock frequency required by



A Mac 'simulation' of the unit. Fit either panel mount DIN sockets or line sockets as shown on the prototype.



The PCB pattern (actual size) for those who can make their own.

```
LIBRARY "midibasic"
  Midiopen 100,100
    midiport 3
    midiport 1
 loop:
WINDOW 2, "Midi Page",(50,100)-(450,250),1
  BUTTON 1,1,"Send Program Change",(5,25)-(200,40),2
   BUTTON 3,1,"Quit",(5,75)-(200,90 ),2
    WHILE DIALOG (0)<>1: WEND
   Buttonpushed =DIALOG(1)
  IF Buttonpushed=3 THEN GOTO Done
 ON Buttonpushed GOSUB Midisend
 GOTO loop
Done:
   WINDOW CLOSE 2
   LIBRARY CLOSE
END
Midisend:
INPUT"Program Number";Y%
   IF Y%<0 THEN GOTO Midisend
     IF Y%>127 THEN GOTO Midisend
     x%=192
    midiout x%
   midiout Y%
  PRINT "midi Sent"
RETURN
```

A simple test program for the Mac to test the interface.

your software by linking to the required point, as shown on the layout diagram. The PCB is already linked to 1MHz, so if you want to alter this, cut the track connecting pin 9 of IC3 to C6.

If you decide to build two units so that you can have two MIDI devices, construct the second board without the oscillator. Assuming the clock frequency required by the second device is the same as the first, simply connect the HSK pins of both ports together, and drive them from the first board. If you want different frequencies, install C6 and R6 on the second board, and connect the oscillator output (from either pin 12, 9 or 8 of IC3, depending on the required frequency) to C6 on the second board.

PARTS LIST

Semiconductors

1 6N138 optocoupler (Jaycar)
1 74LS04 hex inverter
1 74LS93 counter
1 7805 regulator (see text)
3 1N914 diodes

Resistors

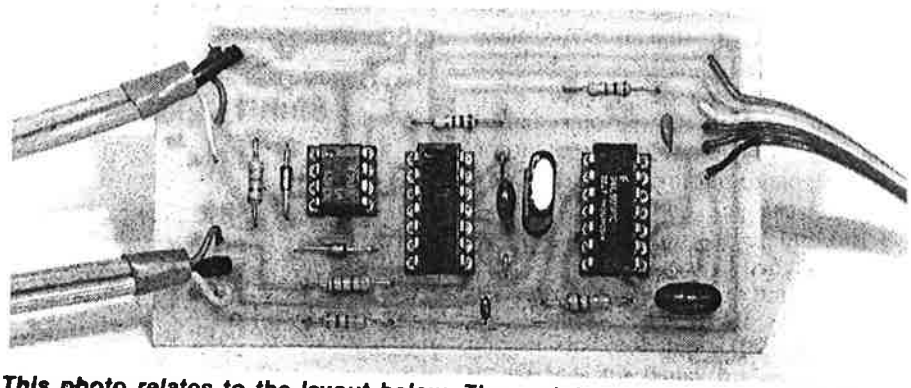
all 1/4 watt. 4 x 220 ohm, 4 x 1k

Capacitors

1 0.01uF polyester
1 0.1uF polyester
3 0.1uF monolithic
1 1000uF electrolytic (see text)

Miscellaneous

1 4MHz crystal
1 PCB coded 89mi1, 90 x 50mm
2 5 pin DIN connectors (plugs or sockets to suit application)
1 DB9 plug (for 512k, E)
1 9 pin mini DIN (other Macs, //GS)
co-ax cable, rainbow cable, 9V 50mA DC plug-pack (if needed)



This photo relates to the layout below. The prototype derived its power from the computer.

You could also add more MIDI outputs by adding extra buffers to be driven by IC1(f). That is, duplicate the circuit of IC1(e), R4 and R5 as many times as you need outputs.

LED indicators could be added if required by adding a buffer connected to pin 2 of IC1(c) (for a MIDI 'in' indicator) and another buffer at the output of IC1(f) (pin 6) for MIDI out. The indicator LEDs would then be connected in series with a 330 ohm resistor between the 5V supply and the output of the added buffers.

The whole unit can then be fitted into a small box (a diecast box was used in the prototype), and the connecting cables arranged to exit the box at either ends. To complete the whole thing, spray paint the box either off white or platinum, depending on the age of your Mac.

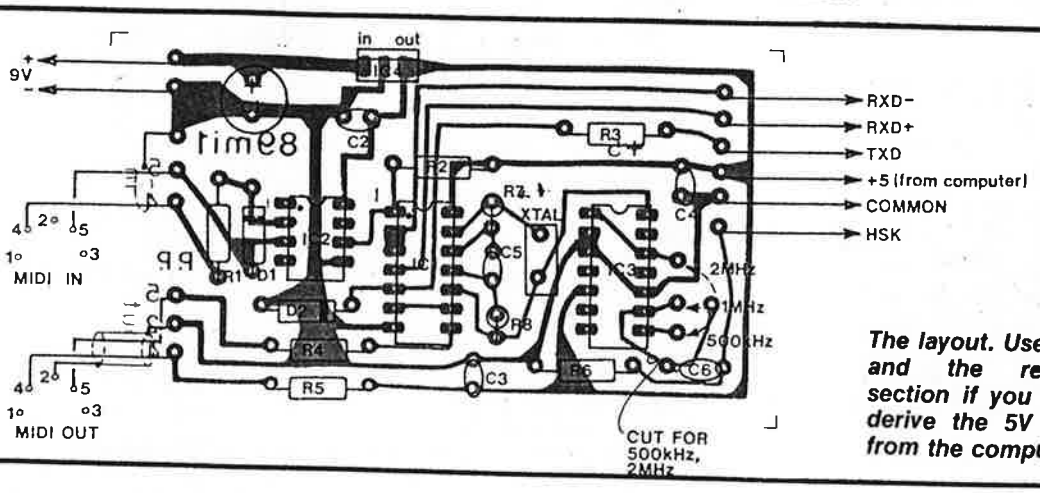
Testing

There are no adjustments to be made; the unit either works or it doesn't. However, if you have a scope or a frequency counter, you can confirm that the oscillator is operating, by monitoring the signal at the HSK pin.

To really test the unit, you need some Mac MIDI software. There are sequencers, patch librarians, effects editors, and even third party Microsoft Basic extensions that enable you to write 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, or simply as a means of learning a bit about MIDI.

The program shows all incoming bytes and will also allow you to send MIDI over the modem or the printer ports. Readers who want a copy can send a 3.5" disk, and a return addressed, stamped envelope, to Simon Leadley c/o Midisoft, 9 Edgecliff Rd, Bondi Junction, 2022. The disk contains all the documentation, and users are free to distribute it to others (as per the public domain notice). Thanks to Ralph Muta at Kurzweil Music System for such a great program.

I have included a short Basic program using Microsoft Basic and MIDI-Basic to illustrate how easy it is to write MIDI routines. The program asks for a program number between 1 and 128, and transmits it on a selected MIDI channel.



The layout. Use 9V AC and the regulator section if you cannot derive the 5V supply from the computer.