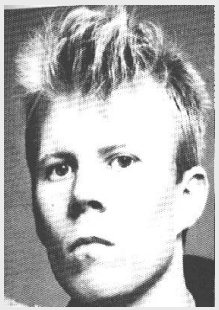
MIDI

Introduction to the Musical Instrument Digital Interface

Born 1983

- Sigh. And I can remember the feature on Tomorrow's World when I first heard about it...
- Vince Clarke (Depeche Mode, Yazoo, Erasure) used to have 8 Casio CZ-101s and 1 BBC Model B Microcomputer connected by UMI-2B MIDI



Then…

- I had a BBC Model B microcomputer with the Acorn Music 500 synthesiser
- It had no keyboard and was programmed using its own programming language Ample

Music on this page stolen from Colin Fraser's 500 page
http://www.colinfraser.com/m5000/m5000.htm

...Now

- Roland D-20 (1990) Boss DS-330 (1993), Oberheim MC-3000 (2000), Proteus 25 (2006), Cubase SX 2.0, numerous VST instruments, Virtualizer Pro

What is it?

- It's a communications protocol. A music description language in binary form. Each word describing an action of musical performance is assigned a specific binary code.
- MIDI was designed for keyboards, so many of the actions are percussion oriented.
- To sound a note in MIDI language you send a "Note On" message, and then assign that note a "velocity", which determines how loud it plays.
- Other MIDI messages include selecting which instrument to play, mixing and panning sounds, and controlling various aspects of electronic musical instruments.

History

- Early synths (1970s) were not designed with interconnectivity in mind.
- Connected via two control ports, one for pitch and note on/off events, and the other to provide a timing reference.
  - The first consisted of two signals: a variable DC control voltage (CV), proportional to pitch; and a trigger pulse, or gate.
  - The second port consisted of a pulse train synchronized with an external clock

CV drawbacks

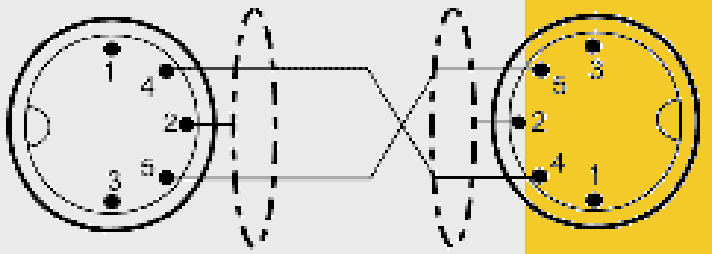
- Only one note at a time could be controlled
  - Newer polyphonic instruments suffered
- No agreement over external clock rate
  - Special conversion boxes were needed to over- or under-sample the clock
  - Connecting multiple instruments, especially from different manufacturers was complex and troublesome
- In 1983 Sequential Circuits, Roland Corporation, and Oberheim Electronics released MIDI 1.0
- MIDI spec. controlled by MIDI Manufacturer's Association (MMA) & Japan MIDI Standards Committee

Specification

- MIDI specifies
  - Hardware interface
  - Binary control language
  - MIDI file formats

Hardware

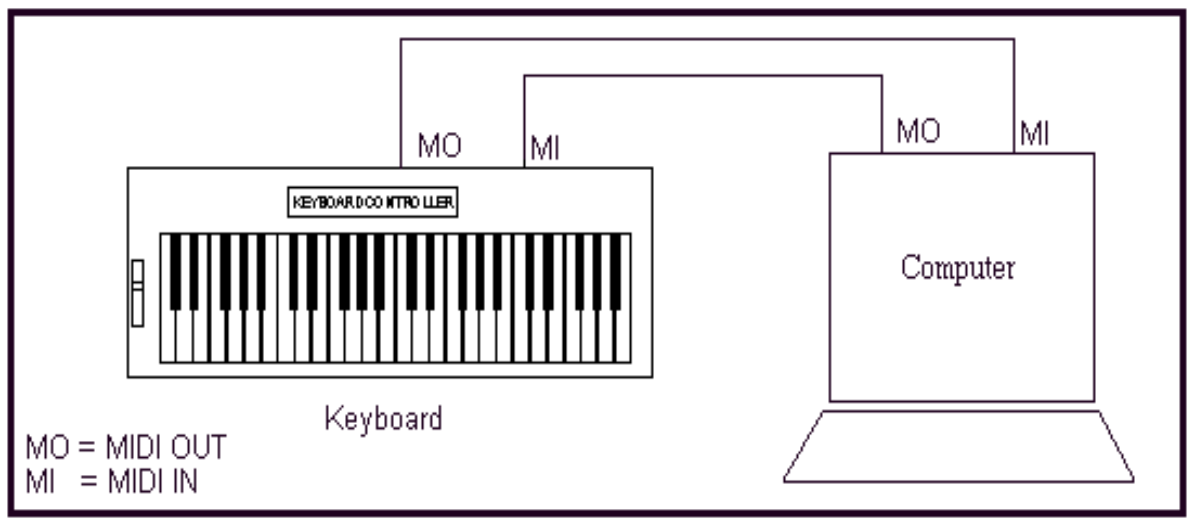
- Bi-directional serial asynchronous link with data rate of 31,250 bits per second (UART)
  - 320µs to transmit 10 bits (MIDI byte is 8 data bits plus a start bit and a stop bit = 10 bits)
  - In 1s can transmit >3000 bytes
- Uses a 5-pin 180° DIN connector
  - Pins 1 & 3 not used
  - Pins 4 & 5 carry 5mA current loop
  - +5v = binary 0, 0v = binary 1
- Opto-isolation to prevent interference



Port requirements

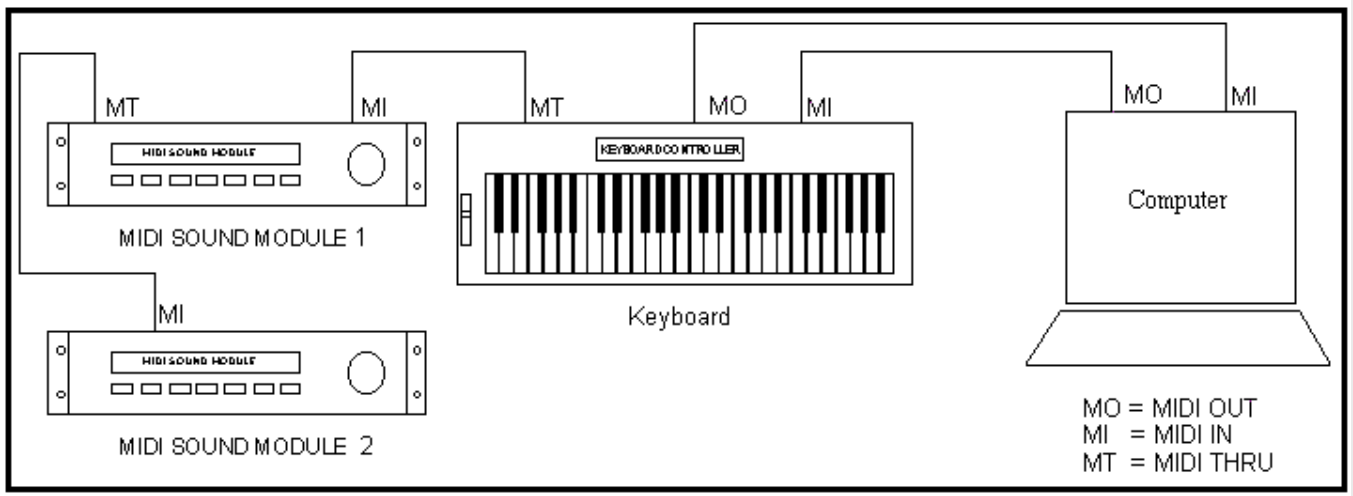
- A MIDI device must have
  - MIDI-IN and MIDI-OUT ports
  - Optionally MIDI-THRU
    - ★ Thru port transmits a copy of data received on the IN port

Connections 1 - synth to computer

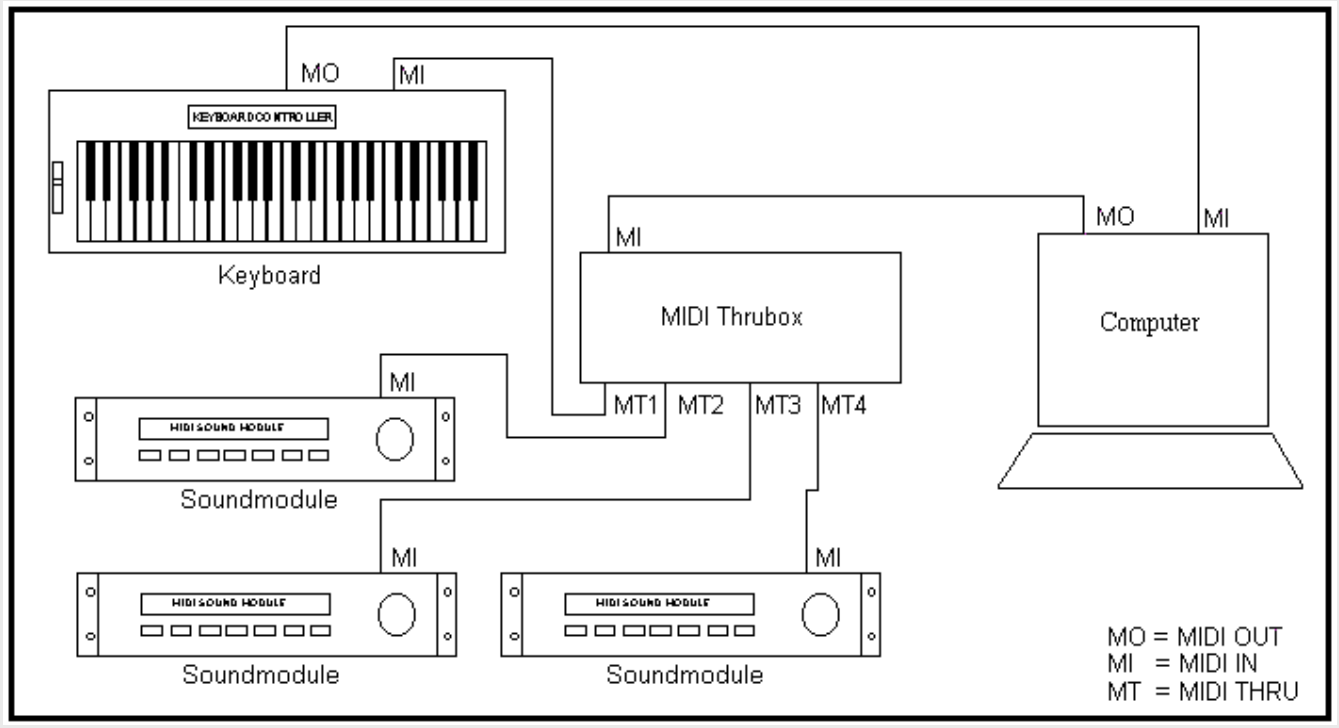


From http://www.midipage.nl/uk_midi_aansl_1.html

Connections 2 - more complex



Connections 3 – star network



MIDI bytes

- Two types of information: status & data
- Status messages generally indicate actions (e.g. pressing a key on the synth)
- Data bytes supply the information for the status byte (e.g. velocity of key press)

MIDI message

- A MIDI message has one status byte followed by 0..n data bytes
- Status and data bytes are differentiated by bit 7
- Thus MIDI values go from 0..127 (27)

Status	**1**	0/1	0/1	0/1	0/1	0/1	0/1	0/1
	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Data	**0**	0/1	0/1	0/1	0/1	0/1	0/1	0/1
	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0

Channels

- If > 1 device connected, which one should respond to the messages?
- Messages are assigned to channels (16)
- Devices set to respond to particular channels
- Every message (except system messages) have a channel number which is stored in bits 0..3 of the status byte

Status	Message type			Channel (11)			
1	x	x	x	1	0	1	1
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0

Other messages

- Other messages allow you to
  - Select another timbre on the synthesiser (program change)
  - Add pitch bend
  - Add sustain
  - Change volume
  - etc.

MIDI files

- You can save MIDI data in Standard MIDI Files (SMF). Usually have a .MID extension
- MIDI files can be played by Windows Media Player (and others) and can be loaded and edited by MIDI sequencing software (word processors for MIDI!), e.g. Cubasis, Cubase, Logic, Cakewalk…
- MIDI files don't contain sound only MIDI language message bytes

Not a sound format

- As it's only a control language, it's not a sound format
- MIDI merely allows devices to speak the same language
- A MIDI file is a sequence of note-on note-off messages to instruct a tone generator to play music
- The sound quality is totally dependent on the quality of the synthesiser playing the file

Input & control

- MIDI input normally comes from a MIDI-equipped instrument
  - Synthesiser/digital piano, etc.
  - Guitar with MIDI converter
  - Wind instrument converters (yes)
  - CV-MIDI boxes for old synths
  - Even voice-MIDI converters
- Or from MIDI files
- Or you create MIDI data using special sequencer programs

MIDI sequencing

- Sequencers originally were hardware devices that allowed you to store sequences of control voltages to control CV synthesisers
- Sequences were normally notes, but could be filter settings, gate controls, etc
- Then MIDI hardware sequencers were developed
- At the same time, people wrote software sequencers for Atari ST, Sinclair Spectrum, BBC Micro, Commodore Amiga

Limitations of MIDI

- Not sufficient for music scoring
- Assumes a 12-tone chromatic framework
  - What about just intonation?
  - Micro tuning?
  - Enharmonic distinctions (e.g. F sharp vs. G flat)
- No way to represent performance dynamics
  - E.g. crescendo, diminuendo, etc.
- Slow serial ports
- 16 channel limit

Things to do with MIDI

- Control one synth from another
- Write and store music (sequencing)
- Write your own MIDI programs
- Sonify your own web pages (really!)
  - See www.beatnik.com (Thomas Dolby)
- Combine MIDI with audio
- Control effects boxes and light shows
  - Yes, you can do this. My reverb unit accepts MIDI controls so my synth can turn on the unit's echo