



MIDI

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MIDI

- message based protocol
- serial transfer of data
- between music instruments
- 31250 b/s
- developed in 1984
- International MIDI Association (IMA)
- MIDI Manufacturers Association (MMA)

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MIDI History

- Piano roll, other mechanical devices to play music
Subject to later session !
- Voltage control and trigger (CV/Gate)
- Contact between Roland and Sequential Circuits at NAMM (1983)
- Roland implements MPU 401 ISA card for IBM compatible computers
- Prophet 600 by Sequential Circuit: First synthesizer available 1983
- Yamaha releases FM synthesizer DX7 (1983)
- Opcode offers MMA definition of MIDI file format standard (1984)

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CV/Gate

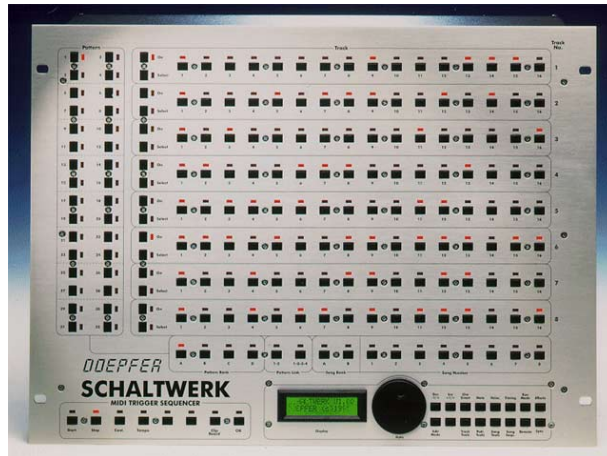
- V/OCT CV OUT - Roland, ARP, Oberheim, Sequential and Moog
- HZ/V CV OUT - Yamaha and Korg
- +12v GATE OUT
- +12v TRIGGER OUT - (+) Voltage trigger: Roland, ARP, Oberheim and Sequential. (-) Shorttrigger - Moog
- +5v ACCENT OUT
- +5v CLOCK OUT - for arpeggiator, analogue sequencers and drum machines
- +5v CLOCK RESET OUT - arpeggiator, analogue sequencers and drum machines

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Doepfer Schaltwerk - Analogue Sequencer



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Roland TR-808 Rhythm composer

TR-808 RHYTHM COMPOSER Advanced rhythm machine with integrated memory.

The Roland TR-808 is a revolutionary computer-controlled rhythm machine which offers up to 768 measures of programming at a time. In addition, this unit offers more percussive variations and more effects than virtually any other unit on the market. With it, you can visualize patterns and real time processing, program complete stores and do just about everything else a rhythm machine should do with more accuracy and less trouble.

- Number of rhythms: Basic: A/B x 12, Intro/Fill-in: A/B x 4 • Rhythm and track: 64 measures x 12 tracks (768 measures by using 12-tracks) • Auto fill-in: Manual/Auto at every 2, 4, 8, 12 and 16 measures
- Measure divisions: 32 steps can be selected at maximum as desired • Sound sources: Bass drum, Snare drum, Low, Mid, Hi Tom/Conga, Rimshot/Claves, Handclap/Maracas, Cow bell, Cymbal, Open hi-hat, Closed hi-hat, Accent
- Dimensions: 508(W) x 85(H) x 305(D)mm (20.0" x 3.4" x 12.0") • Weight: 5kg (11 lbs.)



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MIDI - termini tecnici

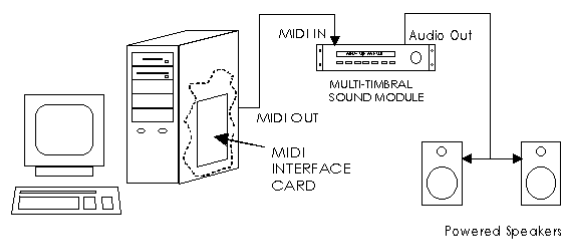
- **Channel** (16 MIDI channels to address receiving instrument)
- **Synthesizer** (sound generator)
- **Sequencer** (storage facility for several MIDI tracks)
- **Track** (... of a sequencer)
- **Voice** (sound generating part of synthesizer; synthesizer has several voices)
- **Patch** (control data to select timbre in synthesizer)
- **Pitch** (note, played by MIDI instrument)
- **Timbre** ("sound colour", or instrument, e.g., flute, cello, ...)
- **Wavetable** (data generated from sound synthesis of real instrument)

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Example MIDI configuration



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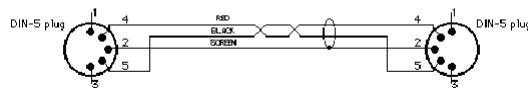


MIDI Specifications

- 31,25 KBaud, UART clock 31,25kHz
- 8 databit
- 1 startbit, 1 stopbit
- current loop at 5mA
- 5mA, current on = logical 0



Standard MIDI Cable

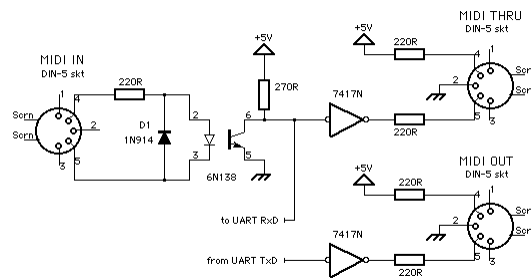


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MIDI HW implementation



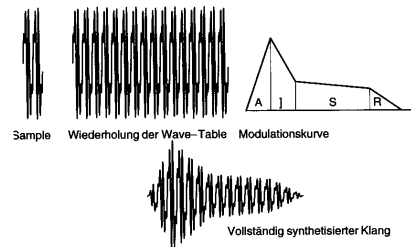
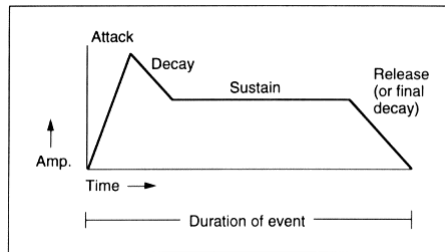
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Sound Synthesis

- FM Synthesizer
- ADSR (Attack-Decay-Sustain-Release)

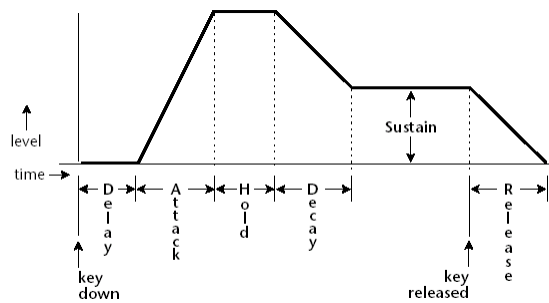
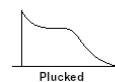
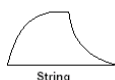
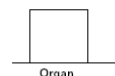
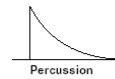


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Sound Synthesis - DAHDSR

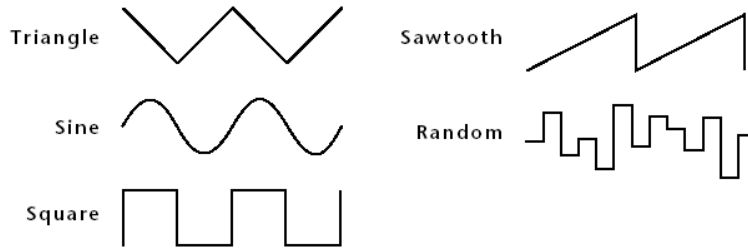


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Wave forms

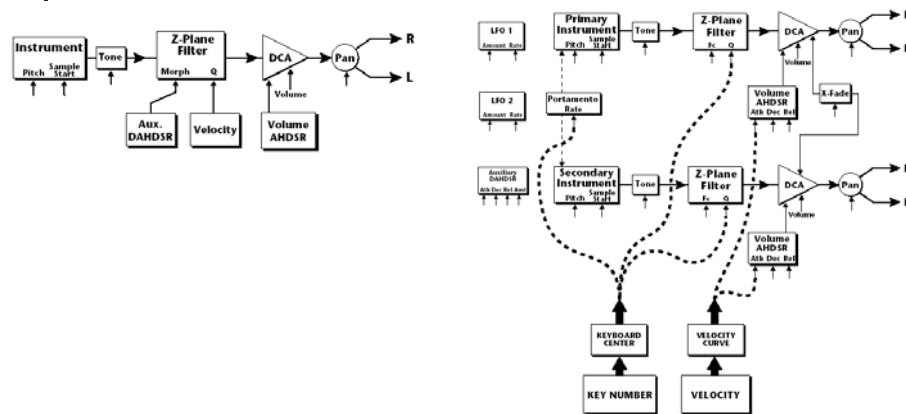


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MIDI sound generator



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MIDI version 1.0

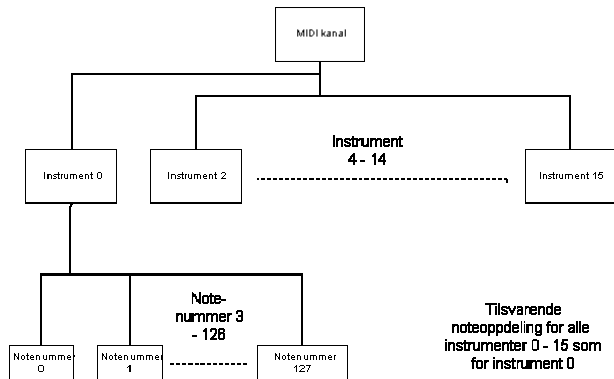
- Published by MIDI Manufacturers Association in 1983
- Defines
 - media,
 - coding,
 - HW implementation recommendations

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Channels



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MIDI Data format



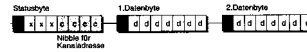
- 1 Status Byte
- 1 or two data bytes (except: system exclusive message)
- For each byte of data:
 - 1 start bit + 1 stop bit
 - most data bytes start with 0 and contain 7 bit !!!
- 16 MIDI channel address (nibble)

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MIDI Data format



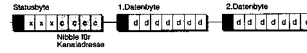
- Channel Voice Messages
 - Note Off (1000cccc 0nnnnnnn 0vvvvvvv)
 - Note On (1001cccc 0nnnnnnn 0vvvvvvv)
 - Polyphonic Key Pressure (1010cccc 0nnnnnnn 0vvvvvvv)
 - Control Change (1011cccc 0nnnnnnn 0vvvvvvv)
 - Program Change (1100cccc 0ppppppp)
 - Channel Pressure (1101cccc 0vvvvvvv)
 - Pitch Bend Change (1110 0lllllll 0mmmmmmm)

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MIDI Data format



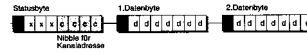
- Channel Voice Messages
- Channel Mode Messages (1011cccc Onnnnnnn Owwwwwww)

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MIDI Data format



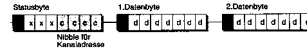
- Channel Voice Messages
- Channel Mode Messages (1011cccc Onnnnnnn Owwwwwww)
- System Common Messages (1111xxxx)
- System Exclusive (11110000 0iiiiiii Oddddddd 11110111)
- Song Position Pointer (11110010 0IIIIIII Ommmmmmm)
- Song Select (11110011 0sssssss)
- Tune Request (11110110)
- EOX (11110111)

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MIDI Data format



- Channel Voice Messages
- Channel Mode Messages (1011cccc Onnnnnnn Owwwwwww)
- System Common Messages (1111xxxx)
- System Real-Time Messages
 - Timing clock (11111000)
 - Start (11111010)
 - Continue (11111011)
 - Stop (11111100)
 - Active Sensing (11111110)
 - Reset (11111111)

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Midi data format

Parameter Data

0 - 31 continuous controllers 0 - 31, most significant byte
 32 - 63 continuous controllers 0 - 31, least significant byte
 64 - 95 on / off switches
 96 - 121 unspecified, reserved for future.
 122 - 127 the "channel mode" messages I alluded to above.

Statusbyte 0x80 - 0x8f er ikke tildelt til kanaler

byte	type	
0xf0	system exclusive	variable length
0xf1	undefined	
0xf2	song position	
0xf3	song select	
0xf4	undefined	
0xf5	undefined	
0xf6	tune request	
0xf7	EOX (terminator)	

MIDI ID for Sysex data

Roland 0x41
 Yamaha 0x43
 S.I.E.L. 0x21

Statusbyte	Etterfølgende databyte
0x80-0x8f note off	1 byte pitch, etterfulgt av 1 byte velocity
0x90-0x9f note on	1 byte pitch, etterfulgt av 1 byte velocity
0xa0-0xaf key pressure	1 byte pitch, 1 byte pressure (after-touch)
0xb0-0xbf parameter	1 byte parameter nummer, 1 byte setting
0xc0-0xcf program	1 byte program selected
0xd0-0xdf chan. pressure	1 byte channel pressure (after-touch)
0xe0-0xef pitch wheel	2 byte gir en 14 bit value, minst signifikante 7 bit først

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GM 1 - General Midi version 1

- Standard for instruments for playing GM files
- Implemented on
 - sound card for computers,
 - sound modules
- Roughly: Defines melody only!

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General Midi 2

- New! Chorus Feedback
- New! Chorus Send to Reverb
- New! Controller Destination Setting
- New! Scale/Octave Tuning Adjust
- New! Key-Based Instrument Controllers
- New! GM2 System On
- GM 2 INSTRUMENT SOUND SET
- GM 2 PERCUSSION SOUND SET

Number of Notes: 32 simultaneous notes
 MIDI Channels: 16
 - Simultaneous Melodic Instruments = up to 16 (all Channels)
 - Simultaneous Percussion Kits = up to 2 (Channel 10/11)
 SUPPORTED CONTROL CHANGE MESSAGES (Some Optional)
 - Bank Select (cc#0/32)
 - Modulation Depth (cc#1)
 - Portamento Time (cc#5)
 - Channel Volume (cc#7)
 - Pan (cc#10)
 - Expression (cc#11)
 - Hold1 (Damper) (cc#64)
 - Portamento ON/OFF (cc#65)
 - Sostenuuto (cc#66)
 - Soft (cc#67)
 - Filter Resonance (Timbre/Harmonic Intensity) (cc#71)
 - Release Time (cc#72)
 - Attack time (cc#73)
 - Brightness (cc#74)
 - Decay Time (cc#75)
 - Vibrato Rate (cc#76)
 - Vibrato Depth (cc#77)
 - Vibrato Delay (cc#78)
 - Reverb Send Level (cc#91)
 - Chorus Send Level (cc#93)
 - Data Entry (cc#96/98)
 - RPN LSB/MSB (cc#100/101)
 SUPPORTED RPNs (Registered Parameter Numbers)
 - Pitch Bend Sensitivity
 - Channel Fine Tune
 - Channel Coarse Tune
 - New! Modulation Depth Range (Vibrato Depth Range)
 - RPN NULL
 SUPPORTED UNIVERSAL SYSTEM EXCLUSIVE MESSAGES
 - Master Volume
 - New! Master Fine Tuning
 - New! Master Coarse Tuning
 - New! Reverb Type
 - New! Reverb Time
 - New! Chorus Type
 - New! Chorus Mod Rate
 - New! Chorus Mod Depth

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DLS-2.1 - Downloadable soundformat 2.1

- Predecessor was DLS-1
- Accepted January 2000
- DownLoadable Sounds
- Standard requires the following:

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Requirements for DLS 2.1

1. A sampled sound source with loop and release
2. Two 6-segment envelope generators characterised as DAHDSR (Delay-Attack-Hold-Decay-Sustain-Release)
3. Two Low Frequency Oscillator (LFO) generators
4. A low pass filter with resonance and dynamic filter cut-off frequency
5. Standardised response to MIDI controllers

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DLS 2.1: Minimum Device Requirements:

6. Min. 32 digital oscillators, each with individually controlled DCA, DCF, LFO generators (two per oscillator), and envelope generators (two per oscillator).
7. Minimum sample playback rate of 22.05 KHz
8. Minimum sample memory of 1,048,576 x 16-bit words
9. Minimum of 512 waves stored simultaneously
10. Minimum of 256 instruments stored simultaneously
11. Minimum of 1,024 regions stored simultaneously
12. Minimum of 8,192 explicit connections stored simultaneously
13. If the device claims support for both DLS and GM, it must be able to support both of them simultaneously.

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SMF Lyric Meta Event Definition

- MMA document RP-017
- Defines file format for lyrics representation included in MIDI format
 - Approved by MMA 11/14/97
 - Approved by AMEI 10/3/97

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The Future of MIDI

- MIDI over 1394 - Firewire
 - 1394 - Developed by Apple (mid 1990)
 - Bandwidth: 400Mbps
 - up to 63 devices on same bus
 - Combines video, audio and MIDI on same bus
- MIDI over USB

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MIDI applications

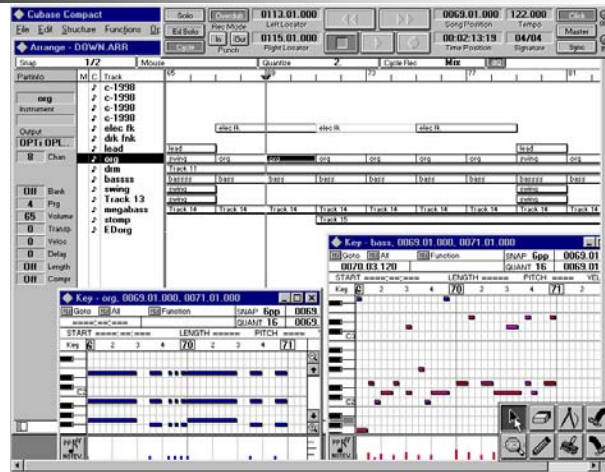
- Sequencers
- Combination of multi track hard disk recording
- control of hardware mixers
- control of other types of HW: e.g., light, robots, ...

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User Interface for Cubase



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User Interface for Logic Audio



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Literature

- www.midi.org - MMA
- <http://www.ibiblio.org/emusic-1/info-docs-FAQs/MIDI-doc/index.html>
- <http://www.borg.com/jglatt/> - MIDI Technical Fanatic's Brainwashing Center

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End of Part

Thank you for your attention!



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