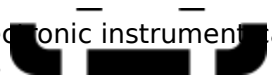
Introduction to MIDI

MIDI (**M**usical **I**nstrument **D**igital **I**nterface) was developed in 1983 as a means of allowing synthesizers from different manufacturers to communicate with one another.

The presence of MIDI capability on any electronic instrument can easily be determined by looking for the round 5 pin DIN connectors  usually located on a rear panel. Some smaller or older electronic instruments are not MIDI equipped.

There are three types of MIDI connector - MIDI IN, MIDI OUT and MIDI THRU. MIDI IN receives messages, MIDI OUT sends messages, and MIDI THRU sends a copy of messages received at the MIDI IN connector.

MIDI Interfaces
MIDI Channels
Tracks
MIDI Messages
Program Changes

MIDI interfaces

Roland was the first company to produce a MIDI processing unit, the MPU-401. This made possible the productive relationship between computers, electronic musical instruments, and musicians. There are now many companies that produce MIDI interface cards - including Midisoft, which produces the Midiface card.

Although some keyboards have hardware sequencers built in, software sequencers combined with a MIDI interface greatly expand the flexibility and memory capacities of MIDI sequencing. Our software works with several MIDI interface cards, including the Midisoft Midiface, the Roland MPU-401, and MPU-401 compatibles (Music Quest, CMS and others).

MIDI messages

There are two MIDI message types: **Channel** messages and **System** messages.

A Channel message includes a Channel number within the message. It is received and understood by any device which is set to that particular Channel, and ignored by any device set to a different Channel. The most basic Channel message is a Note On message. When you press a key on a synthesizer keyboard, a Note On message is sent out with the specific key number encoded within it. When you release the key, a corresponding Note Off message is sent. Other information can be carried by a Channel message, such as Velocity, Volume, Pitch Bend, and Aftertouch.

A System message is meant to be received and understood by all devices that are connected, regardless of their Channel setting. These messages control synchronization between devices, as well as special manufacturer-specific modes of operation.

MIDI Channels

MIDI specifies 16 separate MIDI Channels. Therefore, with one MIDI cable you can control up to 16 different instruments at once.

The concept of MIDI Channels is similar to the idea of television channels. Each television station sends a signal within a particular frequency range. Your television set receives many different ranges (or channels) at once. You then tune your television set to a particular frequency range. You may change ranges (channels) and the program displayed on your picture tube changes accordingly.

To relate this to MIDI, imagine you have a keyboard that sends out on MIDI Channel 7. You record a part into your sequencer. As you play back the sequence, you decide that you want to have the MIDI information control a synthesizer set to a trumpet sound. You would then set the synthesizer to receive on Channel 7, and the MIDI data from the sequencer would cause the synthesizer to play. Another method available on many sequencers is to change the Channel assignment on the recorded part to match the synthesizer's MIDI receive Channel.

Regardless of which device does the Channel tuning or changing, the point to remember is that both the sending device (e.g., the sequencer) and the receiving device (e.g. the synthesizer) must be set to the same MIDI Channel, or no sound will result.

Program Changes

A Program Change message causes any devices tuned to the same Channel to change internal settings corresponding to the number sent. On many synthesizers, this causes a change in patch (or instrument sound). MIDI specifies a possible range of 128 Program Change numbers. Most manufacturers have organized patches in different sequences; for example, Program Change 45 may call up a trumpet on one synthesizer and a harpsichord on another. As of this writing, there is a new standard for Program Change assignments between different synthesizers called General MIDI, but instruments following this standard are just beginning to appear.

Tracks

Tracks are not really part of MIDI, but most sequencers use the concept of tracks on which MIDI data is recorded. We mention it here to distinguish tracks from MIDI Channels.

In a professional recording studio, a multi-track tape recorder is one that records on multiple sections of the tape. Each section is a discrete area called a track. Even though you can record an entire orchestra on one track, you gain much more flexibility by recording each instrument on its own track. This way, if you find that an instrument was too soft or loud, you can adjust that instrument without affecting any others.

The same holds true for MIDI sequencers. You can record each instrument on its own track, and later go back and adjust or edit only the MIDI data on that particular track.

See

More on Tracks

More on Tracks

It is easy to get confused when you look at the number of MIDI Channels (16) compared with the number of sequencer tracks (often many more). Why have more than 16 tracks?

A look at traditional music recording can help to answer this question. In most multi-track studios, even if you are recording a small group (with 4 instruments), you will use many tracks for partial or alternate takes. Possibly you will put the guitar playing verse 1 and chorus 1 on track five, and then put the guitar playing the second verse and chorus on track six. Or you may record ten versions of the sax solo, and choose between them, or put together a final solo that incorporates pieces from many of the takes.

With only 4 tracks to record the above 4 instruments, you lose the ability to experiment.

In a MIDI sequencer, you can make a copy of a track before going off the deep end with editing features, knowing there is an untouched version to revert to if you decide that you have gone too far.

A common technique is to place Program Changes, MIDI Volume messages, various Controller messages, or Pitch Bend messages on individual tracks. This way, you can mute or disable the effect of these messages selectively.

Most sequencers today offer a minimum of sixteen tracks, with many offering more.

Introduction to Musical Notation

Musical notation is a form of communication of musical events, much like MIDI. The three basic attributes of a typical note are:

- **Pitch**
- **Duration**
- **Location in time**

Pitch

The pitch of a note is represented by its vertical position on the five-line staff.

All pitches in Western music correspond to letter names (A through G), with optional flat or sharp assignments.

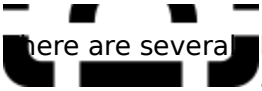
Two notes can have the same letter name, but be different pitches. For instance, if one note is an A (with a frequency vibration of 440 Hz) and a second note is also an A (with a frequency of 880 Hz), the pitches are an octave apart.

A grouping of successive pitches that span an octave is called a **scale**.

See

- Clefs
- Key Signatures

Clefs



There are several clefs in use today. The most common are the treble clef and bass clef .

The reason several clefs are necessary is because there is such a wide range of pitches produced by musical instruments. A standard piano keyboard has 88 keys, but a staff can only comfortably contain about 15 different pitches. Music for keyboards is commonly divided into two staves, treble and bass clefs, divided at Middle C.

Ledger lines indicate notes that fall above or below the staff itself. These are particularly important for instruments which can produce a wide range of pitches, such as the violin (always scored in the treble clef).

Key signatures

Standard (Western) music has twelve notes, from which we derive twelve keys. Each key gets its name from its starting, or tonic note.

Every key contains a different amount of sharps and flats  (the black keys on a piano keyboard). The key of C major contains no sharps or flats, the key of A major contains three sharps, and the key of F major contains one flat.

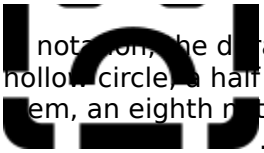
For keys with sharps or flats, a key signature showing these sharps or flats in their proper order and position on the staff appears after the clef. Any affected pitches are played either sharp or flat for the duration of the song, unless indicated by a natural sign.

Sharps and flats never appear in the same key signature.

In music, sometimes notes occur that are not part of the key in which you are playing. In this case you would use an accidental (a temporary natural, sharp or flat). An accidental applies to every subsequent occurrence of that note for the whole measure. If you want that note to return to its proper assignation, you must place the appropriate sharp, flat or natural sign before the next desired occurrence of the note.

Each key signature relates to two keys, one major and one minor. For example, the key signature is the same for C major and A minor.

Duration



In notation, the duration of a note is represented by its particular shape. A whole note is a hollow circle, a half note is a hollow circle with a stem, a quarter note is a filled circle with a stem, an eighth note is a filled circle that has a flag on its stem, and so on .

A whole note = 2 half notes = 4 quarter notes = 8 eighth notes etc.

In addition to note duration, there is also rest duration. A rest is the absence of a note, and actually contributes significantly to the aesthetic quality of music. Rest durations are the same as note durations.

See

- Dotted notes and Ties

Dotted notes and ties

A dot  placed after a note increases its duration by one-half. For instance, placing a dot after a half note (equal to two beats) increases its duration to three beats.

A tie  placed between two notes of identical pitch adds the value of the second note to the first note. This is similar to dotting a note, but is used when you need a duration that is not possible with dotting (such as seven eighth notes). A tie is also used when a note sustains from one measure to the next, across a bar line.

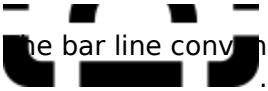
Location

The location in time of a note is represented by its horizontal position on the five-line staff.

See

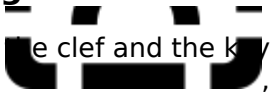
- Measures
- Time Signatures

Measures



The bar line conveniently divides a piece of music into manageable areas, called measures . It is simply a vertical bar that intersects the staff at regular intervals (specified by the time signature). Measures do not affect the way the music sounds, but act as markers to help you keep track of your location in the music.

Time signatures

Following the clef and the key signature at the beginning of a piece of music is the time signature  , also called the meter. Unlike the clef and key signature which appear at the beginning of every staff, the time signature appears only once, unless the time signature changes during the piece.

The time signature seen most frequently is 4/4, also known as Common time. Also seen frequently is 3/4, or waltz time.

More unusual meters such as 5/4 and 12/8 are found in jazz and progressive music. Common meters are found in popular styles because they are more accessible, due to their greater predictability.

Time signatures consist of two numbers, written like a fraction.

The top number indicates the number of beats in a measure. The bottom number indicates the duration of one beat. For instance, in 3/4 time there are three beats to a measure, and each beat is equal to a quarter note. In 5/8 time there are 5 beats to a measure, and each beat is equal to an eighth note.

General MIDI

General MIDI specifies a patch-naming scheme, so that all synthesizers that conform to the standard will play a flute sound when they receive a Program Change 73, for example. Many popular synthesizers have MIDI Mapper files designed so that the synthesizer is General MIDI compatible when used with Windows 3.1/Multimedia Windows.

PIANO

0	Acoustic Grand Piano	1	Bright Acoustic Piano
2	Electric Grand Piano	3	Honky-tonk Piano
4	Rhodes Piano	5	Chorused Piano
6	Harpsichord	7	Clavinet

CHROMATIC PERCUSSION

8	Celesta	9	Glockenspiel
10	Music box	11	Vibraphone
12	Marimba	13	Xylophone
14	Tubular Bells	15	Dulcimer

ORGAN

16	Hammond Organ	17	Percussive Organ
18	Rock Organ	19	Church Organ
20	Reed Organ	21	Accordion
22	Harmonica	23	Tango Accordion

GUITAR

24	Acoustic Guitar (nylon)	25	Acoustic Guitar (steel)
26	Electric Guitar (jazz)	27	Electric Guitar (clean)
28	Electric Guitar (muted)	29	Overdriven Guitar
30	Distortion Guitar	31	Guitar Harmonics

BASS

32	Acoustic Bass	33	Electric Bass (finger)
34	Electric Bass (pick)	35	Fretless Bass
36	Slap Bass 1	37	Slap Bass 2
38	Synth Bass 1	39	Synth Bass 2

STRINGS

40	Violin	41	Viola
42	Cello	43	Contrabass
44	Tremolo Strings	45	Pizzicato Strings
46	Orchestral Harp	47	Timpani

ENSEMBLE

48	String Ensemble 1	49	String Ensemble 2
50	SynthStrings 1	51	SynthStrings 2
52	Choir Aahs	53	Voice Oohs
54	Synth Voice	55	Orchestra Hit

BRASS

56	Trumpet	57	Trombone
58	Tuba	59	Muted Trumpet
60	French Horn	61	Brass Section
62	Synth Brass 1	63	Synth Brass 2

REED

64	Soprano Sax	65	Alto Sax
66	Tenor Sax	67	Baritone Sax
68	Oboe	69	English Horn
70	Bassoon	71	Clarinet

PIPE

72	Piccolo	73	Flute
74	Recorder	75	Pan Flute
76	Bottle Blow	77	Shakuhachi
78	Whistle	79	Ocarina

SYNTH LEAD

80	Lead 1 (square)	81	Lead 2 (sawtooth)
82	Lead 3 (calliope lead)	83	Lead 4 (chiff lead)
84	Lead 5 (charang)	85	Lead 6 (voice)
86	Lead 7 (fifths)	87	Lead 8 (bass + lead)

SYNTH PAD

88	Pad 1 (new age)	89	Pad 2 (warm)
90	Pad 3 (polysynth)	91	Pad 4 (choir)
92	Pad 5 (bowed)	93	Pad 6 (metallic)
94	Pad 7 (halo)	95	Pad 8 (sweep)

SYNTH EFFECTS

96	FX 1 (rain)	97	FX 2 (soundtrack)
98	FX 3 (crystal)	99	FX 4 (atmosphere)
100	FX 5 (brightness)	101	FX 6 (goblins)
102	FX 7 (echoes)	103	FX 8 (sci-fi)

ETHNIC

104	Sitar	105	Banjo
106	Shamisen	107	Koto
108	Kalimba	109	Bagpipe
110	Fiddle	111	Shanai

PERCUSSIVE

112	Tinkle Bell	113	Agogo
114	Steel Drums	115	Woodblock
116	Taiko Drum	117	Melodic Tom
118	Synth Drum	119	Reverse Cymbal

SOUND EFFECTS

120	Guitar Fret Noise	121	Breath Noise
122	Seashore	123	Bird Tweet
124	Telephone Ring	125	Helicopter
126	Applause	127	Gunshot

Percussion Key Map

35 Acoustic Bass Drum	36 Bass Drum 1
37 Side Stick	38 Acoustic Snare
39 Hand Clap	40 Electric Snare
41 Low Floor Tom	42 Closed Hi Hat
43 High Floor Tom	44 Pedal Hi Hat
45 Low Tom	46 Open Hi Hat
47 Low-Mid Tom	48 Hi-Mid Tom
49 Crash Cymbal 1	50 High Tom
51 Ride Cymbal 1	52 Chinese Cymbal
53 Ride Bell	54 Tambourine
55 Splash Cymbal	56 Cowbell
57 Crash Cymbal 2	58 Vibraslap
59 Ride Cymbal 2	60 Hi Bongo
61 Lo Bongo	62 Mute Hi Conga
63 Open Hi Conga	64 Low Conga
65 High Timbale	66 Low Timbale
67 High Agogo	68 Low Agogo
69 Cabasa	70 Maracas
71 Short Whistle	72 Long Whistle
73 Short Guiro	74 Long Guiro
75 Claves	76 Hi Wood Block
77 Low Wood Block	78 Mute Cuica
79 Open Cuica	80 Mute Triangle
81 Open Triangle	

Aftertouch.

(MIDI term) Pressure applied to the keys of a MIDI keyboard after they are depressed. Some MIDI keyboards send this special information, although many devices do not respond to aftertouch. There are two types of aftertouch: **key**, or polyphonic aftertouch (each key sends out aftertouch independently), and **channel** aftertouch (all keys send out the same message).

Channel.

(MIDI term) The MIDI standard allows 16 MIDI channels. Each channel can potentially be assigned to a different MIDI instrument - the MIDI instruments each know which channel(s) to recognize and which to ignore.

Clef.

In musical notation, a symbol that indicates the pitch range of a staff. A treble clef indicates a high range; a bass clef indicates a low one.

Controller.

(MIDI term) A device used to output MIDI messages (e.g. wind controller).

Default.

A number, word or setting that a program assumes without any input by the user.

IRQ or Interrupt.

IBM PC compatible computers use interrupts to let peripherals share the time and resources of the computer. Each peripheral (printer, MIDI interface, modem, etc.) must be assigned a unique IRQ, or interrupt. If two devices are set for the same IRQ, the result will be anything from unreliable operation to complete failure.

MIDI.

Musical Instrument Digital Interface. A language that electronic instruments and computers use to communicate information about musical performance. A sequencer sends and receives messages using the MIDI language so that it can "talk" to any instrument that also uses MIDI. MIDI information is typically sent using a round five-pin (DIN) connector.

MIDI Volume.

A MIDI Controller message that affects the loudness of all notes on a particular MIDI Channel. Compare to *Velocity*.

Patch.

Information that a synthesizer uses to define a specific sound waveform (timbre). See *Program Change*.

Pitch Bend.

(MIDI term) A MIDI message that controls the continuous change of pitch. This often deserves special mention because the MIDI language sends special signals to communicate the Pitch Bend information.

Program Change.

(MIDI term) A MIDI message sent to and from instruments that changes the patch or sound information for that instrument, resulting in a different timbre. See *Patch*.

Sequencer.

A MIDI multi-track recorder.

Track.

A sequencer term, each voice is displayed on the screen and has its own set of music and performance features. A voice can be polyphonic (many simultaneous notes), but cannot be set to more than one MIDI channel.

Velocity.

A synthesizer and MIDI term that means how hard the musical key is pressed (or released). For keyboards that have velocity control, this can affect the loudness or other tonal quality of the sound. Compare to *MIDI Volume*.