Terms of electronic music synthesis

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ADSR Envelope Generator

English abbreviation EG. Envelope generator in synthesizers for the realization of sound effects. ADSR is the abbreviation for the envelope phases attack-decay-sustain-release. See envelope.

Aftertouch

Channel and note-specific MIDI event, which evaluates a keystroke on the keyboard that has changed after a note has been activated. The keyboard's reaction to aftertouch is not defined by default, but a vibrato effect is normally generated.

Amplitude

Width of the deflection of a sinusoidal oscillation. Increasing the volume of sounds is equivalent to increasing their amplitude.

Asynchronous

Data transmission technology between a transmitter and a receiver that is not synchronised in time. See MIDI.

Attack

Phase of envelopes. Attack Time Controller Event No. 73 defines the duration of the attack phase of a note according to NoteON.

Bandpass filter

Abbreviation BPF (Band Pass Filter). Electronic filter function that only allows a frequency range (band) of sounds to pass through, limited both upwards and downwards. See also Blocking Pass Filter, Low Pass Filter and High Pass Filter.

BPM

See Tempo

Brightness

Sound Brightness Controller Event No. 74 changes the filter cutoff frequency. Higher parameter values cause sharper sounds.

Byte

Data unit of computer technology. A byte consists of eight bits, each of which can take the values 0 or 1. Thus a byte can only contain whole numbers between 0 and 255. The status bytes of MIDI events have values between 128 and 255, data bytes have values between 0 and 127.

Channel

see channel.

Channel Press

Today only little used MIDI-Event. In contrast to Aftertouch, Channel Press does not affect individual notes, but the entire keyboard. Keyboards use Aftertouch when each key is equipped with its own pressure sensor, otherwise Channel Press is generated.

Chord

The chord notations (chords) used in MIDI, e.g. F#m6, are stored as special chord events. Chord events are evaluated for protocol purposes or for the automatic generation of polyphonic sounds (harmony effects) for keyboards.

Chorus

Chorus is a sound effect in which the sound is superimposed with a sound derived from it. The frequencies are slightly altered in the process. This effect gives the feeling of a chorus, i.e. the interaction of several identical instruments. The sound effect is controlled by controller event no. 93 or via XG SysEx.

Controller Events

Standardised, i.e. manufacturer-independent MIDI events that affect or otherwise control certain effects when sound is generated by MIDI devices. Controller events have channel-specific effects. Controller events are used, for example, to switch voice banks and set sound effects such as main volume, sustain and portamento. Not all of the 128 possible controller events are specified in GM. Normally only a part of them is implemented in the MIDI devices.

Decay

see envelope curve.

Delay

see envelope curve.

drum kit

A drum kit consists of a number of percussion sounds (drums) in which, unlike melody voices, each key is assigned a different sound. Channel 10 is reserved at GM exclusively for standardised GM percussion. In XG, for example, several drum kits are provided, which are addressed via voice bank and voice number. XG also allows drum kits to have channel numbers other than 10.

DSP

DSP is the abbreviation for Digital Signal Processor. With DSP's the sounds are changed in their digitalised form. Powerful software and hardware functions perform complicated mathematical calculations to create effects such as delays, echoes, reverb, polyphony.

Equilizer

Equilizers (abbreviation EQ) are hardware or software functions that change the volume (amplitude) of sounds depending on their frequency. They can be used, for example, to amplify bass or suppress high frequencies.

Envelope

synonymous with envelope.

Event

English Event or message. Elementary MIDI instruction that is sent or received. MIDI songs are transmitted as a time-controlled sequence of events. Each event has a clearly defined effect on the MIDI device in the MIDI specifications. An event consists of a sequence of bytes of varying length. It is introduced by a so-called status byte with values between 128 and 255, i.e. the first bit is occupied. The subsequent data bytes of the event have values between 0 and 127, i.e. the first bit is zero.

Expression

Controller event no. 11 determines the percentage effective share of the channel-specific main volume volume. If, for example, Controller No. 7 Main Volume is set to 80 and Expression is set to 64, i.e. 50%, the effective volume is only half the Main Volume value. Expression is mainly used for diminuendo and crescendo.

Filter

Function in synthesizers that filters (eliminates) frequency ranges from sounds. A distinction is made between low pass filter, high pass filter, band pass filter and reject filter.

Filter Cutoff Frequency

Cut-off frequency, from which all higher frequencies of sounds are filtered out by low-pass filters or all lower frequencies by high-pass filters. The width of the transition range between the filtered and unfiltered frequencies can be manipulated. The steepness of the transition is specified in db/freq. In MIDI, the filter cutoff frequency is influenced by controller event no. 74 (Brightness).

Filter Resonance

The resonance of the low-pass filter causes an additional amplification factor of the higher frequencies directly before the filter cutoff frequency. This effect makes the sound sharper. In MIDI the filter resonance is influenced by controller event no. 71 (Harmonic Content).

Frequency

Number of periods of an oscillation per time unit (second). Specified in Hertz (hz). The frequency is a measure for the pitch. Doubling the frequency causes the tone to increase by one octave.

Gain

English profit. Effectively audible increase in the volume of sounds.

General MIDI

see GM.

GM

GM (General MIDI) are agreements that MIDI device manufacturers have made among themselves to achieve compatibility of the MIDI protocol. GM allows manufacturer-specific extensions such as XG (YAMAHA) and GS (Roland); these do not contradict the GM agreements, but are not compatible with each other.

GM1 (General MIDI Level 1) was adopted by MIDI device manufacturers in 1991 as a generally accepted MIDI standard. Most MIDI devices and especially sound cards are able to process sequences of MIDI events or MIDI files that meet this standard. In GM 128 voices are defined, which are divided into 16 voice groups. Channel 10 was reserved exclusively for drum kits. This was the first time that music data could be exchanged between devices from different manufacturers.

At the end of 1999, an extension of GM1 was agreed with GM2 (General MIDI Level 2), which in particular removes the limitation to 128 voices. In addition, there is an increase in polyphony to at least 32, a series of controller events and RPNs for effect control and new universal SysEx. In future, MIDI devices from Roland and YAMAHA will be able to process GM2 as well as GM1. XG and GS are not backward compatible to GM2.

GS

The GS format introduced by Roland is a manufacturer-specific extension of the GM Level 1 standard. A number of new voices and new controller events have been introduced. The extensions do not violate the GM standard, so that playback of normal GM1 MIDI files is also possible.

Harmonic Content

Controller Event No. 71 is used to influence the frequency content of the sounds. Higher parameter values produce eccentric sounds.

Hexadecimal

In data technology frequently used spelling of numbers. In contrast to decimal numbers, which are based on the number base 10, hexadecimal numbers have the number base 16, whereby the (decimal) numbers 10 to 15 are represented by letters a to f.

Comparison of decimal and hexadecimal numbers:

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	...
0	1	2	3	4	5	6	7	8	9	a	b	c	d	e	f	10	11	...

SysEx events are usually documented as sequences of hexadecimal numbers.

High Pass Filter

English abbreviation HPF (High Pass Filter). An electronic filter that only allows a frequency range of sounds to pass through that is limited by the filter cutoff frequency. See also Bandpass Filter, Low Pass Filter and Blocking Pass Filter.

Envelope curve

English term "envelope". Volume progression over time during the playback of a sound. The envelope is divided into several sections:

Delay	Start delay after pressing the key
Attack	Settling phase until the maximum volume is reached
Decay	Decay phase until a certain volume is reached
Sustain	Phase in which the volume is held
Release	Decay phase after releasing the key.

The envelope can be influenced by controller events, in XG also by SysEx. See also ADSR Envelope Generator.

Channel

MIDI devices normally know exactly 16 independent "addresses" of elementary sound generators for the transmission or acceptance and processing of MIDI events. These addresses are called channels. Exactly one voice can be assigned to each channel so that only up to 16 different voices can be played at any one time. Normally the channels are named with the numbers 1, 2, ...16. Channel 10 is usually reserved for drum kits only.

LFO

Abbreviation for Low Frequency Oscillator. Component or function in synthesizers.

LSB

Abbreviation for Least Significant Byte. Data in MIDI events can only accept values between 0 and 127. If in individual cases larger numbers are required, two data are transmitted: MSB and LSB. The resulting number is then calculated using the formula 128*MSB + LSB.

Lyric Event

In MIDI, a special event is used to store song lyrics. Lyric events are used for time-controlled logging of lyrics parallel to music (karaoke).

Main Volume

Channel-specific setting of the playback volume. The value range is between 0 (mute) and 127 (maximum volume). Main Volume is to be distinguished from Velocity, Expression and also from the channel independent setting of the Master Volume on the keyboard. Main Volume is set by controller event no. 7.

MBT

The sequence of events in MIDI files are arranged one after the other according to the execution time. Each event is assigned a timestamp that shows when it will be executed. In the event list of sequencers, the time is generally displayed as so-called MBT or M:B:T using the three numbers measure, beat and tick.
In the example MBT 0058:04:0253 the event is in bar 58 and there 253 ticks after the fourth beat. The beat is defined by the time signature valid at this time.
A 3/4 bar has three beats of a quarter note, a 6/8 bar has 6 beats of an eighth note. The size PPQN defined in the MIDI file defines the number of ticks per quarter note. Thus the number of ticks in a 3/4 bar is in the range of 0 <= tick < PPQN; in a 6/8 bar 0 <= tick < PPQN/2 applies.

MIDI

MIDI is an asynchronous serial interface for the transmission of music data between MIDI devices. Here, not the analog sounds to be evaluated are transmitted, but only "commands" to a sound generator (synthesizer), through which the sound to be finally output via loudspeakers is generated. The variety of transmitted MIDI commands (events) provides sufficient information for a high-quality sound image. However, the quality of the reproduction is highly dependent on the performance of the synthesizer. MIDI is standardised under the name General MIDI.

MIDI devices

Hardware such as PC sound cards, sound modules, keyboards, etc., which is capable of generating, sending, receiving or processing MIDI via MIDI cables.

MIDI 0

synonymous with SMF0

MIDI 1

synonymous with SMF1

MIDI file

An SMF-MIDI file is a standardised file format for music data (songs) that can provide all the information needed to operate the MIDI interface. MIDI files contain sequences of MIDI events, each with its own time stamp. The generation of MIDI files from a stream of MIDI events or by manual editing and vice versa the generation of the time-controlled sequence of MIDI events based on MIDI files is the task of sequencer programs.
See also SMF 0 and SMF 1

MIDI Specification

Binding description of MIDI instructions for standard and also manufacturer-specific MIDI implementations.

Modulation

Channel-specific sound effect that can be manipulated with controller event no. 1. Usually this creates a vibrato effect. However, the keyboard's modulation wheel affects several channels simultaneously.

MSB

Abbreviation for Most Significant Byte. See also LSB

Note OFF

MIDI event that causes the termination of a sound activated with Note ON.
Instead of Note OFF, Note ON with Velocity=0 can be transmitted with the same effect.

Note ON

MIDI event that causes a sound to sound. With a note ON, the channel, note value and velocity are sent. In contrast, note OFF.

NRPN

Abbreviation for Non-registered Parameter Number. Manufacturer-specific extensions to the parameterisation of controllers by applying a special sequence of controller events.

Oscillator

Component in synthesizers for generating periodic waveforms such as sine, sawtooth, square and triangular curves. VCO (Voltage Controlled Oscillator) and LFO (Low Frequency Osillator) are used in synthesizers.

Panorama

Stereo effect, synonymous with panpot.

Panpot

Stereo effect. The channel-specific setting is made via controller event no. 10. The parameter value 0 specifies only the left and 127 only the right audio output. With 64, the same intensity is output on both outputs (middle position).

Patch

Synonymous with voice.

Percussion Voice

Group of percussion instruments, synonymous with drum kit.

Polyphony

Maximum number of tones that can be generated in parallel on synthesizers. The assignment of the tones to channels is not important. GM (Level 1) requires a polyphony of at least 24.

Portamento

This is the sliding transition from one note to another, if the notes are activated slightly overlapping. The control is done with the controller events no. 5 and no. 65.

PPQN

In MIDI files a size PPQN is defined. PPQN is the abbreviation for "Pulses per Quarter Note"; in English "number of ticks of a quarter note". PPQN is the smallest time unit used by the sound generator when playing. At very small values the sound generator will quantize short notes, in this case the performance will sound artificial because the timing that gives the music a "human" feeling is lost. Today's MIDI files have a PPQN of 480 and higher - currently up to 1920 for modern sound generators.
The duration of a tick depends on the current tempo BPM of the MIDI files. With PPQN 480 and BPM 120 a tick lasts about one millisecond. This corresponds approximately to the resolution of the timers under Windows.

Program

synonymous with voice

Programme Change

MIDI event with which a new voice is switched channel-specifically. When using voice banks, the new voice is taken from the currently set bank.

Release

Release Time Controller Event No. 72 sets the time for a note to decay after Note Off.
See also envelope curve

Reverb

Reverb is a sound effect in which the sound is overlaid by many short sound delays of different lengths. This creates a reverb effect of varying intensity. The intensity of the sound effect is controlled by controller event no. 91 or by XG SysEx.

RPN

Abbreviation for Registered Parameter Number. Standardised extensions of the parameterisation of controllers by applying a special sequence of controller events. RPNs are used for the Master Tuning functions (changing the pitch) and for adjusting the sensitivity of the Pitch Bend. See also NRPN.

Sedecimal

synonymous with hexadecimal

Sequencer

Software programme with which MIDI files as well as the MIDI interface for other MIDI devices can be created. Well known sequencer programs are Cubase, Cakewalk and XGWorks.

Serial

Transmission technology of data. Here, the data are transmitted one after the other over only one data line. This is in contrast to parallel data transmission, in which data is transmitted simultaneously over several line connections.

SMF

Abbreviation for "Standard MIDI File". SMF is standardised and is implemented in two variants, format 0 (SMF 0) and format 1 (SMF 1). A third format SMF 2 is no longer current today.

SMF 0

A MIDI file of format SMF 0 consists of exactly one track that records all MIDI events

SMF 1

A format 1 MIDI file contains several tracks, each of which contains a group of MIDI events. Normally a separate track is created for all events of a channel. Often additional tracks are created for controller, lyrics, chord events or just for comments.

Sound Effects

The application of sound effects affects the playback of voices. To create these effects some controller events are available, e.g. for Vibrato, Reverb, Chorus, Harmony Content, Brightness, Portamento, Panpot. The Yamaha XG SysEx can be used to create a variety of additional DSP effects, e.g. different types of reverb and echo.

Blocking pass filter

The term "Band Reject" or "Notch" filter. Electronic filter that only blocks a frequency range of sounds that is limited upwards and downwards. Lower and higher frequencies are let through. See also band-pass filter, low-pass filter and high-pass filter.

Track

Equivalent to track.

Status Byte

First byte of a MIDI event to identify the event type. Value range between 128 and 255.

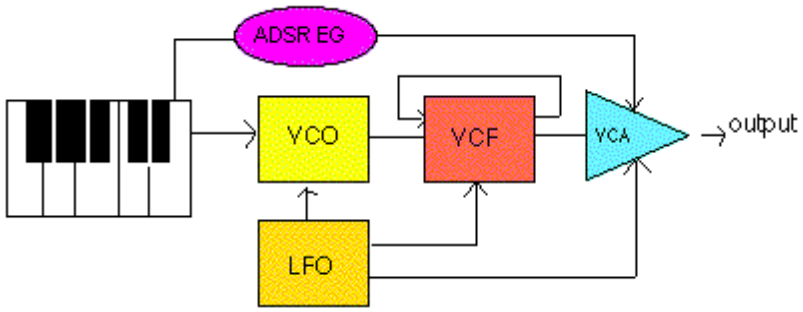
Sustain

Holding a sound. The sustain effect is switched on and off by the channel-specific controller event no. 64. With many MIDI devices, sustain acts on several channels. Sustain is created on the keyboard by the sustain pedal.
See also envelope curve

Synthesizer

Originally, this term is used for a tone generator whose sounds are produced exclusively on the basis of electronic circuits. Today it is also used to describe a device that generates sounds using waveforms, i.e. from digitised analogue material.

Basic structure:



When a key is pressed on the keyboard (touch, key value, aftertouch), different electrical voltages (volts) are generated which control the functions of the synthesizer. VCO (Voltage Controlled Oscillator) is the actual source of the sound oscillations. LFO (Low Frequency Oscillator) generates oscillations between 0.01 and 25 Hz. LFO is influenced by the modulation wheel, among other things, and produces vibrato effects. The VCO output is then modified by VCF (Voltage Controlled Filter) and VCA (Voltage Controlled Amplifier). VCA is additionally controlled by the ADSR envelope generator. VCA and VCF can also be controlled by LFOs.
The electronic filters VCF are divided into low-pass filter, high-pass filter, band-pass filter and reject filter. With VCF a part of the VCF output can be re-introduced. This allows reverb, echo and harmony effects to be created. The process is called resonance.

The functions of analogue synthesizers described here are also available in digital synthesizers. Instead of the VCO, a so-called DCO (Digital Controlled Oscillator) is used.

SysEx

Abbreviation for System Exclusive Event.
Manufacturer and MIDI device-specific event for controlling special device functions such as device initialisation or parameterisation of digital signal processors (DSP).
SysEx are usually represented as a sequence of hexadecimal numbers. With a few exceptions (e.g. the SysEx Turn General MIDI System On) the second byte is an identification number of a manufacturer, which is defined worldwide. This enables MIDI devices to read instructions from other manufacturers that are unknown to them.

System Exclusive Event

synonymous with SysEx

Tempo

The tempo of MIDI files is internally controlled by a meta-event through three bytes tt tt tt as the number of microseconds per quarter note.

However, MIDI sequencers usually indicate the tempo of a piece of music as BPM (beats per minute or number of beats per minute), with the beat generally referring to quarter notes. BPM of MIDI files thus indicates how many quarter notes are played in each minute during playback.
BPM is calculated from hex (tt tt tt) in the tempo event by "60.000.000 divided by dec(tt tt tt)".

Tick

See PPQN

Low pass filter

English abbreviation LPF (Low Pass Filter). Electronic filter function that only allows a frequency range of sounds limited by the filter cutoff frequency to pass. See also Bandpass Filter, Blocking Pass Filter and High Pass Filter.

Track

MIDI files consist of one (for SMF 0) or more (for SMF 1) successive groupings, the tracks or tracks, of MIDI events separated by a special "End of Track" event. Each track has its own time management starting with 1:1:0. While in SMF 0 all events of the MIDI file are contained in the single track, in SMF 1 they are distributed in several tracks and must therefore be processed in parallel. In SMF 1 the events for each channel are normally stored in separate tracks. Often, separate tracks are also created for controller events, lyric or chord events. The term track or track must not be confused with channel.

Turn General MIDI System On

This is a manufacturer-independent SysEx that enables GM-compatible MIDI devices to play MIDI files of type GM Level1. The devices are thereby set to an initial state. This SysEx is usually the first event in a MIDI file.
"Turn General MIDI System On" is defined by the hexadecimal number sequence "`f0 7e 7f 09 01 f7`".

Variation

Controller Event No. 94 is used to set the intensity of the variation effect. The variation effect has different characteristics. On XG-Devices the variation only works if the device is set to the state "Connection System" and the desired variation effect with SysEx-Events.

VCA

Abbreviation for Voltage Controlled Amplifier. Component or function of synthesizers. VCA is responsible for amplitude modulation (volume and envelope).

VCF

Abbreviation for Voltage Controlled Filter. Component or function of synthesizers. VCF is responsible for cutting out frequency ranges, see filters.

VCO

Abbreviation for Voltage Controlled Oscillator. Component or function of synthesizers.

Velocity

Strength of a key. Value range from 0 to 127. Velocity is transmitted as a parameter of Note-ON MIDI events.

Voice

A voice (also known as a patch or program) is a MIDI sound provided on MIDI synthesizers. The assignment of a voice to a MIDI channel is made by the program change event and a voice number. GM Level 1 knows 128 voices by default, which are assigned to sixteen voice groups. Modern MIDI devices use voice banks, which each provide an additional set of up to 128 voices.

Voice Bank

In modern MIDI devices more than the 128 GM1 voices are provided. This is done by switching the channel to further sets of up to 128 additional voices each, the so-called voice banks. Switching to voice banks is done with controller events no. 0 and no. 32. The voice is only activated by a subsequent programme change event.

Voice Groups

The 128 melody sounds of General-Midi, which are defined by voice numbers, are divided into sixteen groups of eight voices each, each assigned to a specific type of sound.

Group	Voice numbers
Piano	0-7
Chrome Percussion	8-15
Organ	16-23
Guitar	24-31
Bass	32-39
Strings	40-47
Ensemble	48-55
Brass	56-63
Reed	64-71
Pipe	72-79
Synth Lead	80-87
Synth Pad	88-95
Synth Effects	96-103
Ethnic	104-111
Percussive	112-119
sound effects	120-127

Normally, this assignment is also followed by the manufacturers for voice non-GM voice banks.

Voice number

Numerical specification of a voice. It is used as a parameter in the Program Change Event. While only numbers between 0 and 127 can be used here, numbers higher by 1 are often used in sequencer programs and in manuals, which sometimes adds to the confusion.

Wah effect

This effect is achieved by changing the centre frequency of equalizers over time or by changing the filter cutoff frequency. The wah-effect can be set more easily as Variation SysEx.

XF

Yamaha's own extension of XG MIDI files. The special instructions allow you to store lyrics, chords, titles, and copyright information. XF MIDI files can generally be played on GM1 MIDI devices without significant limitations.

XG

The XG format introduced by Yamaha is a manufacturer-specific extension of the GM Level 1 standard, similar to Roland's GS format. It introduced 480 new Yamaha-specific XG voices, a number of special drum kits and a large number of Yamaha XG SysEx to control special DSP effects. The extensions are backward compatible, allowing playback of normal GM1 MIDI files on XG MIDI devices.

XG System On

This is a SysEx for XG-enabled MIDI devices, which enables XG synthesizers to play XG type MIDI files. This puts the devices into an initial state. This SysEx is usually the second event in a MIDI file after the SysEx Turn General MIDI System On.
"XG System On" is defined by the hexadecimal number sequence "`f0 43 10 4c 00 00 7e 00 f7`".

End