

Appendix F

Continuous Controllers in the MIDI Specification

Excerpted from “MIDI for the Professional”, by Paul D. Lehrman and Tim Tully. Copyright © 1993 Amsco Publications, a division of Music Sales Corporation. International Copyright Secured. All Rights Reserved. Reprinted by Permission.

Of the 128 possible Continuous Controllers in the MIDI Spec, many are defined either in terms of being part of a transmitter, a receiver, or both. Controllers 120 and above are reserved for Mode messages, and although they can be used for real-time expressive purposes, it's best not to, for fear of confusing some receiving devices.

The first 64: 14-bits?

The first 64 Controllers were originally designed so that they could be sent in pairs, as 14-bit Controllers. When Controller pairs are used, the lower-numbered Controller is sent first, and its value is considered the Most Significant Byte (MSB) of the command. The higher-numbered Controller follows immediately afterwards, with the Least Significant Byte (LSB). Combined, the two Controllers constitute a single message with a resolution of 16,384 discrete values, as opposed to the 128 available with a single Controller. The MIDI Specification says that an MSB can be sent without an LSB. As it turns out, with the exception of Bank Select (where it is probably the *least* useful), almost *nobody* has bothered to implement 14-bit controllers in any hardware or software. Although the practice is still called for in the MIDI Spec, it is essentially moribund, and Controllers 33-63 are considered more or less up for grabs.

Here's how the first 64 Controllers are defined and used:

Decimal	Hex	Name	Applications and note
00/32	00/20	Bank Select	see Chapters 5, 8, and 9
01/33	01/21	Modulation	Transmitter is a wheel or lever; receiver is usually vibrato depth. PC88 default assignment (01) is Wheel 2.
02/34	02/22	Breath	Transmitter is a breath controller originally made by Yamaha or part of a wind controller; receiver is usually related to loudness or timbral change. Also, many early Korg keyboards used this to transmit information from one axis of a joystick.
03/35	03/23	undefined	Original DX7 used this for aftertouch
04/36	04/24	Foot Pedal	Transmitter is a foot pedal; receiver is loudness or timbral change. PC88 default assignment (04) is Pedal 2 and Slider C.
05/37	05/25	Portamento Time	Transmitter is a slider; receiver controls time to glide from one note to the next when Portamento switch (41H) is On.
06/38	06/26	Data Entry	Transmitter is a slider; receiver is any parameter change, used in conjunction with Registered and Non-Registered parameters (62-65H)
07/39	07/27	Main Volume	Transmitter is a slider or pedal

08/40	08/28	Balance	Transmitter is a slider; receiver is the balance between two layers of a sound, or the wet/dry mix of an effects device
09/41	09/29	undefined	
10/42	0A/2A	Pan	Transmitter is a slider; receiver changes stereo pan position of sound
11/43	0B/2B	Expression	Transmitter is a pedal; works in conjunction with 07 (Volume) to make “temporary” volume changes or performance inflections. Volume can be thought of as a fader on a console, while Expression the pedal on an organ. PC88 default assignment (11) is Pedal 1.
12/44	0C/2C	Effect Control 1	Transmitter is a slider or knob; receiver is a control in an effects device—reverb, delay, equalizer, etc.—which might be send, wet/dry mix, or a particular parameter of the effect
13/45	0D/2D	Effect Control 2	same as Effect Control 1
14/46	0E/2E	undefined	
15/47	0F/2F	undefined	
16/48	10/30	General Purpose #1	Transmitter and receiver can be anything. General Purpose Controllers are designated essentially to prevent them from being defined for anything specific. This controller is also used by some transmitters for the x-axis position of a joystick.
17/49	11/31	General Purpose #2	Used by some transmitters for the y-axis position of a joystick.
18/50	12/32	General Purpose #3	
19/51	13/33	General Purpose #4	

The remainder of the set, 20-31 and 52-63, are at present undefined.

The Switches: 64-69

The next set of Controllers was originally reserved for binary switched functions, transmitted by momentary-contact or locking pedals, and could have one of only two values: 0 (off) or 127 (on). The MIDI Spec says a receiver is supposed to consider any values between 0 and 63 to be “off”, and values 64 and up to be “on”, although some older receivers interpret any value above 0 as “on”. These Controllers are still used as switches for the most part, but some manufacturers use them as full-value (0-127) Controllers.

Decimal	Hex	Name	Applications and notes
64	40	Sustain	Also known as Damper or Hold #1. Retains Sustain portion of sound's envelope on all notes played, until turned off. In some instruments with complex envelopes, it turns on a special Release segment, to allow the sound to die away more slowly. PC88 default assignment is Switch Pedal 1.
65	41	Portamento	Turns on and off Portamento Control (see 05H and 54H)
66	42	Sostenuto	Sustains notes that are being held when the control is turned on, but subsequent played notes (unlike 40H) are not sustained. PC88 default assignment is Switch Pedal 2.
67	43	Soft Pedal	Lowers volume and/or softens timbre by a pre-set amount
68	44	Legato Footswitch	Puts receiver into "legato" mode: only one note can sound at a time, and overlapping notes result in change of pitch without re-attacking.
69	45	Hold #2 or Freeze	A second hold pedal that sustains a portion of the sound, like the middle pedal on an upright piano; or that triggers an alternate Release segment (like 40H).

Sound Controllers: 70-79

These ten Controllers, officially known as "Sound Controllers #1-10", have been set up to allow a common and easy way to accomplish real-time control over a variety of timbral characteristics of a sound in any synthesizer, without having to deal with individual manufacturers' System Exclusive commands. Exactly how these Controllers work is entirely up to the manufacturer, and the user doesn't have to know about it—all he or she needs to know is that increasing Controller 74 makes the sound brighter.

Decimal	Hex	Name	Applications and notes
70	46	Sound Variation	Deliberately vague. Once upon a time, this Controller was "Velocity Replace", but it was never implemented by anybody.
71	47	Harmonic Content	Richness or intensity of timbre. PC88 default assignment is Button E
72	48	Release Time	Length of release portion of envelope. PC88 default assignment is Slider D.
73	49	Attack Time	Length of attack portion of envelope
74	4A	Brightness	High-end content
75-79	4B-4F	Sound Controllers #6-#10	Undefined

Controllers 80-97

Decimal	Hex	Name	Applications and notes
80-83	50-53	General Purpose #5-#8	Similar to 16-19 and 48-51. The PC88 uses #83 to set Algorithms for the Internal effects processor.
84	54	Portamento Control	When Portamento Switch (41H) is turned on, and Portamento Time (05H) is not zero, the value of this Controller is the number of the note at which the glide will <i>start</i> .
85-90	55-5A	Undefined	The PC88 uses #90 to set Algorithms for the VGM effects processor.
91	5B	Effect 1 Depth	Most commonly used as an effects “send”, but can be used for any effects-related control. Roland GS instruments use this as a reverb send. The PC88 uses this for “Reverb Wet” control of the Internal effects processor.
92	5C	Effect 2 Depth	The PC88 uses this for “Reverb Wet” control of the VGM effects processor.
93	5D	Effect 3 Depth	Roland GS instruments use this as a chorus send. The PC88 uses this for “Effects Wet” control of the Internal effects processor.
94	5E	Effect 4 Depth	The PC88 uses this for “Effects Wet” control of the VGM effects processor.
95	5F	Effect 5 Depth	Similar to 91
96	60	Data Increment	The transmitter is a button, usually labelled “+1” or “Yes”, so this is a “unipolar” controller, with only one value: 127=On. Similarly to Data Entry (06), the receiver is any parameter change, and this can be used in conjunction with Registered and Non-Registered parameters (98-101).
97	61	Data Decrement	The opposite of 96, the transmitting button is labelled “-1” or “No”. Receivers are the same.

Registered and Non-Registered Parameters: Controllers 98-101

Decimal	Hex	Name
98	62	Non-Registered Parameter Least Significant Byte (LSB)
99	63	Non-Registered Parameter Most Significant Byte (MSB)
100	64	Registered Parameter Least Significant Byte (LSB)
101	65	Registered Parameter Most Significant Byte (MSB)

Registered and Non-Registered Parameters combine three commands. The first two define the Parameter to be changed: the first is the Parameter number’s Least Significant Byte (LSB), and the second its Most Significant Byte

(MSB). The third command is a Data Slider (06) followed by the desired value, or else a Data Increment or Decrement (96 or 97), which increases or decreases the current value of the selected Parameter by 1.

Non-Registered Parameters can be anything a manufacturer wants them to be: any parameter in a synthesizer, sampler, effects device, mixing console, lighting controller, etc. that is remotely addressable can be set up as a Non-Registered Parameter. Registered Parameters, however, have certain specific functions, which are defined in the MIDI Specification. These are:

Decimal (MSB/LSB)	Hex (MSB/LSB)	Name	Applications
----------------------	------------------	------	--------------

00/00	00/00	Pitch Bend Sensitivity	Range of the Pitch Bend wheel, with the MSB referring to semitones and the LSB to cents (1/100ths of a semitone) The PC88 transmits and responds to this message (“BndRng”).
00/01	00/01	Fine Tuning	Tuning of the receiving device, with each increment of the LSB equal to 1/8192nd of a semitone, and an overall range (using both MSB and LSB) of -1 to +1 semitone. The PC88 responds to this message (“Tuning”).
00/02	00/02	Coarse Tuning	Tuning of the receiving device in semitones, with a range of -64 to +64. The PC88 responds to this message (“Recv Trans”).
00/03	00/03	Tuning Program Select	Selects a scale tuning that is stored in the device’s RAM.
00/04	00/04	Tuning Bank Select	Selects a bank of tunings, which is then followed by selection of a particular tuning program (RPN 03).
127/127	7F/7F	Null Function	This “turns off” the last RPN or NRPN so that the Data Slider and Data Increment/ Decrement switches can be used for something else. Its use is optional, but it can help to avoid confusion in very complex data streams.

102-119: Uncharted Territory

Controllers 102 through 119 do not have specific functions. On the Kurzweil PC88, however, these four do:

Decimal	Hex	Name	Applications and notes
---------	-----	------	------------------------

116	74	Arpeggiator Active	A switch, turns the Arpeggiator on and off.
117	75	Arpeggiator Velocity	Determines the play velocity for Arpeggiated notes when the Arpeggiator Velocity Mode is set to “Ctrl”
118	76	Arpeggiator Latch 2	A switch, latches currently-played notes so the Arpeggiator will process them, and un-latches them. (Pedals mode only)
119	77	Arpeggiator Latch 1	A switch, latches currently-played notes so the Arpeggiator will process them, and un-latches them.

120-127: Mode Messages

Above 119, Controller messages are considered “mode messages”, and have specific functions that address an entire instrument, rather than a single voice.

Decimal	Hex	Name	Applications and notes
120	78	All Sound Off	Instantly mutes the sound without changing the Volume (Controller 07)
121	79	Reset All Controllers	Set all Controllers (and Pitchbend) to their initial or default values.
122	7A	Local Control Off	“De-couples” control surface (keyboard) and sound-producing circuits for use with sequencers.
123	7B	All Notes Off	Turns off or forces into the release segment of their envelopes all sounding notes.
124	7C	Omni Off	Takes instrument out of Omni mode (so it can receive on one or more individual channels).
125	7D	Omni On	Puts instrument into Omni mode (it will play all incoming MIDI data, regardless of channel).
126	7E	Mono On	Puts instrument in Mono mode, in which only one note can play per channel. Used for solo instruments.
127	7F	Poly On	Puts instrument in Poly mode, in which multiple notes can play per channel (the usual way things are done!)