

An Introduction To



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**Yamaha Corporation of America, CBX Group,
P.O. Box 6600, Buena Park, CA 90622**

Introduction

For more than a decade, MIDI has provided musicians with a powerful set of tools, forever changing the way we create and listen to music. MIDI has proven to be a durable standard and has undergone relatively few refinements through the years. But the original specification provided few exact guidelines as to how these tools should be used. This has proven to be a double-edged sword—on the one hand, manufacturers have had the freedom to implement MIDI in a variety of unique and forward-thinking ways, but on the other hand, end users have sometimes been frustrated by the lack of consistency from one instrument to the next.

The widespread introduction of MIDI music files (such as sequencer files and “SMFs,” short for “Standard MIDI Files”) in the late 1980s highlighted this inconsistency, since there was no guarantee that a file created on one MIDI instrument would sound at all the same when played back on a different instrument. For example, one instrument might have a guitar preset stored in memory slot #18, while another might have a tuba preset stored in the same slot. Also, one instrument’s drum kit might use note number 40 for a bass drum sound, while another might use note number 40 for a snare drum sound.

General MIDI

In 1991, the American and Japanese organizations that oversee the MIDI specification sought to increase consistency by introducing a “recommended practice” called General MIDI (GM for short). This is a set of rules and minimum requirements for instruments which are categorized as “General MIDI-compatible.” These rules can be summarized as follows:

- The instrument must provide a minimum of 24-voice polyphony and at least 16-way multitimbral capability.
- The instrument must have a minimum of 128 preset sounds, accessed via standard MIDI program change messages. This “General MIDI Sound Set” is organized into 16 groupings of 8 presets each. For example, piano presets are always stored in memory slots 1 - 8, bass presets in slots 33 - 40, etc.
- Key-based percussion must always be on channel 10. A “GM Percussion Map” for key numbers #35 - #81 is specified and must be utilized.
- The instrument must be able to receive MIDI note on/note off and velocity messages, as well as channel pressure, pitch bend and RPNs (Registered Parameter Numbers) for realtime control of pitchbend sensitivity and master coarse and fine tuning.
- The instrument must be able to receive nine specific control change (“cc”) messages: Modulation (cc #1), Volume (cc #7), Pan (cc #10), Expression (cc #11), Sustain (cc #64), RPNs (Registered Parameter Numbers) (cc #100, #101), Reset All Controllers (cc #121), and All Notes Off (cc #123)
- The instrument must be able to receive two specific Universal Non-Realtime System Exclusive messages: “Turn GM System On” and “Turn GM System Off.”

These rules not only guarantee a good degree of compatibility from one instrument to the next but also ensure that a MIDI music file will retain its essential character when played on different General MIDI instruments.

Enter XG

General MIDI was a terrific idea that has also proven to be a commercial success. It has opened up the world of MIDI to thousands of musicians who do not wish to get involved in technical intricacies. But GM is limited to basic MIDI functions and is unable to support the full powers of today's multi-timbral tone generators. As we enter the multimedia age, it is time for the introduction of an enhanced format that builds on the foundation laid by General MIDI—and that format is XG.

Yamaha's development of the XG format has focused on the following three key goals:

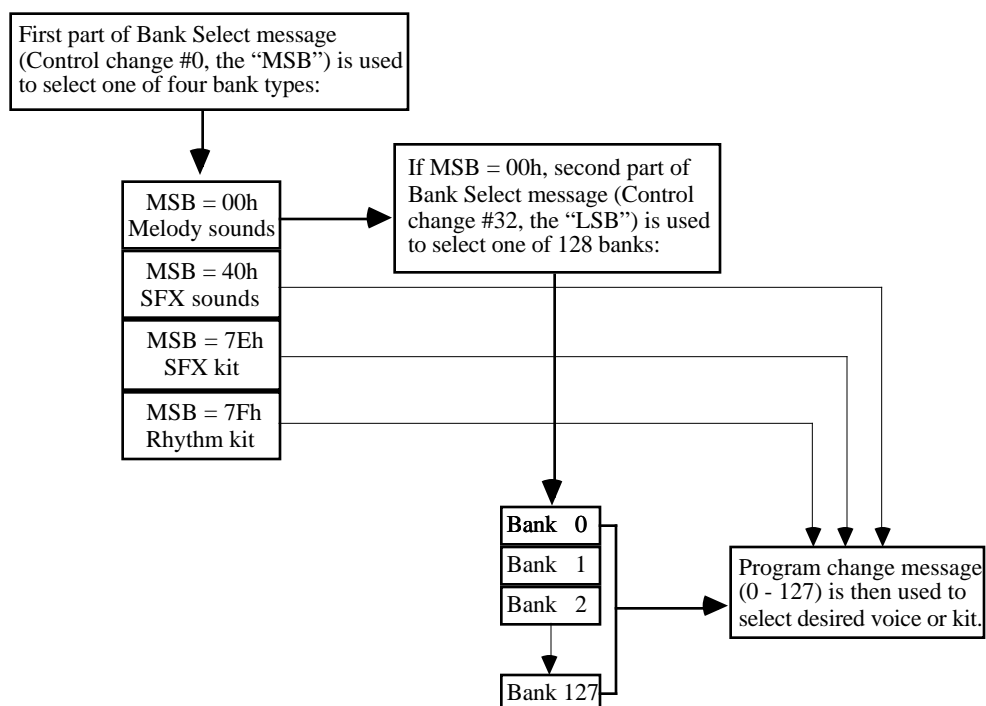
- 1. Compatibility** - Any XG instrument, regardless of model or manufacturer, will provide faithful reproduction of XG music files—and will also be completely 100% General MIDI-compatible, since *it is an enhancement to, and not a replacement for,* General MIDI. You can think of General MIDI as being a kind of minimum “building code”—all XG instruments are built “to code” but then add a large number of new features (we'll talk about these shortly) that make them more like luxury condos!
- 2. Scalability** - There are actually three different levels of XG compatibility. The first level is implemented in instruments such as the Yamaha MU50; the second level is implemented in instruments such as the Yamaha MU80; and details of the third level will be announced shortly. These different levels mean that we'll be seeing a wide range of XG instruments in the years ahead, each with its own character and each offering a unique feature set at a different price point. Each, however, will faithfully replay XG data in accordance with its level of sophistication—if a particular instrument doesn't support a variation voice, for example, it will automatically substitute the corresponding basic GM voice.
- 3. Expandability** - The XG format—like MIDI itself—is an “open” architecture, which will allow for the addition of new enhancements as future technology continues to evolve.

XG Features

The XG format expands on the General MIDI standard in the following major areas:

1. Number of voices - GM supports 128 voices (accessed via MIDI program change messages 0 - 127), which seemed like a lot back in 1991. But reduced memory costs enable today's MIDI instruments to store many hundreds (or even thousands!) of voices, giving musicians a much broader sonic palette from which to work. The XG format enables access to literally thousands of voices by utilizing MIDI Bank Select (Control change #0 and #32) messages.

2. Voice organization - GM stipulates that its 128-voice sound set be organized into 16 groupings of 8 presets each. XG instruments take things many steps further by using the first part of the Bank Select message (Control change #0, the "MSB") to select any of four bank types: Melody sounds, SFX (Special Effects) sounds, SFX kit (the SFX sounds, mapped one to a key), and Rhythm kit (various drum and percussion sounds, mapped one to a key). The second part of the Bank Select message (Control change #32, the "LSB") is then used to select any of 128 banks of Melody sounds, each containing 128 presets (which are accessed by standard MIDI program change messages). Program change messages are also used to select different SFX sounds, SFX kits or Rhythm Kits. The illustration below shows how this works:



Note that, in all XG instruments, Melody sounds Bank 0 contains the standard GM sound set (other banks contain what are known as "variation" voices) and Rhythm Kit #1 utilizes the standard GM note mapping (other "variation" Rhythm Kits are accessed with program change messages. Because these are the

defaults selected when a “GM System On” message is received by an XG instrument, you can be sure of complete compatibility when playing back GM music files.

3. Polyphony - GM instruments are required to have only a 24-note minimum polyphony, while XG instruments are required to have at least 32. This facilitates the creation of dense instrumentations and the use of multiple complex sounds.

4. Optional Support for Additional MIDI channels - The XG format supports up to 32 MIDI channels, enabling full 32-way multitimbral operation.

5. Additional Rhythm Channels - Following the GM convention, XG instruments normally use MIDI channel 10 for rhythm parts (though, unlike GM, channel 10 can optionally be designated for melody parts). However, the XG format allows additional channels to be designated for rhythm parts as well, allowing the musician to easily create complex drum and percussion parts.

6. Support for Internal Effects - Sometimes it’s amazing how the addition of one little effect can completely change the character of a sound. However, GM has no provision for the usage of internal effects processors. The XG format addresses this deficiency by providing support for a minimum of three different internal effects (Reverb, Chorus, and a switchable global or “insertion” effect) as well as for a fourth internal “insertion” effect and an optional internal master graphic equalizer. Standardized MIDI messages are used to set the send levels of each of these effects (per channel, and, in the case of Rhythm or SFX kits, per individual voice) as well as the parameters of internal effects. This allows the musician to create complete, finished productions in one XG instrument, all under complete MIDI control.

7. Optional Support for External Audio (A/D) Input - The XG format allows you to participate in your MIDI music by providing optional support for external audio input. XG instruments that utilize this feature have an audio input jack into which you can plug a microphone, electric guitar, or any line-level source. This signal is digitized by a chip called an Analog-to-Digital (A/D) converter and is then routed to the internal effects processors, same as your MIDI data—great for multimedia and karaoke applications!

8. Voice Modification - GM specifies the use of only a handful of control sources for the realtime modification of voices. XG supplements these with more than a dozen additional control change messages, including Sostenuuto and Soft pedal, data increment/decrement, and portamento time. There is also support for realtime control of voice filter and envelope settings, as well as effects levels. In addition, XG uses a series of Non-Registered Parameter Numbers (NRPNs) for realtime control over variables such as vibrato rate, depth and delay, and for enabling the user to alter filter cutoff frequency, envelope, pitch, level, pan, and effects send levels of *individual* drum voices within a Rhythm or SFX kit.

XG Music Data

The introduction of GM in 1991 quickly led to the proliferation of commercially available GM music data—standard MIDI files on disk, optimized for playback on GM instruments. Similarly, a wide range of XG music data (again, standard MIDI files on disk, but optimized for playback on XG instruments) will shortly be available. This data will conform to Yamaha’s “XG Format Music Data Production Recommendations” document, thus ensuring compatibility when played back on any XG instrument. XG music files differ from GM music files in that they support 32-note polyphony and can contain multiple rhythm parts. In addition, they may contain data which automatically customizes internal effects, sets preset external A/D input levels, and provides enhanced expressive realtime voice control during playback.

Comparative Table: GM vs. XG

The table below shows the major distinctions between GM and XG; bear in mind, however, that *XG instruments are always completely GM-compatible*.

	GM	XG
Number of MIDI channels supported	16	16 minimum; 32 supported
Minimum polyphony	24	32
Minimum multi-timbral capability	16	16 minimum; 32 supported
Number of voices supported	128	Thousands
Bank Select (cc #0 and #32) supported	No	Yes
Support for multiple Rhythm parts	No	Yes
Support for effects (internal or external)	No	Yes
Support for external audio input	No	Yes
Control change messages supported	#1 (Modulation), #7 (Volume), #10 (Panpot), #11 (Expression), #64 (Sustain), #100, 101 (RPNs), #121 (Reset All Controllers), #123 (All Notes Off)	All GM controllers <i>plus</i> #0 & #32 (Bank Select), #5 (Portamento Time), #65 (Portamento), #66 (Sostenuto), #67 (Soft Pedal), #71 (Harmonic Content), #72 (Release Time), #73 (Attack Time), #74 (Brightness), #84 (Portamento Control), #91 (Effect 1 Depth [Reverb]), #93 (Effect 3 Depth [Chorus]), #94 (Effect 4 Depth [Variation]), #96 (Data Increment), #97 (Data Decrement), #98 & #99 (NRPNs), #120 (All Sound Off), #124 (Omni Off), #125 (Omni On), #126 (Mono On), #127 (Poly On)