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3rd Edition

# The **MIDI** Manual

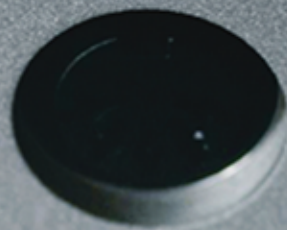
A Practical Guide to MIDI in the Project Studio

MIDI

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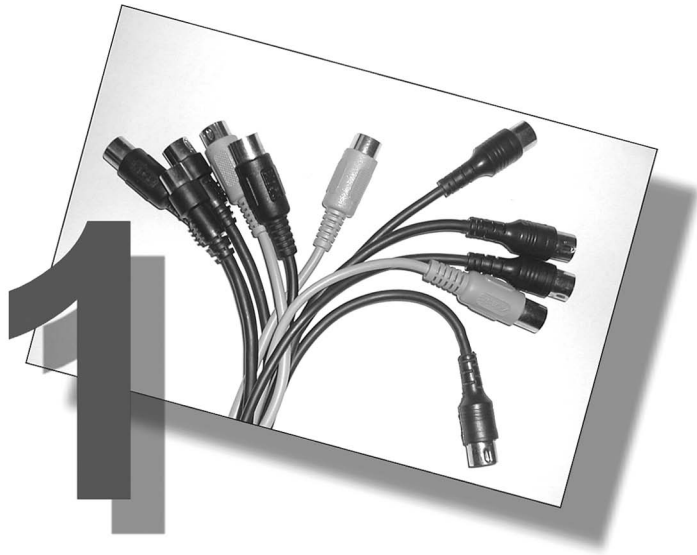
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**David Miles Huber**

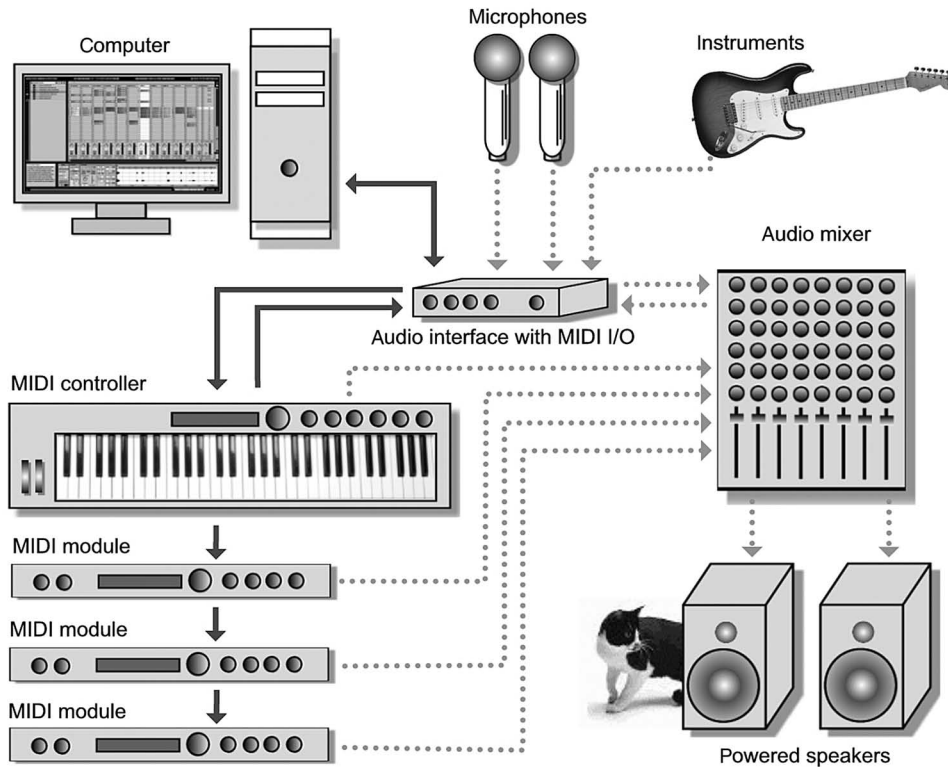




# What Is MIDI?

Simply stated, Musical Instrument Digital Interface (MIDI) is a digital communications language and compatible specification that allows multiple hardware and software electronic instruments, performance controllers, computers, and other related devices to communicate with each other over a connected network (Figure 1.1). MIDI is used to translate performance- or control-related events (such as playing a keyboard, selecting a patch number, varying a modulation wheel, triggering a staged visual effect, etc.) into equivalent digital messages and then transmit these messages to other MIDI devices where they can be used to control sound generators and other performance parameters. The beauty of MIDI is that its data can be recorded into a hardware device or software program (known as a sequencer), where it can be edited and transmitted to electronic instruments or other devices to create music or control any number of parameters.

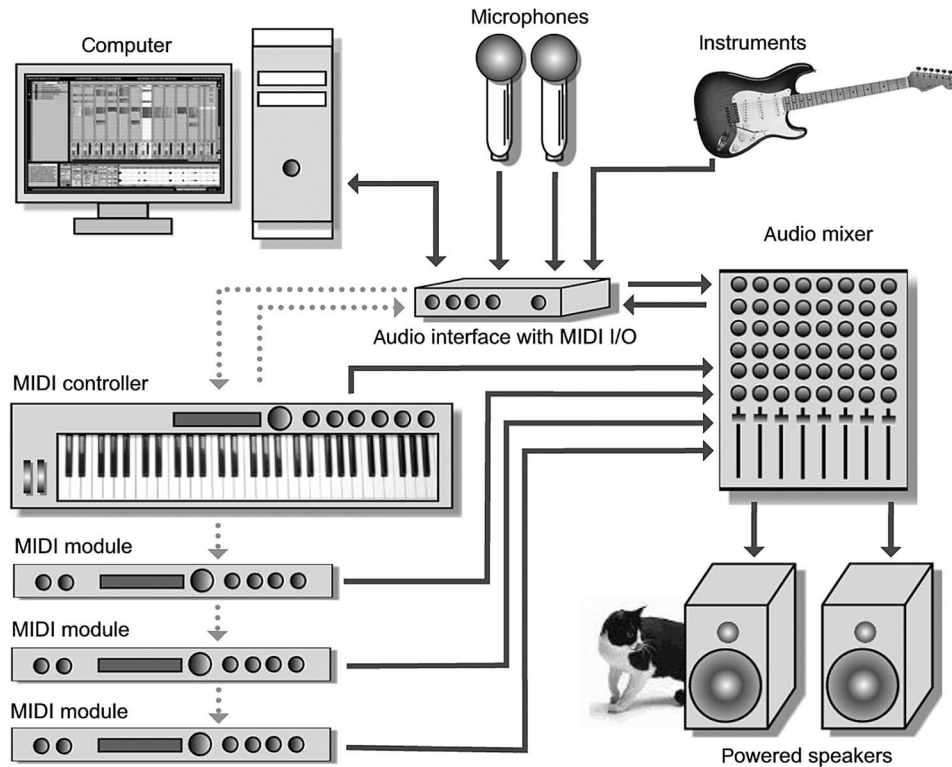
In artistic terms, this digital language is an important medium that lets artists express themselves with a degree of flexibility and control that, before its inception, wasn't possible on an individual level. Through the transmission of this performance language, an electronic musician can create and develop a song or composition in a practical, flexible, affordable, and fun production environment.



**Figure 1.1.** Example of a typical MIDI system with the MIDI network connections.

In addition to composing and performing a song, musicians can also act as techno-conductors, having complete control over a wide palette of sounds, their timbre (sound and tonal quality), overall blend (level, panning), and other real-time controls. MIDI can also be used to vary the performance and control parameters of electronic instruments, recording devices, control devices, and signal processors in the studio, on the road, or on the stage.

The term “interface” refers to the actual data communications link and software/hardware systems in a connected MIDI network. Through the use of MIDI, it is possible for all of the electronic instruments and devices within a network to be addressed through the transmission of real-time performance and control-related MIDI data messages throughout a system to multiple instruments and devices through a single data line (which can be chained from device to device). This is possible because a single data cable is capable of transmitting performance and control messages over 16 discrete channels. This simple fact allows electronic musicians to record, overdub, mix, and play back their performances in a working environment that loosely resembles the multitrack recording process. Once mastered, MIDI surpasses this analogy by allowing a composition to be edited, controlled, altered, and called up with complete automation and repeatability—providing production challenges and possibilities that are well beyond the capabilities of the traditional tape-based multitrack recording process.



**Figure 1.2.** Example of a typical MIDI system with the audio connections.

## What MIDI Isn't

For starters, let's dispel one of MIDI's greatest myths: *MIDI does not communicate audio nor can it create sounds!* It is a digital language that instructs a device or program to create, playback, or alter sounds. MIDI is a data protocol that communicates on/off triggering and a wide range of parameters to instruct an instrument or device to generate, reproduce, or control audio or production-related functions. Because of these differences, the MIDI data path and the audio routing paths are entirely separate from each other (Figure 1.2). Even if they digitally share the same transmission cable (such as through FireWire™ or USB), the actual data paths and formats are completely separate.

In short, MIDI communicates information that instructs an instrument to play or a device to carry out a function. It can be thought of as the dots on a player-piano roll—when we put the paper roll up to our ears, we hear nothing. When the cut-out dots pass over the sensors on a player piano, the instrument itself begins to make beautiful music. It's exactly the same with MIDI. A MIDI file or data stream is simply a set of instructions that pass down a wire in a serial fashion, but when an electronic instrument interprets the data we begin to hear sound.

## A Brief History

In the early days of electronic music, keyboard synthesizers were commonly monophonic devices (capable of sounding only one note at a time) and often generated a thin sound quality. These limiting factors caused early manufacturers to look for ways to combine instruments together to create a thicker, richer sound texture. This was originally accomplished by establishing an instrument link that would allow a synthesizer (acting as a master controller) to directly control the performance parameters of one or more synthesizers (known as slave sound modules). As a result of these links, a basic control signal (known as control voltage, or CV) was developed (Figure 1.3).

This simple yet problematic system was based on the fact that when most early keyboards were played, they generated a DC voltage that could directly control another instrument's voltage-controlled oscillators (which affected the pitch of a sounding note) and voltage-controlled amplifiers (which affected the note's volume and on/off nature). Since many keyboards of the day generated a DC signal that ascended at a rate of 1 volt per octave (breaking each musical octave into 1/12-volt intervals), it was possible to use this standard control voltage as a master-reference signal for transmitting pitch information to other synths. In addition to a control voltage, this

**Figure 1.3.** *The late, great synth pioneer Bob Moog, who was outstanding in his field. (Photograph courtesy of Roger Luther; [www.moogarchives.com](http://www.moogarchives.com).)*



standard required that a keyboard transmit a gate signal. This second signal was used to synchronize the beginning and duration times of each note. With the appearance of more advanced polyphonic synthesizers (which could generate more than one note at a time) and early digital devices, it was clear that this standard would no longer be the answer to system-wide control, and new standards began to appear on the scene (thereby creating the fun of having incompatible control standards). With the arrival of early drum machines and sequencing devices, standardization became even more of a dilemma.

Synchronization between these early devices was also problematic, as manufacturers would often standardize on different sync-pulse clock rates. Synchronizing incompatible systems could be extremely difficult, because they would lose sync over a very short period of time, rendering sync nearly impossible without additional sync-rate converters or other types of modifications. Because of this mess, Dave Smith and Chet Wood (then of Sequential Circuits, a now-defunct manufacturer of electronic instruments) began creating a digital electronic instrument protocol, which was named the Universal Synthesizer Interface (USI). As a result of this early protocol, equipment from different manufacturers could finally communicate directly (*e.g.*, a synth from one company finally worked with another company's sequencer). In the fall of 1981, USI was proposed to the Audio Engineering Society. During the following two years, a panel (which included representatives from the major electronic instrument manufacturers) modified this standard and adopted it under the name of Musical Instrument Digital Interface (MIDI Specification 1.0).

The strong acceptance of MIDI was largely due to the need for a standardized protocol and fast-paced advances in technology that allowed complex circuit chips and hardware designs to be manufactured cost effectively. It was also due, in part, to the introduction of Yamaha's popular DX-7 synthesizer in the winter of 1983, after which time keyboard sales began to grow at an astonishing rate.

With the adoption of this industry-wide standard, any device that incorporated MIDI into its design could transmit or respond to digital performance and control-related data conforming to the MIDI 1.0 specification. For the first time, any new device that conformed to the MIDI spec would integrate into an existing MIDI system and actually work ... without any muss or fuss.

Over the course of time, new instruments came onto the market that offered improved sound and functional capabilities that led to the beginnings of software sound generators, samplers, and effects devices. With the eventual maturation of software instruments and systems that could emulate existing devices or create entirely an entirely new range of functions and sound, hardware controllers began to quickly spring onto the scene that made use of MIDI to communicate physical control movements into analogous moves in a program or plug-in software interface. In fact, this explosion of software emulation and control has breathed a new degree of life into the common, everyday use of MIDI.

## Why Is MIDI?

Before MIDI, it was pretty much necessary to perform a musical passage in real time. Of course, there are a few exceptions to this statement. In earlier days, music could be created and re-created though the mechanical triggering of a musical device (music boxes and the aforementioned player

piano come to mind). When tape-based recording came along in the middle part of the last century, it became possible to edit two or more problematic performances together into a single, good take. However, when it came to the encoding of a musical passage and then faithfully playing it back—while still being able to edit or alter the tempo, notes, and control variables of a performance—we were pretty much back in the horse-and-buggy days.

With the introduction of electronic music production and MIDI, a musical performance could be captured in the digital domain and then faithfully played back in a production-type environment that mimicked the traditional form and functions of multitrack recording. Basic tracks could be recorded one at a time, allowing a composition to be built up using various electronic instruments. But, here's the kicker: MIDI finally made it possible for a performance track to be edited, layered, altered, spindled, mutilated, and improved with relative ease and under completely automated computer control. If you played a bad note, fix it. If you want to change the key or tempo of a piece, change it. If you want to change the expressive volume of a phrase in a song, just do it! Even its sonic character (timbre) can be changed! These capabilities just hint at the power of MIDI!

This affordable potential for future expansion and increased control throughout an integrated production system has spawned the growth of an industry that's also very personal in nature. For the first time in music history, it is possible for an individual to cost-effectively realize a full-scale sound production on his or her own time. Because MIDI is a real-time performance medium, it is also possible to listen to and edit a production at every stage of its development, all within the comfort of one's own home or personal project studio.

I'd also like to address another issue that has sprung up around MIDI and electronic music production. With the introduction of drum machines, modern-day synths, samplers, and powerful hardware or software instruments, it is not only possible but also relatively easy to build up a composition using instrument voices that closely mimic virtually any instrument that can be imagined. In the early days, studio musicians spoke out against MIDI, saying that it would be the robot that would make them obsolete. Although there was a bit of truth to this, these same musicians are now using the power of MIDI to expand their own musical palate and create productions of their own. Today, MIDI is being used by many professional and nonprofessional musicians alike to perform an expanding range of production tasks, including music production, audio-for-video and film postproduction, and stage production. Such is progress.

## MIDI in the Home

A vast number of electronic musical instruments, effects devices, computer systems, and other MIDI-related devices are currently available on the new and used electronic music market. This diversity lets us select the type of production system that best suits our own particular musical taste and production style. With the introduction of the large-scale integrated circuit chip (which allows complex circuitry to be quickly and easily mass produced), many of the devices that make up an electronic music system are affordable for almost every musician or composer, whether he or she is a working professional, aspiring artist, or beginning hobbyist (Figure 1.4).

One of the greatest benefits of a project or portable production system centers around the idea that an artist can select from a wide range of tools and toys to generate specific sounds—or to get



*Figure 1.4.* Gettin' it all going in the bedroom studio. (Photograph courtesy of Yamaha Corporation of America; [www.yamaha.com](http://www.yamaha.com).)

the particular sounds that he or she likes. This technology is often extremely powerful, as the components combine to create a vast palette of sounds and handle a wide range of task-specific functions. Such a system might include one or more keyboard synthesizers, synth modules, samplers, drum machines, a computer (with a digital audio workstation and sequencing package), effects devices, and audio mixing capabilities.

Systems like these are constantly being installed in the homes of working and aspiring musicians. Their size can range from taking up a corner of an artist's bedroom to being a larger system that's been installed in a dedicated project studio. All of these system types can be designed to handle a wide range of applications and have the important advantage of letting the artist produce his or her music in a comfortable environment whenever the creative mood hits. Such production luxuries, which would have literally cost an artist a fortune twenty years ago, are now within the reach of almost every working and aspiring musician.

## MIDI on the Go

Of course, MIDI production systems can appear in any number of shapes and sizes and can be designed to match a wide range of production and budget needs. For example, a portable, all-in-one keyboard instrument (known as a MIDI workstation) often includes an integrated keyboard, polyphonic synthesizer, percussion sounds, built-in sequencer, and audio recording capabilities ... all in a single hardware package. Laptops have hit the production scene big time, as they can combine software recording and production applications with portable keyboard

**Figure 1.5.** *Between takes.* (Photograph courtesy of M-Audio, A Division of Avid Technology; [www.m-audio.com](http://www.m-audio.com).)



controllers and audio interface devices to create a professional production system that lets us compose, produce, and mix in the studio or on the beach of a remote seaside island (Figure 1.5).

## MIDI in the Studio

MIDI has also dramatically changed the sound, technology, and production habits of the recording studio (Figure 1.4). Before MIDI and the concept of the home project studio, the professional recording studio was one of the only production environments that allowed an artist or composer to combine instruments and sound textures into a final recorded product. Often, the process of recording a group in a live setting was (and still can be) an expensive and time-consuming process. This is due to the high cost of hiring session musicians and the high hourly rates that are charged for a professional studio—not to mention Murphy’s studio law, which states that you’ll always spend more time and money than you thought you ever could in an effort to capture that elusive “ideal performance.”

Because of the digital audio workstation (DAW) and MIDI, much of the music production process can now be preplanned and rehearsed (or even totally produced and recorded) before you step into the studio (Figure 1.6). This out-and-out luxury has reduced the number of hours that are needed for laying down recorded tracks to a cost-effective minimum; for example, it is now commonplace for groups to record and produce entire albums in their own project studios. Once completed (or nearly completed), the group can either dump the tracks to tape or simply bring their entire set of MIDI and recorded audio tracks into the studio and lay the instrument tracks down to disc or tape. In a professional studio, the tracks can be sweetened into a polished state by adding vocals or other instruments. Finally, the tracks can then be professionally mixed down into a final product. In essence, through the use of careful planning and preproduction in the project studio, a project can be produced in a much more timely fashion (and hopefully on budget) than would otherwise be possible.

**Figure 1.6.** Steve Tushar, sound effects editor and musician, with his MC Media Application Controller running Nuendo. (Photograph courtesy of Andrew Wild, Euphonix, Inc.; [www.euphonix.com](http://www.euphonix.com).)



**Figure 1.7.** Euphonix System 5 console at Goldcrest Post in London. (Photograph by Patrick Denis, courtesy of Euphonix, Inc.; [www.euphonix.com](http://www.euphonix.com).)



## MIDI in Audio-for-Visual and Film

Electronic music has long been an indispensable tool for the scoring and audio postproduction of television commercials, industrial videos, television shows, and full-feature motion picture sound tracks (Figure 1.7). For productions that are on a tight budget, entire scores are often written and produced in a project studio at a mere fraction of what it might cost to hire the musicians, a studio, and mixdown rooms. Even high-budget projects make extensive use of MIDI in the preproduction and production phases. Often, orchestral scores for such projects are composed, edited, and finessed as a MIDI version of the composer's score before the expensive orchestral tracks are finally recorded in the studio. Before MIDI, this simply wasn't possible. Once approved, the final MIDI score can be printed and distributed to the musicians before the session.

## MIDI in Live Performance

Electronic music production and MIDI are also at home on the stage. Obviously, MIDI has played a crucial role in helping to bring live music to the masses. The ability to sequence rhythm and background parts in advance, chain them together into a single, controllable sequence (using a jukebox-type sequencing program), and then play them on stage has become an indispensable live-performance tool for many musicians. This technique is widely used by solo artists who have become one-man bands by singing and playing their guitar to a series of background sequences. Larger techno-groups commonly use extensive on-stage loop and power sequencing to drive instruments, lighting and visuals in ways that are staggeringly compelling.

Again, the power of MIDI lies in the fact that much of a performance can be composed and produced in advance of going on stage or on tour. With advances in digital audio, recorded sounds can be easily integrated into the performance. The integration of looping technology often allows for on-the-spot improvisation, adding a fresh and varied feel to the performance for those on stage and in the audience. In addition to communicating performance data, MIDI controllers can be used to vary a staggering range of control parameters in real time.

In addition to allowing for control over on-stage music performance, lighting, and preproduced sequencing, MIDI can play a strong role in the production and execution of on-stage lighting and special effects. Most modern-day lighting boards are equipped with a MIDI interface, allowing the lighting to be controlled from a linear sequencer over the course of a song or production—or, from a loop-based sequencer that allows for scene changes in a more interactive and on-the-spot manner (while still allowing scenes to be synchronized to the basic script, when needed).

## MIDI and Visuals

Speaking of on-screen effects, the ability to offer control over a preprogrammed sequence or interactive loops has put MIDI directly into the driver's seat when it comes to on-stage visuals and video playback (Figures 1.8 and 1.9). Many music acts are beginning to integrate visuals into their band—so much so that VJs now stand alongside their bandmates on-stage, offering up compelling visuals that can be diced, sequenced, and scratched in forms that can instantly switch from being totally chaotic to being in perfect sync ... and then back again.

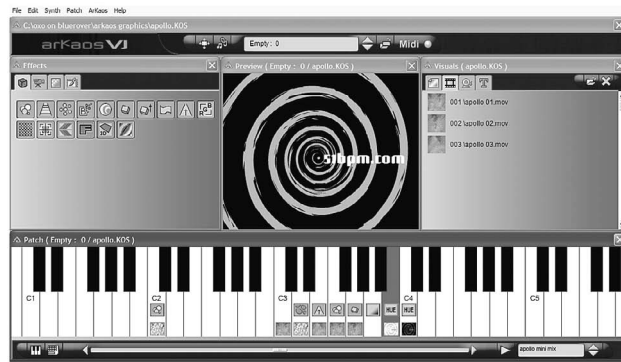
## MIDI and Multimedia

One of the “media” in multimedia is definitely MIDI. It often pops up in places that you might expect—and in others that might take you by surprise. With the advent of General MIDI (a standardized specification that makes it possible for any soundcard or GM-compatible device to play back a score using the originally intended sounds and program settings), it is possible (and common) for MIDI scores to be integrated into multimedia games, text documents, CD-ROMs, and even websites. Due to the fact that MIDI is simply a series of performance commands (unlike digital audio, which actually encodes the audio information), the media's data

**Figure 1.8.** *The motion dive .tokyo performance package. (Photograph courtesy of Roland Corporation; [www.rolandus.com/edirol](http://www.rolandus.com/edirol).)*



**Figure 1.9.** *ArKaos VJ MIDI video authoring software. (Photograph courtesy of ArKaos S.A.; [www.arkaos.net](http://www.arkaos.net).)*



overhead requirements are extremely low. This means that almost no processing power is required to play MIDI, making it the ideal medium for playing real-time music scores while you are actively browsing text, graphics, or other media over the Internet. Truly, when it comes to weaving MIDI into the various media types, the sky (and your imagination) is the creative and technological limit.

## MIDI on the Phone

With the integration of the General MIDI standard into various media devices, one of the fastest-growing MIDI applications, surprisingly, is probably comfortably resting in your pocket or purse

**Figure 1.10.** *One ringy-dingy ... MIDI helps us to reach out and touch someone through ring tones.*



right now—the ring tone on your cell phone (Figure 1.10). The ability to use MIDI (and often digital soundfiles) to let you know who is calling has spawned an industry that allows your cell to be personalized and super fun. One of my favorite ring tone stories happened on Hollywood Boulevard in L.A. This tall, lanky man was sitting at a café when his cell phone started blaring out the “If I Only Had a Brain” sequence from *The Wizard of Oz*. It wouldn’t have been nearly as funny if the guy didn’t look a lot like the scarecrow character. Of course, everyone laughed.