M-AUDIO

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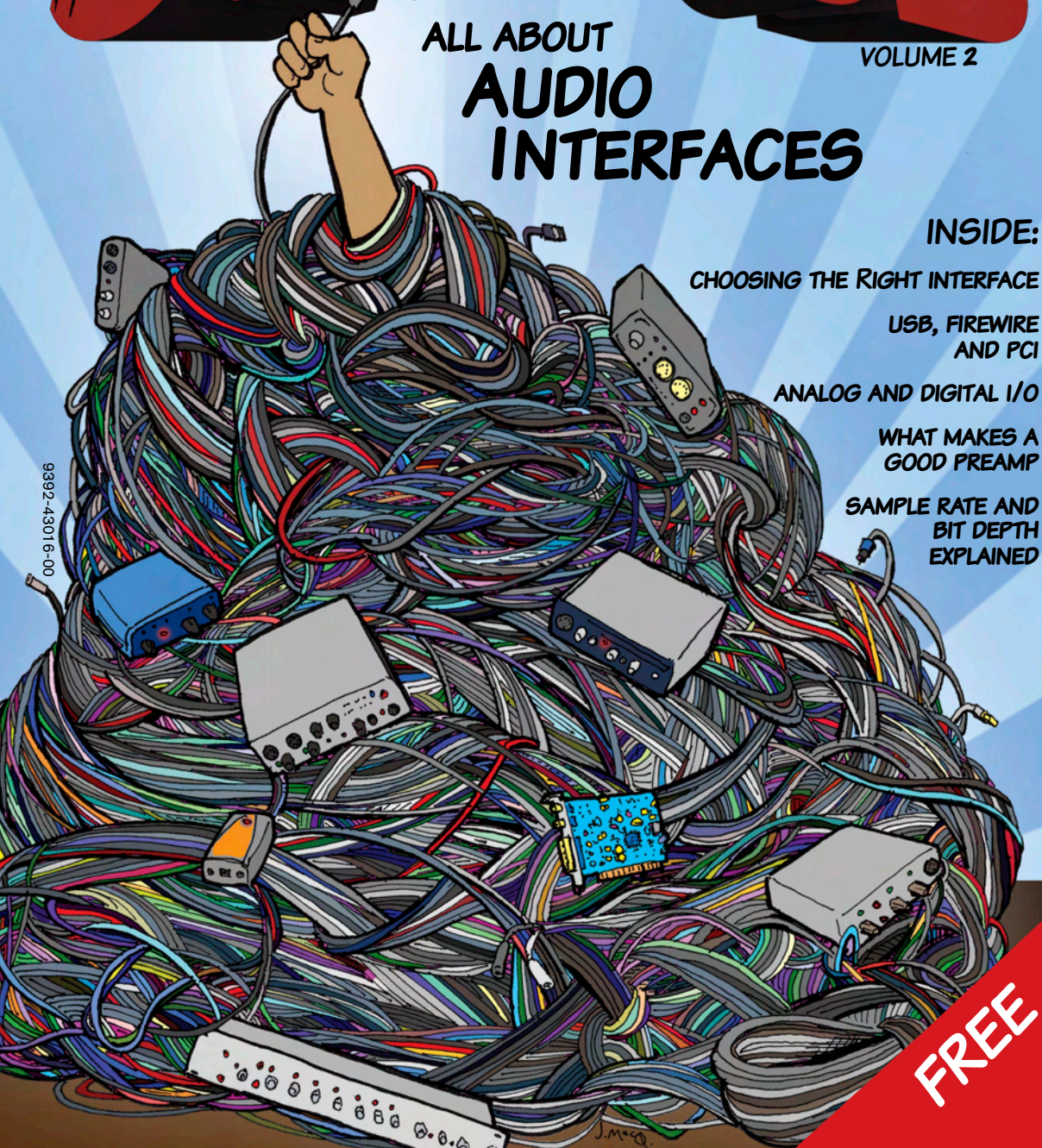
OVERDUB

VOLUME 2

ALL ABOUT AUDIO INTERFACES



INSIDE:

- CHOOSING THE RIGHT INTERFACE
- USB, FIREWIRE AND PCI
- ANALOG AND DIGITAL I/O
- WHAT MAKES A GOOD PREAMP
- SAMPLE RATE AND BIT DEPTH EXPLAINED

FREE

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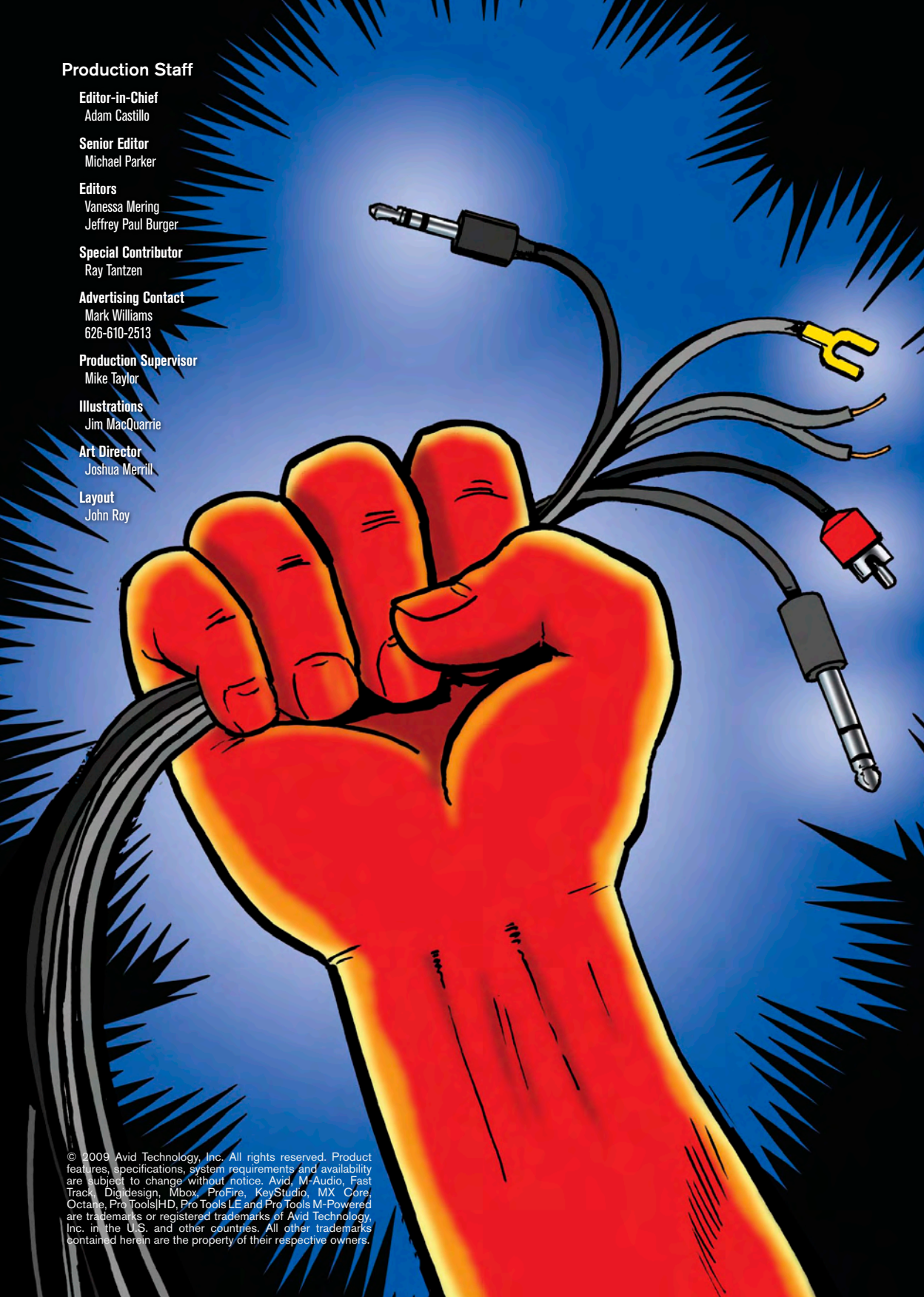


OVERDUB

ALL ABOUT AUDIO INTERFACES

So you wanna make music with your computer? There's never been a better time to get started—technology has come a long way since the "dinosaur days" of analog tape and $30,000 recording machines. You can get up and running for a lot less these days—and make high-quality recordings that would have been practically impossible 20 years ago.

Even if you've already made the plunge into digital recording, reading this issue of *Overdub* can help you better understand how your gear works and identify ways you can improve your studio. So we hope you enjoy reading this issue and as always, invite you to contact us at overdub@m-audio.com.

Understanding the Basics

To fully understand digital audio technology, consider how the analog recording process works: Microphones pick up sound waves, which are converted to electrical energy and sent to a tape recorder. The tape recorder then stores these electrical signals on magnetic tape, allowing the recorded sounds to be played back and stored.

The digital recording process is similar, except that instead of being stored on magnetic tape, the electrical signals pass through an analog-to-digital converter and are stored as data on a hard disk drive. Today's digital audio workstation software, such as Pro Tools, can emulate many aspects of the analog process, including multitrack recording, tape compression, track editing, punch recording, direct monitoring and more. The key difference is that expensive analog gear can now be replaced by an affordable digital studio—with an audio interface as its centerpiece.

Why do I Need an Audio Interface?

Most of today's computers feature a built-in sound card for connecting speakers, headphones and perhaps even a microphone to your computer. Although sound cards may be sufficient for listening to music, they typically lack the high-quality components and flexible connection options that you need for professional-level recording. If you're serious about music production, you're going to need a dedicated audio interface. An audio interface serves several purposes: First, it allows you to connect microphones, instruments and line-level gear. Second, it converts the incoming analog audio signals to digital audio data and sends the information to your host computer. And finally, on playback it converts digital audio from your computer back to analog signals that can be heard over speakers or headphones.

Choices, Choices, Choices

A quick web search or visit to your local music store will reveal that there are many, many audio interfaces from which to choose. Maybe you've wondered:

- How many inputs and outputs do I need?
- What's the difference between USB and FireWire?
- Why do some interfaces sound great while others don't?
- What makes a good preamp?
- What's the deal with different sample rates?
- How can I get into Pro Tools?

This issue of Overdub will help you answer these questions and find an audio interface that matches your needs. As you spend time reading about the different options available, make a list of features that are important to you. Your goal should be to find an interface that matches your requirements and gives you the functionality you need to produce music.

What Are You Planning To Record?

More than any other factor, this is going to decide which interface is best for you. Vocalists, solo musicians, DJs, hip-hop producers, electronic performers and bands all have different needs when it comes to recording. In order to select an interface that will stand the test of time, it's wise to consider what projects you are currently working on—as well as what studio endeavors you might explore in the future.

Analog Inputs

Choosing the right number of inputs and outputs is perhaps the most important decision you have to make when selecting an interface, and it all depends on what you plan on recording. If you record just two tracks at a time—or if you produce music using strictly loops, samples and soft synths—a basic two-channel interface will be more than sufficient. The M-Audio® Fast Track® Pro and Digidesign® Mbox® 2 both feature standard XLR microphone inputs that allow you to record vocals and acoustic instruments using dynamic microphones. Recording drum kits usually necessitates at least four inputs, and tracking a live band requires a minimum of eight, each with individual mic preamps. Large-scale project studio owners will need an interface that offers flexible I/O options for connecting with a variety of outboard analog and digital equipment.

Line Inputs

The most common type of analog connections are called "line level," and are used to connect keyboards, synth modules, signal processors, CD players and other gear at a standardized signal level. Line level signals require amplification in order to have enough strength to be heard over speakers. You can use 1/4" line-level connections to hook up the outputs of an analog mixer to your audio interface. This allows you to utilize the mixer's preamps and EQ before sending the signals to your interface.

Soloists, DJs, electronic artists and bands each have different interface needs

Instrument Inputs

Most guitars and basses, on the other hand, are basically simple transducers that don't even put out enough juice to attain line level. In order to record guitar, bass or other "high impedance" (Hi-Z) signals, you either need a direct box (DI) or an audio interface with one or more dedicated Hi-Z instrument inputs. An instrument input functions like a mini direct box, converting the high-impedance instrument signal to a level that can be handled by pro-level recording gear (see Appendix C). This will enable you to record guitar or bass without

using an amplifier—for which your neighbors will be grateful. Most M-Audio interfaces—including the entire Fast Track series—provide at least one instrument input, eliminating the need to purchase an extra DI box.

It's usually a good rule of thumb to get a few extra inputs and outputs, since you never know what projects you might be working on in the future. Not enough I/O is actually the number one reason for having to upgrade audio interfaces!

Microphone Preamps

Microphones also generate weak audio signals that must be amplified in order to match the level of recording gear. A preamp allows you to adjust the amount of gain and boost the microphone output signal to the desired level.

Some preamps are designed to offer clean, transparent results—while others are meant to "color" the audio and provide a distinctive character to the sound. Either way, you want preamps that deliver high gain without introducing unwanted noise and hiss from their internal circuitry. This will allow you to achieve clean, natural sounding audio without having to crank the preamp all the way up. Switchable pads help you record exceptionally loud sources by decreasing the signal by a given amount, usually -20dB.

Signal-to-Noise Ratio

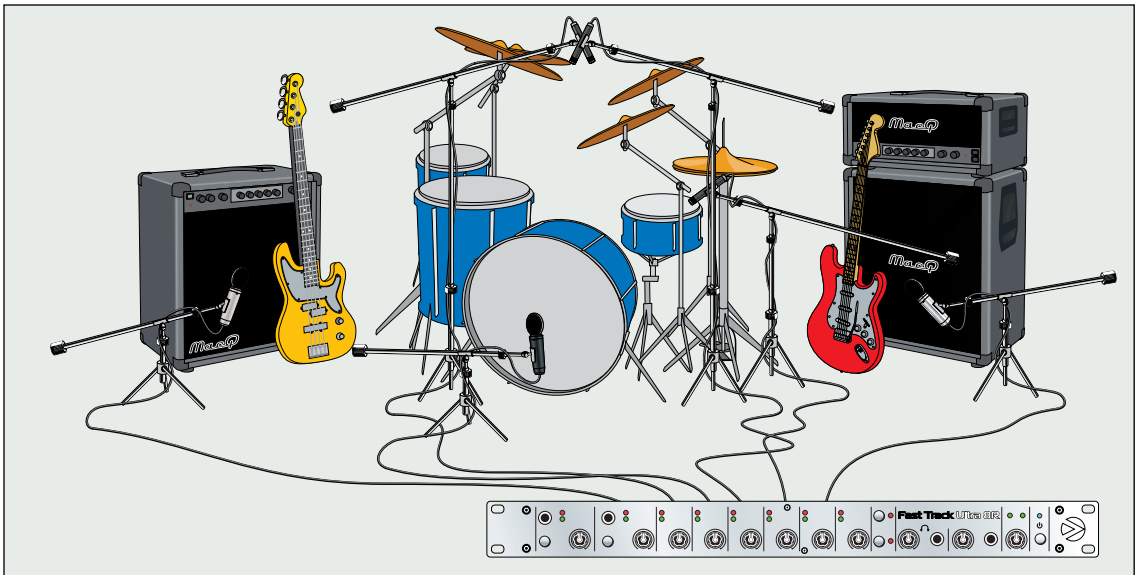
When comparing preamps, signal-to-noise ratio is one of the most important specs to consider. It indicates how much noise is introduced by the preamps' internal circuitry. The lower the ratio, the better. For example, a signal-to-noise ratio of -100dB indicates that the noise is -100dB quieter than the maximum level of gain before distortion. The flagship M-Audio ProFire™ 2626 interface delivers an excellent signal-to-noise ratio of -109dB.

Truth in Specs—M-Audio vs. the Competition

Beware when comparing signal-to-noise specs from different manufacturers! Some companies fudge their specs by publishing the noise introduced by the preamps and ignoring the round trip signal path. This results in a signal-to-noise ratio that is misleading. M-Audio publishes only "real-world" specs so you know how your interface will perform before you make a purchase.

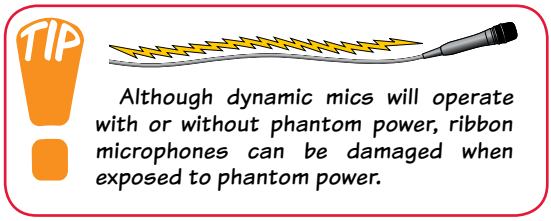
About Phantom Power

All condenser microphones (except electrets) need DC power in order to operate properly. While some high-end and vintage microphones draw power from an external dedicated power supply, most condenser mics are designed to receive "phantom power" supplied by the preamp or mixing desk. Phantom power provides



Recording a band usually requires an eight-input interface

between 12 and 48 volts of power along the same XLR cable that carries the audio signal. If you plan on recording with condenser microphones, make sure to choose an interface that offers phantom power.



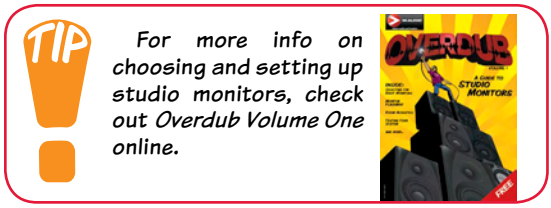
Although dynamic mics will operate with or without phantom power, ribbon microphones can be damaged when exposed to phantom power.

Analog Outputs

Since an audio interface processes sound outside of your computer, you'll need at least one pair of outputs to connect to active reference monitors or to a power amp and speaker system. Additional analog outputs are useful for routing audio to external gear like headphone amps, effects processors and mixing boards. For example, you could send a pair of outputs to an outboard reverb unit and feed the processed signal back into the interface inputs. Or you could assign each channel in your digital audio workstation (DAW) to its own individual output and route all your tracks through an analog mixer.

Using Studio Monitors

Although it is possible to monitor through a home stereo or desktop speakers, using dedicated studio monitors will yield much better performance from your setup. If your interface has multiple outputs, you can hook up several pairs of monitors and compare your mixes between them.



For more info on choosing and setting up studio monitors, check out *Overdub Volume One* online.

Headphone Outputs

Dedicated headphone outputs can come in very handy, especially in situations where you're unable to use studio reference monitors. All FireWire and USB interfaces from M-Audio and Digidesign include at least one headphone output with a dedicated volume control. Multiple headphone outputs are useful if you record with other musicians, and can save you the expense of purchasing a separate headphone amplifier. As mentioned later, software control panels can provide I/O control for creating different dedicated headphone mixes for each headphone output—such as a main mix plus a click track for a drummer.

Surround Sound Mixing

Use an interface with two headphone outputs to record multiple musicians

Nowadays, most music for video games, TV and film is mixed in surround sound. If you plan on doing multimedia work, get an interface with enough simultaneous outputs to drive a full surround sound system. The M-Audio ProFire 2626 and ProFire 610 each have eight analog outputs—allowing you to hook up seven monitors and a subwoofer and mix in 7.1 surround sound. Both interfaces also feature an assignable master volume knob that lets you control the volume of all speakers simultaneously.

About Insert Cables

An insert cable is wired in a way that lets you send and receive signals over a single cable. Insert cables feature a TRS (tip/ring/sleeve) connector on one side and two TS (tip/sleeve) connectors on the other. The TRS side connects to an insert jack on the audio interface. The "send" TS connector goes to your external

device's input and the "return" TS connector goes to your external device's output. This allows signals to be sent and returned using a single cable.

Integrated Control Surfaces

Some audio interfaces also offer a built-in control surface for hands-on operation and mouse-free mixing. The M-Audio ProjectMix I/O and Digidesign 003 Factory each offer a full-featured control surface with touch-sensitive motorized faders, rotary encoder knobs and dedicated switches—as well as bank-switching controls to allow the hardware channel controls to address all the virtual channels of your software. If you love working with a traditional mixer or recording console but want the power and flexibility of a digital audio interface, a built-in control surface combines the best of both worlds.

Get hands-on with an integrated control surface

Digital I/O Options

If you own outboard gear that supports digital I/O (or if you plan on expanding your setup), it's good to have an interface that offers digital inputs and outputs. Transferring audio in the digital domain has several advantages. You avoid unnecessary conversions that can degrade the quality of your signal. You can send as many as eight digital audio signals over a single ADAT cable. And since digital audio is simply a series of zeros and ones, you never have to worry about setting levels or clipping the signal. There are several digital audio formats currently in widespread use, the most common are S/PDIF (Sony/Phillips Digital InterFace) and ADAT (Alesis Digital Audio Tape).

S/PDIF

The S/PDIF format is capable of sending a stereo audio signal over a single RCA-type or ADAT TOSLINK cable. Many effects processors, A/D-D/A converters, microphone preamps, CD players, keyboards and samplers support S/PDIF.

ADAT

The ADAT optical standard supports multitrack digital I/O over a fiber optic cable. A single ADAT port is capable of transferring either eight channels of 44.1/48kHz audio, four channels of 88.2/96kHz audio, or two channels of high-definition 192kHz audio. Many digital audio converters, digital mixers and multichannel preamps are ADAT-compatible.

MIDI I/O

MIDI, or Musical Instrument Digital Interface, is a communication protocol that enables electronic musical instruments, computers and other digital equipment to communicate and share data. Nearly all modern keyboards, synthesizers and DAW applications support MIDI. If you want to integrate synths, effects processors and other MIDI gear into your setup, look for an audio interface that offers at least one MIDI input and one MIDI output.

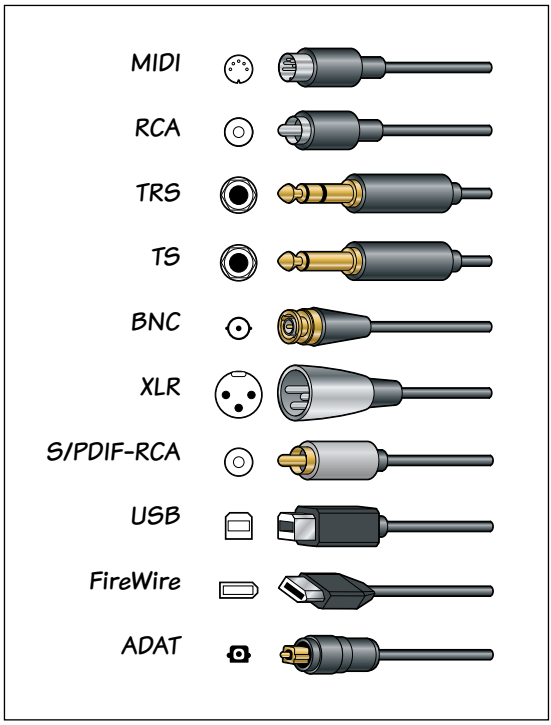
It's a Keyboard... And an Audio Interface!

When you're putting together a mobile rig or just tight on space, you might appreciate the efficiency of a MIDI keyboard controller with an audio interface built right in. Check out the M-Audio KeyStudio™ 49i, ProKeys Sono 61 and ProKeys Sono 88. They even have built-in sounds including a stereo-sampled grand piano.

Word Clock

Your computer-based DAW stores and manipulates music as digital samples (more on sampling later). Each device in your interconnected digital world must share the same timing in order to communicate correctly—that is, their clocks must be synchronized.

Word clock makes this possible by designating one device as the timing "master," and all other connected devices as "slaves," locking the slaves to the master. This ensures that all digital gear is running at a common sample rate. Without word clock, your digital audio signal will be filled with clicks and pops (if, in fact, it plays at all). Many M-Audio and Digidesign interfaces can send and receive word clock data via S/PDIF, ADAT or coaxial BNC cable—allowing you to synchronize with A/D converters, outboard preamps or other digital gear.



Connectivity Options—PCI, USB and FireWire

Once you have decided roughly how much analog and digital I/O you need, you should consider which connectivity option to use—USB, FireWire or PCI. Each format presents unique advantages and disadvantages. It all depends on what works best for your system.

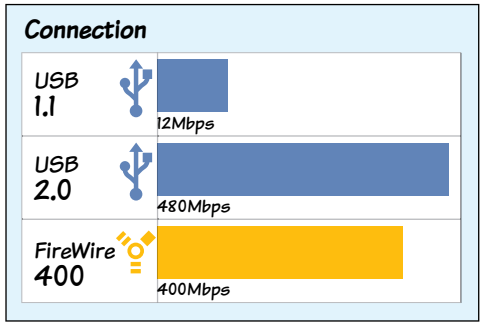
USB 1.1

The vast majority of computers today come with USB ports, making USB audio interfaces an attractive option for musicians and producers.

USB 2.0

USB 1.1 is a good choice for working with two channels at once and creating CD-quality tracks. But when you want to record at higher sample rates and/or capture multiple channels at once, you need the increased data transfer speed offered by USB 2.0. USB 2.0 devices have become more common in recent years, and provide a stable, reliable solution for working with high-fidelity audio. To use a high-speed USB 2.0 recording device, all you need is a computer that supports USB 2.0.

USB vs. FireWire



FireWire

Like USB 2.0, FireWire offers the bandwidth necessary to record multiple tracks at high sample rates. But unlike USB 2.0, which transmits data in "packets," FireWire provides a continuous flow of data—allowing FireWire interfaces to process audio more efficiently. FireWire can be an especially attractive choice for Mac users, since many Apple computers come standard with the necessary port. Many PC manufacturers also include FireWire ports on their latest machines. If your PC doesn't support FireWire, you can always purchase and install a third-party card.

FireWire comes in two flavors—FireWire 400 and FireWire 800. FireWire 400 is the industry-standard for audio interface technology, while FireWire 800 offers increased data transfer rates and is typically used for external hard drive enclosures. If your computer only has a FireWire 800 port, don't worry—all M-Audio FireWire interfaces are fully compatible with both 400 and 800 ports. All you need is the proper cable and you're good to go.

PCI

The third most common type of audio interface consists of a PCI hardware card placed directly into a slot on the motherboard. Some units feature audio connections on the card itself, while others offer a separate breakout box with analog and digital I/O. These interfaces provide tight integration with the host computer, which results in low latency and excellent MIDI timing. However, PCI-based interfaces must be installed inside a computer tower, so they're inherently less mobile.

Form Factor

Are you turning a spare room into a project studio, or are you looking to make music on the road? Audio interfaces come in all different shapes and sizes, some designed for permanent rack-mount installations, and some designed for mobile music production. If you want something portable—or if desk space is an issue—check out a small, bus-powered interface like the M-Audio ProFire 610 or Digidesign Mbox 2.

Other audio interfaces, such as the M-Audio ProFire 2626 or Digidesign 003 Rack+ Factory, are primarily designed for in-studio applications. The rack-mount form factor is great for hooking up tons of extra gear and hiding the cable mess behind the desk. If you have the room and want expanded I/O capabilities, a larger interface like the M-Audio ProjectMix I/O offers FireWire connectivity, expanded I/O choices and a built-in control surface.

Other Factors to Consider

Audio Quality

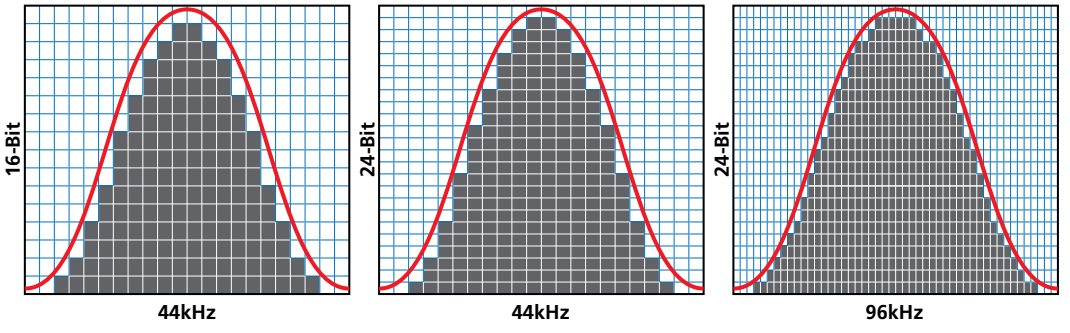
Visit any online audio forum and you'll no doubt find a heated discussion about which audio interface sounds the best. Everyone seems to have a different opinion on the subject, so it's hard to separate fact from the fiction. One thing is for sure—when it comes to overall audio quality, internal components play a big role. But it's also important to select the right sample rate and bit depth for your project in order to capture the entire dynamic range of the performance.

Sample Rate Explained

A thorough discussion of digital audio sampling would probably encompass several volumes of text. However, it is possible to understand the basics with a brief overview...

Digital audio interfaces sample analog audio signals and convert them to digital data. These individual samples are like quick "snapshots" of sound. A sample rate of 44.1kHz means that the audio interface takes 44,100 snapshots per second. A higher sample rate of 96kHz means that 96,000 samples per second are captured.

Higher sample rates sound better because more information is captured. When the interface converts the digital data back to analog audio, the empty space between the samples is "smoothed over" (see figure). When recording at higher sample rates, there is less empty space between samples, which results in more accurate smoothing and better-sounding audio.



As bit depth and sample rate increase, more information is captured—resulting in higher-quality audio

Higher sample rates also capture a wider range of frequencies. While it's true that the human ear can't hear past 20kHz, there are harmonics and overtones that reach much higher into the frequency range. These harmonics, when captured by an interface running at 96kHz or higher, can impact the frequencies that we do hear.

Bit Depth Exposed

While the sample rate determines how often the interface captures audio, the bit depth determines how much information is captured by each sample. It's kind of like a digital photograph—an eight-megapixel photo captures more detail and has higher resolution than a three-megapixel shot. Likewise, 24-bit recordings capture better detail than 16-bit recordings (while 8-bit audio sampling should best be left to old-school Nintendo games!). Higher bit depths also allow you to capture a greater dynamic range and record hotter signals.

Selecting the Right Audio Quality

Many wonder why it's worth recording at high sample rates and bit depths—especially since those formats consume extra system resources and hard drive space. The answer depends on what's being recorded, as well as what the final output medium will be. If the final destination is CD, the audio will have to be downsampled to 16-bit/44.1kHz—at which point the extra information captured at 24-bit/96kHz will be lost. However, as mentioned earlier, those upper-range frequencies do impact what we hear in the lower bands. Recording at high sample rates can be especially beneficial when recording acoustic instruments, cymbals and other sources with high-frequency "air-like" qualities. Any EQ, effects and other processing will be done at a higher level of audio quality, resulting in better-sounding audio even when downsampled to CD format.

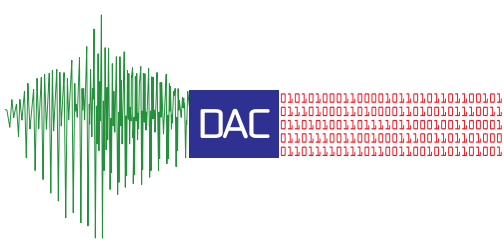
If the final output will be on DVD, it's definitely a good idea to record at higher rates. DVDs, video games and other multimedia formats typically use far higher sample rates than standard CDs. The M-Audio ProFire 2626 and ProFire 610 audio interfaces allow you to record at rates up to 24-bit/192kHz.

Internal Components—DACs Make a Big Difference

So why do some interfaces sound great while others don't—even when recording at equal sample rates and bit depths? The answer lies in the quality of internal components. Every interface contains internal digital audio converters (DACs) that convert incoming analog signals to digital data that can be read and stored. The performance of these components makes a huge impact on the quality of your recordings. When it comes to DACs, there are two key factors to consider: signal-to-noise ratio and internal clock stability.

A low signal-to-noise ratio (S/N specs are expressed in negative values) means that the interface delivers a wide dynamic range without introducing much noise. Remember, unwanted noise can degrade the quality of your audio and ruin an otherwise good recording!

The other factor that can impact digital audio conversion is clocking. Audio interfaces must sample at regular intervals in order to capture sound accurately. A poorly designed clock can cause the interface to sample audio irregularly, resulting in "jitter." You'll find that all M-Audio interfaces have very stable clocks. Some M-Audio interfaces, like the ProFire 2626, even feature JetPLL jitter-elimination technology—ensuring that the digital audio converters stay rigidly locked on time and sample audio accurately. So just because two audio interfaces are recording at the same sample rate and bit depth (let's say, 24-bit/48kHz)



A digital audio converter (DAC) converts analog audio to digital data

doesn't mean the results will sound the same. The quality of the internal components—and in particular, the DACs—makes a really big difference in performance.

Software Drivers

Some audio interfaces are class-compliant, meaning they are plug-and-play ready right out of the box. Most interfaces however, require specific software drivers in order to operate efficiently with your computer and DAW software. Drivers are very important because they tell the computer how to communicate with your hardware. M-Audio has been making audio interfaces for years, so the drivers you get are stable and mature—ensuring rock-solid performance with your computer. Most M-Audio drivers are also accompanied by software control panels for controlling internal I/O routing for purposes such as creating headphone mixes and external effects loops.

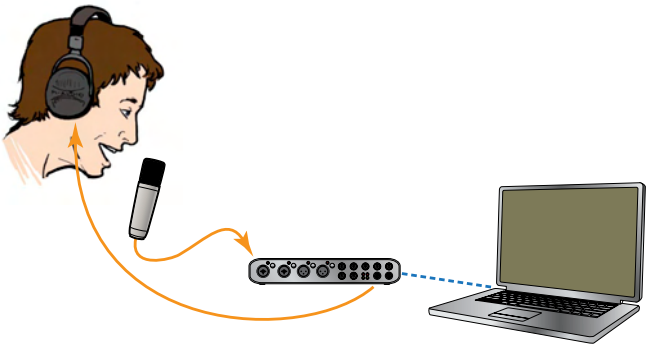
Onboard DSP

Your computer provides most of the power needed to record, mix and edit digital audio. However, in order to conserve CPU resources, some interfaces feature onboard DSP (digital signal processing), which allows you to create latency-free cue mixes and perform audio processing tasks on the interface itself. M-Audio's MX Core™ DSP technology—found on the Fast Track Ultra and Fast Track Ultra 8R models—even offers reverb and delay effects processing during tracking. Since the functionality takes place inside the interface, you don't need a super-powerful computer to monitor with effects.

But even the most powerful systems will crawl to a halt when juggling tons of I/O, real-time monitoring and heavy plug-in processing. That's why Digidesign's powerful Pro Tools|HD® systems are the industry standard for professional audio recording, post-production and mastering. Pro Tools|HD hardware utilizes advanced DSP chips that can process massive amounts of digital audio without taxing the host CPU. A typical Pro Tools|HD system consists of one or more dedicated PCI cards loaded with DSP, a Digidesign audio interface and Pro Tools HD software. No other digital audio workstation (DAW) is used more in top music studios, broadcast facilities, editing suites and mobile production trucks worldwide.

Solving The Latency Problem

All digital audio systems introduce a certain amount of delay between input and output, otherwise known as "latency." Latency can present a challenge, especially when recording vocals—the singer hears his own voice "live," as well as the delayed, processed signal coming back from the DAW. The resulting delay makes it difficult to maintain proper pitch and timing. Hardware direct monitoring solves this problem by letting you monitor directly through the interface, before any latency is introduced by the host CPU. You just open the audio interface software control panel and select which live inputs and software returns you want to hear while recording. By monitoring your live inputs before they pass through the computer, you'll enjoy a more natural recording experience—just like when using a standard analog mixer. You'll find direct hardware monitoring on most M-Audio interfaces.



Direct hardware monitoring allows you to hear yourself without the delay (latency) introduced by digital recording

Final Thoughts

Choosing the right interface can be a daunting task, especially if you're just getting started in the world of recording. As you spend time exploring the choices available to you, remember to select an interface that offers the following:

- *The right amount of inputs and outputs*
- *High-quality preamps and digital converters*
- *Driver compatibility with your computer system*
- *The right computer connectivity format*

Once you've found the ideal audio interface, you'll be well on your way to making great recordings and ready to explore the creative world of music production.

Notes:

Appendix A—Getting Into Pro Tools

Digidesign's industry-standard Pro Tools software comes in three versions—Pro Tools|HD, Pro Tools LE® and Pro Tools® M-Powered™. A standardized user interface means that once you know how to run one version of Pro Tools, you know how to run them all—the primary distinction is that each version of Pro Tools works with different hardware. Pro Tools|HD systems take advantage of Digidesign's powerful DSP-based hardware. Pro Tools LE works with Digidesign's LE system hardware, including the Mbox and 003 series audio interfaces. Pro Tools M-Powered works with approximately two-dozen different M-Audio interfaces.

All versions of Pro Tools share the same file format, making it possible to interchange projects between any of these systems—and on both Macs and PCs. Let's say that you have Pro Tools M-Powered 8 and a compatible M-Audio interface such as ProFire 610. You can collaborate and exchange files with other musicians who are using Pro Tools LE and Digidesign hardware. You can also take the files you track at home to a professional studio that uses a Pro Tools|HD or Pro Tools TDM (the predecessor to Pro Tools|HD) system for the full benefit of additional studio tracking, processing and mixing at the hands of a seasoned engineer and/or producer.

Conversely, you can travel or work at home with tracks created in a Pro Tools|HD studio—all you need is a compact M-Audio mobile interface. This might include tracking a live act, capturing inspiration wherever life takes you, or sitting on the living room couch with your family while cutting sound effect cues on your laptop. You can also take the studio tracks you create on any version of Pro Tools right to the stage as backing tracks.

Appendix B—Balanced vs. Unbalanced Cables

Audio interfaces and other studio gear typically include a combination of both balanced and unbalanced connections. An unbalanced connection uses two conductors—"hot" and "ground." The hot wire carries the audio, while the grounded return conductor acts as a voltage reference. Standard 1/4-inch TS (tip/sleeve) instrument cables and RCA cables are examples of unbalanced wiring.

Balanced connections on the other hand, use three conductors to transmit the signal. The ground wire acts as a voltage reference, while two independent wires carry identical signals 180 degrees out-of-phase—thereby balancing the signal across two wires. If noise is somehow introduced into the signal, it gets canceled out by the time it reaches the destination. Examples of balanced three-conductor wiring include XLR microphone cables and 1/4-inch TRS (tip/ring/sleeve) cables.

All other things being equal, balanced and unbalanced connections generally sound the same. However, using balanced cables and connections can help to reduce noise—especially when using cable runs longer than 20 feet. If you are using short patch cable runs, unbalanced wiring is probably sufficient. Remember that when using microphones, it's always best to use balanced cables.

Using a balanced cable on an unbalanced connection jack will not make the signal balanced.

Appendix C—Professional (+4dBu) vs. Consumer (-10dBV) Level

You may have noticed that the output level of some instruments, processors and recording gear is stated in terms of professional-level (+4dBu) or consumer-level (-10dBV). While a discussion of the physics behind these readings is well beyond the scope of this issue, it is important to note the difference between the two specs.

Professional audio equipment uses balanced connections capable of transmitting signals at high levels without introducing noise. Therefore, pro audio gear is designed to produce a maximum output level rated at +4dBu.

Most consumer-level electronics produce a lower-level line output, expressed as the reading -10dBV. This goes back to the days when consumer gear utilized unbalanced RCA connections. In order to prevent noise from entering the signal, the output levels were capped at the relatively low level of -10dBV.

Appendix D—M-Audio & Digidesign Interface Comparison Chart

	Simultaneous I/O	Analog Inputs	Analog Outputs	Phantom Power (48V)		Resolution	ADAT Optical	S/PDIF Digital	MIDI I/O	Word Clock I/O	Headphone Output	Connection Type	Bus-Powered	Integrated Control Surface	Mic Preamps
M-Audio Interfaces	Compatible with Pro Tools M-Powered*, Abelton Live, Logic, Cubase, SONAR & more														
 **ProFire 2626****	26 x 26	8 (combo XLR/ 1/4" TRS)	8 (1/4" TRS)	yes		24-bit/ 192kHz ^	16-in/ 16-out	1-in/1-out, RCA (optical input/ output port B capable of S/PDIF)	1 x 1	yes	2 (1/4")	FireWire	–	–	8
 **ProFire 610*****	6 x 10	4 (2 combo XLR/ 1/4" TRS, 2 1/4" TRS)	8 (1/4" TRS)	yes		24-bit/ 192kHz ^	–	yes (RCA I/O)	1 x 1	–	2 (1/4")	FireWire	yes	–	2
 **ProjectMix I/O**	16 x 12	8 (8 XLR, 8 1/4" TRS/TS, 1 1/4" TS inst.)	4 (1/4" TRS)	yes		24-bit/ 96kHz	8-in/ 8-out	yes (optical I/O, RCA I/O)	2 x 2 (1 x 1 DIN5)	yes	2 (1/4")	FireWire	–	yes	8
Fast Track Ultra 8R**	8 x 8	8 (combo XLR/ 1/4" TRS)	8 (1/4" TRS)	yes		24-bit/ 96kHz	–	yes (RCA I/O via adapter)	1 x 1 via adapter	–	2 (1/4")	USB 2.0	–	–	8
 **Fast Track Ultra****	8 x 8	6 (2 mic/line/inst., 2 mic/line, 2 line)	6 (1/4" TRS)	yes		24-bit/ 96kHz	–	yes (RCA I/O)	1 x 1	–	2 (1/4")	USB 2.0	yes	–	4
 **Fast Track Pro**	4 x 4	2 (2 combo XLR/ 1/4" TRS/TS)	4 (2 1/4" TRS, 4 RCA)	yes		24-bit/ 96kHz	–	yes (RCA I/O)	1 x 1	–	2 (1/4")	USB	yes	–	2
 **Fast Track**	2 x 2	2 (1 XLR, 1 1/4" TS inst.)	2 (RCA)	Yes		24-bit/ 48kHz	–	–	–	–	1 (1/4")	USB	yes	–	1
 **Delta 1010**	10 x 10	8 (1/4" TRS/TS)	8 (1/4" TRS/TS)	–		24-bit/ 96kHz	–	yes (RCA I/O)	1 x 1	yes	–	PCI	–	–	–
 **Audiophile 2496**	4 x 4	2 (RCA)	2 (RCA)	–		24-bit/ 96kHz	–	yes (RCA I/O)	1 x 1	–	–	PCI	–	–	–
Digidesign Interfaces	Compatible with Pro Tools LE														
 **003 Factory**	18 x 18	8 (4 XLR, 8 1/4" TRS)	8 (1/4" TRS)	yes		24-bit/ 96kHz	8-in/ 8-out	yes (RCA I/O)	1 x 2	yes	2 (1/4")	FireWire	–	yes	4
 **003 Rack+ Factory**	18 x 18	8 (8 XLR, 8 1/4" TRS)	8 (1/4" TRS)	yes		24-bit/ 96kHz	8-in/ 8-out	yes (RCA I/O)	1 x 1	yes	2 (1/4")	FireWire	–	–	8
 **Mbox 2 Pro**	6 x 8	4 (2 combo XLR/ 1/4" TRS, 2 1/4" TRS)	6 (1/4" TRS)	yes		24-bit/ 96kHz	–	yes (RCA I/O)	1 x 1	yes	2 (1/4")	FireWire	yes	–	2
 **Mbox 2 Mini**	2 x 2	2 (1 XLR, 2 1/4" TS)	2 (1/4" TS)	yes		24-bit/ 48kHz	–	–	–	–	1 (1/4")	USB	yes	–	1
 **Mbox 2 Micro**	0 x 2	n/a	1 (1/8" stereo)	–			–	–	–	–	1 (1/8")	USB	yes	–	–

* Visit digidesign.com/ptmpgrid for the complete list of hardware compatible with Pro Tools M-Powered.
** Compatible with Pro Tools M-Powered 7.4 with downloadable update from m-audio.com, and higher.
*** Compatible with Pro Tools M-Powered 8 and higher.

^Pro Tools M-Powered supports a maximum of 18 x 18 I/O at 44.1 or 48kHz, and a max of 14 x 14 I/O at 88.2 or 96kHz. Pro Tools M-Powered does not support sample rates above 96kHz.

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