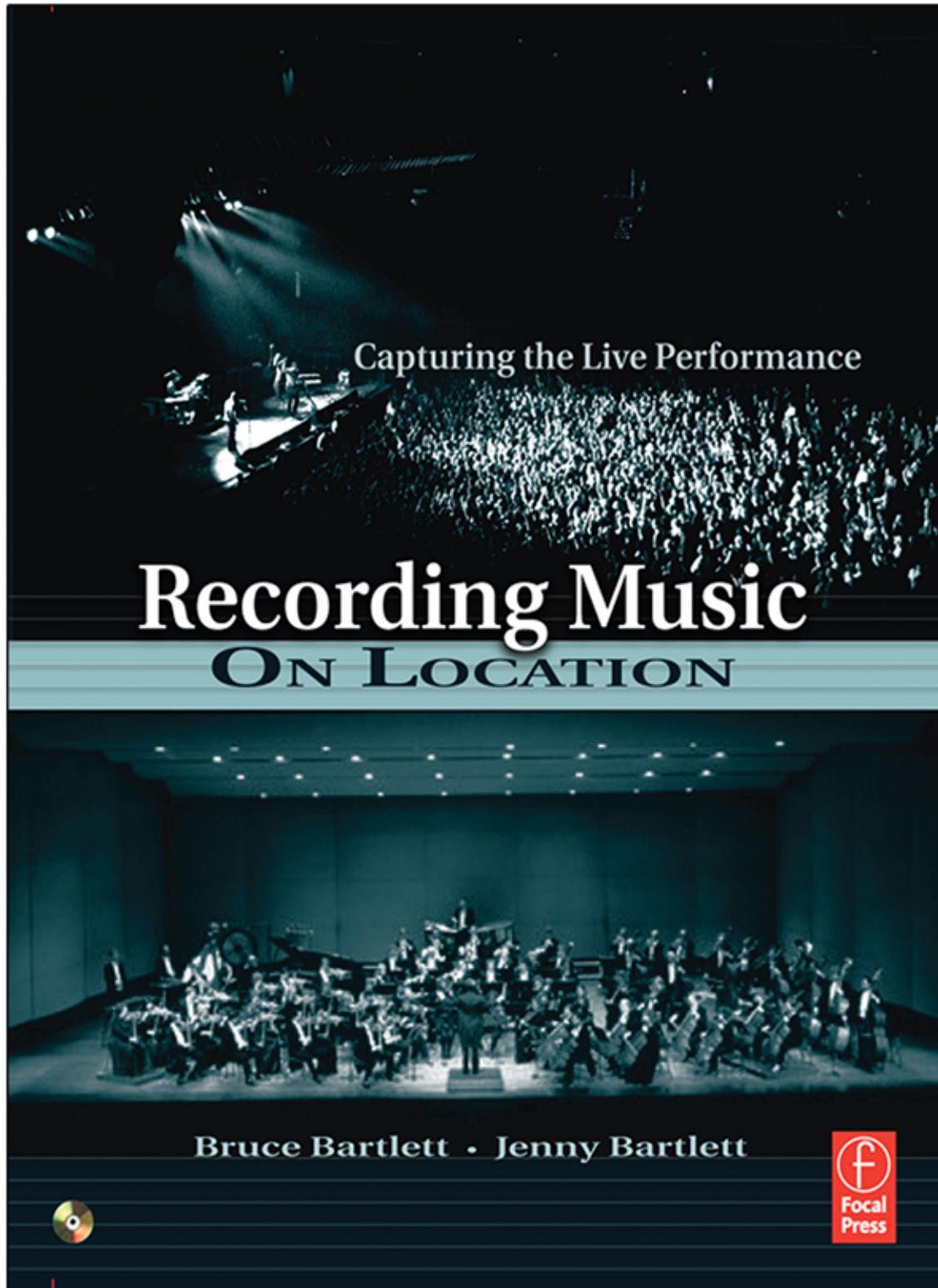




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GEAR FOR LIVE RECORDING

Whether you are a musician, concert taper, live sound engineer, or studio engineer, you'll find helpful information on live recording in this book. This chapter is an overview of the necessary equipment.

Your simplest option is to record live to a portable stereo recorder. The process is easy and the required gear costs under \$600. A stereo recording may not offer the sound quality of a professional multitrack recording. But if you record how the band sounds from a seat in the audience, that may be good enough—especially if the recording is just for yourself or your friends.

Audio professionals can use a mobile recording rig with a multitrack hard-drive (HD) recorder or laptop computer. This setup is convenient and provides excellent sound for about \$2000 and up. We'll look at the pros and cons of these options in a minute.

This chapter offers a basic survey of equipment for recording music on location. For a deeper understanding of recording technology, we suggest our book, *Practical Recording Techniques*, fourth edition, published by Focal Press.

Stereo Systems versus Multitrack Systems

You can make live recordings with a stereo recorder or a multitrack recorder. Basically, a stereo recording system uses two mics (or a stereo mic)

plugged into a portable stereo recorder. The mics pick up the group as a whole from several feet away, and the mic signals are recorded. A multitrack system uses several mics, each close to an instrument or singer. The mic signals are amplified and sent to a multitrack recorder. One track might be a recording of the lead vocal, another track might be the sax, another the kick drum, and so on. You mix the tracks back in the studio.

Stereo recording is easy and cheap, and it captures the sound as heard in the audience (including the room reverberation and background noise). You could call it a “documentary” or “audio snapshot” recording. The multitrack approach is more challenging and expensive, but it offers a cleaner, more commercial sound, probably with a well-balanced mix. It’s the most common method used by professional recording engineers to record live pop music.

A stereo recording can sound very good if no PA system is in use—but most bands use a PA. When you record the band you’re also recording the sound of the PA speakers. Thus, the mix or balance you get depends on the PA engineer’s skill.

The first half of this chapter focuses on stereo recording systems, while the second half covers multitrack systems.

Stereo Recording Systems

Figure 1-1 shows the parts of a typical stereo recording system using microphones. Placed several feet from the performers, the mics pick up the group, room sound reflections, and any background noise. The sound and signals move or flow from start to finish (left to right in Figure 1-1).

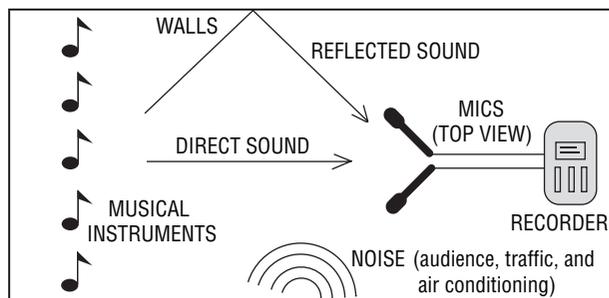


Figure 1-1 Signal flow in a typical stereo recording system.

This is the signal flow shown in Figure 1-1:

1. Musical instruments produce sound.
2. Background noise and room reverberation add to the musicians' sound.
3. Microphones pick up the total sound and change it into electrical signals.
4. Mic choice and placement affect the tone quality (bass and treble), the stereo effect, and the amount of background noise and room reverberation that are picked up.
5. Mic cables carry the mic signals to the recorder. Some mics plug directly into the recorder.
6. The recorder makes a stereo recording of the left- and right-mic signals.

If you can record off the PA mixing board, all you need is a portable stereo recorder and cables.

Equipment for Stereo Recording

Let's describe in detail the gear you need to make a simple stereo recording.

Microphones

A microphone changes sound into an electrical signal. Classified by how that is done, there are three types of mics for recording: condenser, dynamic, and ribbon.

Condenser, Dynamic, and Ribbon Types

Condenser mics typically give a clear, detailed, natural sound. They are the preferred choice for stereo recording. Condenser mics require a power supply to work, explained later under the heading "Mic Connectors, Powering, and Cables."

Dynamic (moving-coil) mics work without any power supply. They are rugged and reliable. Most dynamic mics do not sound as clear and natural as condensers and are less sensitive, so dynamics are seldom used for stereo recording.

A *ribbon* mic provides a smooth sound that many people prefer, and it works without power, but it's delicate and expensive.

Sound Pickup Patterns (Polar Patterns)

Microphones also differ in the way they respond to sounds coming from different directions:

- An *omnidirectional* (*omni*) mic picks up sound equally well in all directions.
- A *unidirectional* mic picks up sound best in front of the microphone. It partly rejects sounds to the sides and rear of the mic. Three types of unidirectional mic are *cardioid*, *supercardioid*, and *hypercardioid*. Each has a progressively narrower pickup pattern.
- A *bidirectional* (figure-eight) mic picks up best in two directions: in front of and behind the microphone. Most ribbon mics have a bidirectional polar pattern. Mics with this pattern are used in the Blumlein stereo technique, described in Chapter 8. Figure 7-1 in Chapter 7 shows various polar patterns.

Which mic pattern is right for your needs? Choose omni mics when you need all-around pickup, extra deep bass, less handling noise and wind noise, or binaural (headworn) miking for headphone playback. Choose cardioid mics when you need sharp stereo imaging, rejection of room reverberation, and rejection of background noise.

Mic Connectors, Powering, and Cables

As shown in Figure 1-2, mics come with either an XLR (3-pin) connector or a phone plug (called a “jack” plug outside the US). Most condenser mics with an XLR connector are powered by 12–48 V *phantom power*. This powering can be supplied by a phantom power supply, mic preamp, recorder, or mixer. Condenser mics with a phone plug (jack plug) either use an internal battery, or they receive *plug-in power* (3–10 V DC) from a mini mic preamp or recorder. Some mics can be powered by a separate *battery module*, which helps the mic pick up loud sound sources with less distortion (increased dynamic range).

A mic with an XLR connector has what’s called a “low-impedance, balanced” output. Such a mic can be used with very long mic cables without picking up hum or losing treble. A mic with a phone plug (jack plug outside the US) comes with a short, permanently attached cable or no cable. This type of mic has an unbalanced output that is low-to-medium impedance.

What if your mics have XLR connectors, but your recorder or mic preamp has one or two phone jacks (sockets outside the United States)? You’ll need an adapter cable, shown in Figure 1-3.

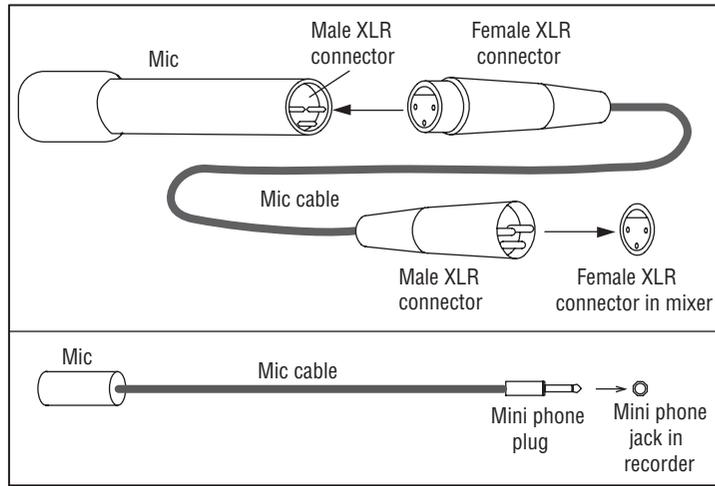


Figure 1-2 (Top): Male and female XLR connectors. (Bottom): Phone plug and phone jack connectors (jack plug and socket connectors outside the US).

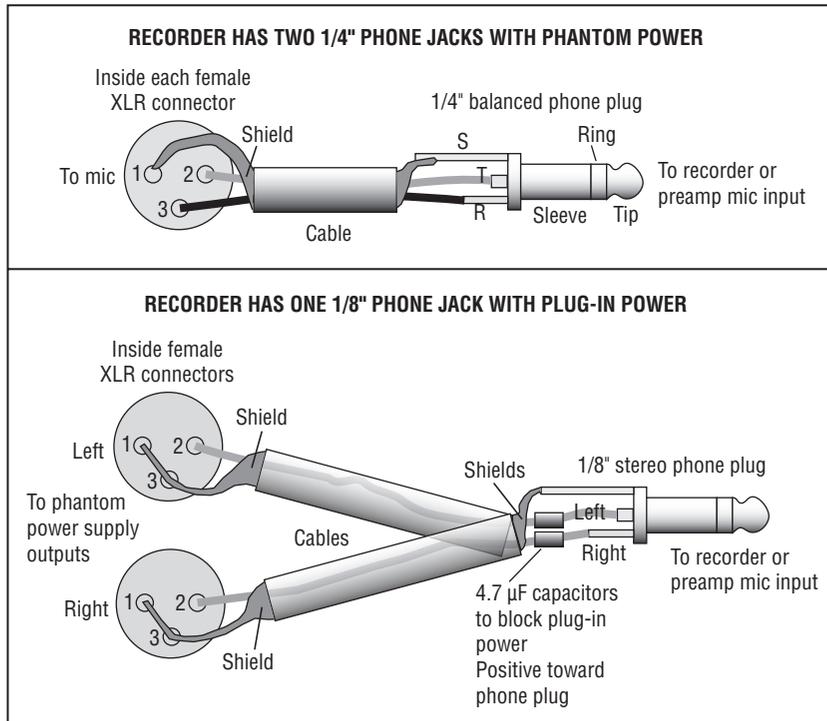


Figure 1-3 XLR-to-phone adapters (XLR-to-jack adapters outside the US).

Cheap 1/8-inch phone plugs (3.5mm jack plugs) with thin gold plating are actually less reliable than plugs with nickel plating. Thin gold plating wears off quickly, exposing a brass surface that makes poor contact.

Special-Purpose Mics

A *stereo mic* has two mic capsules in the same housing for convenient stereo recording. A *mini stereo mic* plugs directly into some portable digital recorders. Mini stereo mics that use cardioid mic capsules tend to have less bass and more noise (hiss) than larger stereo mics. A headworn *binaural mic* has two miniature omni condenser mics that you wear in or near your ears; you play back the recording on headphones. Chapter 12 lists all these types of microphones.

You can make yourself a decent stereo or binaural mic for experimenting. Purchase some Panasonic WM-61B102B omni mic capsules from www.Digikey.com for \$1.85 each. Get an adapter cable with a 1/8-inch stereo plug (3.5mm stereo jack plug outside the US) and two RCA (phono) plugs. Cut off the two RCA (phono) plugs and solder the wires to the mics. If you want mics that are rugged, of higher quality, and better looking, check out the commercial mics listed in Chapter 12.

Microphone Mounting Styles

Microphones also can be classified by the way they mount onto objects:

- A stand-mounted stereo mic attaches to a mic stand, which provides the most secure and stable mounting. A stereo pair of mics can mount on a stereo bar (stereo mic adapter), which holds two mics on a single mic stand. However, mic stands might be too large to be acceptable in certain venues, and they are a hassle to carry.
- Plug-in mics plug into a mic preamp or portable recorder. No mic stand is needed.
- “Gooseneck” stereo mics are worn around the neck.
- Clip-on mics can be clipped to a shirt at the shoulders or to eyeglass earpieces.
- Headband-mounted mics are attached to a headband. Some headband products have “street” styling.
- Handheld mics have a handgrip. Watch out for rubbing noises if you use a handheld mic.
- Desktop mics sit a few inches above a desk or a table, so they might pick up an unnatural, filtered sound due to surface-sound reflections.

- Boundary mics eliminate this problem by mounting directly on surfaces.

Mic Specs

When you shop for a mic, consider these other specifications on the mic data sheet:

- *Signal-to-noise (S/N) ratio*: 67 dB at 1 Pa (Pascal) is fair; 74 dB is very good; 84 is excellent. But 67 dB is good enough if you are recording loud rock concerts.
- *Frequency response range*: 100 Hz to 15 kHz is fair; 50 Hz to 18 kHz is very good; 20 Hz to 20 kHz is excellent.
- *Frequency response tolerance*: ± 6 dB is fair; ± 3 dB is very good; ± 1 dB is excellent.
- *Maximum sound pressure level*: 100 dB is fair; 110 dB is very good; 120 dB is excellent (high enough for rock concerts).
- *Size*: Small-diameter microphones (under 1/2 inch) tend to be relatively noisy, but this may not be a problem if you are recording loud music. Omni mics of any size can have excellent bass. They pick up deeper bass than small cardioid mics, which sound “thin” by comparison.
- *Accessories*: A foam windscreen for recording outdoors is a handy accessory. If your mic lacks a windscreen, you can purchase one from Radio Shack (or a music store) and cut it to fit. A stereo bar or stereo mic adapter mounts a pair of mics on a single mic stand for convenient stereo miking.

Portable Stereo Recorder

Having covered mics for stereo recording, let’s move on to the recording device itself. We’ll look at five different types of portable stereo recorder: a flash-memory recorder, flash-memory recording system, MiniDisc recorder, digital audiotape (DAT) recorder, and a laptop computer with recording software.

Flash-Memory Recorder

A flash-memory recorder (Figures 1-4 and 1-5) is a portable digital recorder with no moving parts. Also called a *solid-state recorder*, it records into a flash-memory card such as a Compact Flash or Secure Digital (SD) card. A 2 GB card, which records 2 hours of 24-bit/44.1 kHz wave audio



Figure 1-4 M-Audio Microtrack 2496, an example of a stereo flash-memory recorder.



Figure 1-5 Tascam HD-P2, an example of a stereo flash-memory recorder.

files, costs about \$65. Flash-memory recorders can record MP3 or uncompressed PCM wave files (which are CD quality or better).

These recorders have a number of features to consider. Power comes from replaceable or rechargeable batteries. Available mic connectors are XLR, 1/4-inch phone (6.35 mm socket), or 1/8-inch phone (3.5 mm socket), with or without 48V phantom power or plug-in power. Some units come with built-in or plug-in stereo microphones. Prices range from \$400 to \$2000.

After making a recording, you connect the USB (Universal Serial Bus) port in the recorder to the USB port in a computer. The recorder shows up as a storage device on your computer screen. You drag-and-drop the recorded sound files to the computer's HD for editing and CD burning. The files transfer in a few minutes. Then the flash-memory card is empty, free to make more recordings.

Nearly all flash-memory recorders include a mic-gain switch to accommodate both quiet and loud sound sources. Low gain or low amplification (0–15 dB) is for recording loud sounds (rock concerts); medium gain (25 dB) is for recording medium sounds (acoustic music, lectures, or rehearsals); and high gain (50 dB) is for recording quiet sounds (nature, quiet talking). Most recorders have AGC (automatic-gain control), which sets the recording level automatically depending on how loud the sound is. Some units include a limiter to prevent recording above 0 dB level, which otherwise would cause distortion.

Some examples of flash-memory recorders are the Sony PCM-D1; Marantz PMD660, PMD670, and PMD671; Core Sound PDAudio® System, AEQ PAW-120, Edirol R-1 and R-09, M-Audio MicroTrack 2496, Nagra Ares-M, PocketRec software, Sound Devices 722/744T, Fostex FR-2, Roland CD2, Mayah Communications Flashman, and Tascam HD-P2.

Flash-Memory Recording System

A lower-cost alternative to a flash recorder is a flash-memory recording system made of several components (Figure 1-6(a)). This is the signal flow from start to finish (left to right):

1. A **stereo mic** (or mic pair) picks up sound and changes it to an electrical signal at mic level (a few millivolts).
2. The mic signals go into a stereo **mic preamp**. This device amplifies the mic-level signals up to line level (about a volt). It is built into a Gemini iKey Plus.
3. The stereo line-level signals go into an **audio interface** (such as the Gemini iKey). It includes an A/D (analog-to-digital) converter that

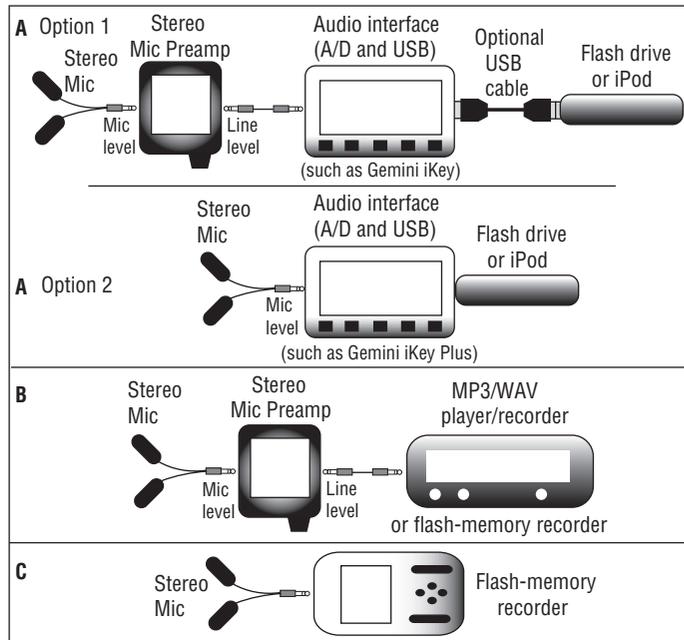


Figure 1-6 Three equivalent flash-memory recording systems: (a) stereo mic, mic preamp, interface, and flash drive; (b) stereo mic, mic preamp, and MP3/WAV player/recorder; and (c) stereo mic and flash-memory recorder.

changes the analog line-level signal into a digital signal (a series of ones and zeros).

- Also in the interface is a USB encoder, which converts the digital audio signal into USB format. USB is a connection for high-speed transfer of digital data from one device to another. The USB signal data comes out of the USB connector in the interface.
- The USB cable connects to a USB port in a **flash drive (USB flash memory)**, which records the audio in flash memory as an MP3 or WAV file. An alternative to a flash drive is an **MP3 player** that can record MP3 or WAV files. Some newer iPods can record stereo WAV files at 44.1 kHz in extended mode..

In summary, the signal flow in Figure 1-6(a) is mics > mic preamp > interface (A/D converter and USB encoder) > flash drive with flash memory. During playback, the digital audio plays back from flash memory, is converted to analog audio by a D/A (digital-to-analog) converter, and comes out the headphone jack.

Let's take a closer look at the audio interface in Figure 1-6(a). The battery-powered Gemini iKey USB audio interface (about \$100) has a line input and a USB output (www.ikey-audio.com). Its noise floor is not up to professional standards, but it is quiet enough for hobbyist use. The iKey Plus (\$169) has a MIC input.

Some of the components in the flash-memory recording system have been combined into one device. For example, Figure 1-6(b) shows a stereo mic plugged into a mic preamp, which feeds the line input of a portable MP3 player that can record MP3 or WAV files. One example of an MP3 player/recorder is the Cowon Systems iAudio U2 (www.eng.iaudio.com, about \$130), which includes USB 2.0 and records on a flash-memory card up to 2 GB. Other units are the iriver T30-1GB for \$119 (www.iriver.com) and the NOMAD Jukebox 3 for \$259 (www.nomadworld.com).

As shown in Figure 1-6(b), you also need a stereo mic and battery-powered mic preamp to record live music with an MP3/WAV player/recorder. The mic preamp amplifies the mic signal and sends it to the player's line-in connector. One mic preamp is made by Archos (www.hotmp3gear.com/Microphone.htm). Selling for \$49, the Archos preamp is not professional quality, but it might be all you need. A step up in quality is the Church Audio ST20A preamp for \$80 (www.church-audio.ca or <http://stores.ebay.com/church-audio>). The SP-preamp-4 by The Sound Professionals is a pro-quality unit for \$199 (www.soundprofessionals.com). So is the PA-24NJ preamp from www.sonicstudios.com.

Check out these specs when shopping for a mic preamp:

- *S/N ratio*: 90 dB is fair; 110 dB or higher is excellent.
- *Frequency response*: 20 Hz to 20 kHz ± 2 dB is fair; ± 1 dB or less is excellent.
- *THD*: 0.5% is fair; 0.06% or less is excellent.

If no specs are given, the unit probably is not professional quality.

The components in a flash-memory recording system have been combined in other ways. For example, Figure 1-6(c) shows a stereo mic plugged into a flash-memory recorder, which we discussed earlier. Built into the recorder are mic preamp, A/D converter, and flash memory. Audio is recorded (stored in memory) as an MP3 or WAV file. The signal flow is mics > mic preamp > A/D converter > flash memory. A USB port in the recorder can be used to transfer the audio recordings (files) to a computer for editing.

When assembling a flash-memory recording system to record live music, consider these options:

- If you already have a flash drive, iPod, or MP3 player/recorder with a USB port, add a stereo mic, mic preamp, and audio interface. Omit the MIC preamp if using iKey Plus.
- If you already have a portable MP3/WAV recorder with line-in, add a stereo mic and mic preamp.
- If you already have a PDA (Personal Digital Assistant), add a stereo mic, mic preamp/A-D converter, PDAudio card, and PDAudio recording software (all available at www.core-sound.com).
- If you want the convenience of an all-in-one system, use a stereo mic and a flash-memory recorder. Some recorders come with a stereo mic built in. Dedicated flash-memory recorders offer higher sound quality than the multi-component systems.
- If you are recording directly off a mixing board, you can omit the stereo mic and mic preamp in any of the systems above. Simply plug the board's tape-out or rec-out connectors into the line-in connector(s) of your recording device, using an appropriate adapter cable.

One source of stereo mics, mic preamps, interfaces, and recorders is The Sound Professionals (www.thesoundprofessionals.com). They offer a wide variety of devices at different price/quality levels.