Are You Ready For CD-R?

TASCAM®

CONTENTS

Introduction 1

Getting Started 7

Mastering 8

The Stand Alone CDR Recorder 11

Hooking Up 12

Computer Software 15

Computer Hardware 16

Choosing A CDR Recording System 18

Final Thoughts 19

Trouble Shooting 20

Glossary 22

INTRODUCTION

Why am I here?

So you're about to take the plunge into CDR recording? Or maybe you've already started but find the jargon, hardware choices and media options a little scary. This booklet will help by presenting the main concepts you'll need to know in a clear, easy to understand way. We'll not bore you with confusing tech-babble (you like it already, right?). Instead, after reading this you'll have the knowledge to make decisions about hardware, software, blank CDR media and CD recording techniques. You'll also have the confidence that comes with that knowledge to speak to a retailer, ask the right questions and walk out with the things that you actually need to get started! Then, if you like it so much that you want to learn every technical detail there is then there are books available much thicker than this one to satisfy your quest. For now grab some chips and a soda and let's dive in!

The Way We Were.

For many years the vinyl record, now considered "retro" was the standard and most common way to reproduce recordings for mass distribution. Then in the early 1980's the compact disc (CD) was introduced with much hype and controversy as a replacement to our familiar and comfortable friend, the LP. Today the CD and CD player are as common and familiar as our kitchen toaster and the slice of toast that comes out of it.

To better understand the present and the future let's first revisit the past... analog recording:

An analog sound recording is an electrical or physical copy or "analog" of an original sound.

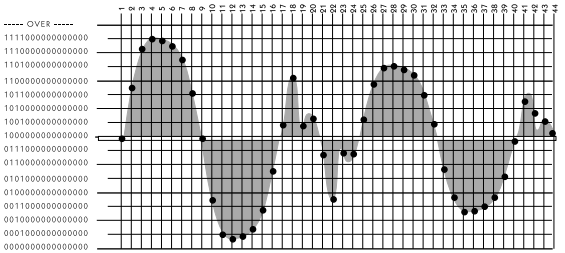
In the case of vinyl, sound in the form of electrical energy is sent to a cutting lathe where a cutting head follows the frequency and amplitude of the sound, carving a groove into a lacquer plate to be sent to a pressing plant for mass duplication. That groove would then be a physical copy of the sound's electrical energy and could be played back by dragging a playback needle or stylus along the groove, reconverting it back to electrical energy to be sent to your stereo system and out through the speakers. This kind of system, or something like it has been in use since the days of Thomas Edison!

Analog recording and playback of a physical groove in plastic had some limitations. Dirt could get in the groove, the groove could get scratched or simply worn out by dragging that stylus through it hundreds of times while listening to your favorite song causing static, crackle, skipping or other noise that would distract from your enjoyment of the music. Additionally if the sound got too loud or had too much bass, sibilance or out of phase content the groove could not keep up and the record would skip, distort or be limited in length.

Something better was needed. Something that resisted physical corruption or damage, something that could hold more minutes of sound, something that could better reproduce the dynamics of musical performances with little or no noise, something that was small, convenient and allowed for fast access to different songs without "turning over the record".

Enter the compact disk.

A digital sound recording on a CD is a set of 44,100 pictures (samples) per second of a sound stored in a binary format. Each vertical line in the drawing below represents a sample of an analog sound wave.



In the case of digital audio on a CD this binary information (that's just a fancy way of saying one's and zero's) is stored as "pits" stamped into a metal layer encased within a protective plastic layer. These pits are read by a laser that is focused exactly on the metal layer. This avoids any scratches or contamination on the actual surface of the protective plastic layer.

Since the pits are read by a laser and no actual physical contact occurs, extra noise such as hiss and crackle cannot be introduced into the sound. Additionally binary information is not limited by the physical restrictions of a groove on plastic allowing greater range between the softest and the loudest sounds, called “dynamic range”. With a diameter of only 4.75 inches, the CD can now easily be played back in your car or portable CD player.

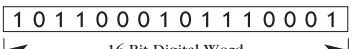
And best of all, the CD is capable of holding up to 74 minutes of uninterrupted stereo sound!

44.1k, 48k, Bits, A/D, D/A What is all this stuff?

Sampling Frequency (44.1k vs. 48k)

On a CD there are 44,100 samples per second. The human ear can hear frequencies as high as 20k varying a little from person to person. In order to digitally store frequencies that high a sample rate of at least double the highest audible frequency is needed. When the specification for the compact disc was created a sampling rate of 44.1 was adopted. A sampling rate of 48k was also adopted by many manufacturers of digital audio tape machines. This created some confusion and compatibility problems in those early days of digital so those 48k machines were later designed with the ability to operate at 44.1k and 48k. In order to digitally record 48k material on a CD the sample rate must be converted by either a piece of hardware or a software process.

Bits



Every "One" or "Zero" represents a single "bit".

Each sample on a CD is stored as a 16 bit binary word. That means there are sixteen places in the word that could be a “one” or a “zero” represented by a single pit on a CD. While there are no 24 bit CD’s there are many digital recording and mixing tools available that record or process audio at 24 bit or higher resolutions. Let’s use a visual description to imagine the difference that higher bit resolution makes. An 8 bit computer screen can only show you 256 colors while a 16 bit screen will show you over 65,000 colors. Imagine how much more realistic a 16 bit picture would be over an 8 bit picture. Now imagine a screen that can show you 16.7 million colors! That’s 24 bit. In the audio world higher bit resolution not only means more detail heard in the sound, it also means more space required to store the information.

Dither

CD's are 16 bit but what if your recording or digital mixing format is 24 bit? When transmitting 24 bit information directly to a 16 bit format the last eight bits are simply omitted. However, this omission produces a loss of sonic resolution that can be audible. To counteract this loss of resolution a process called "dithering" is used. This process works by adding a very specific type of noise to the digital signal at a very low level. Yes, adding noise goes against everything we've always learned about recording. However, the noise that is added does not detract from the original source material. In essence, the source material masks the noise added to mask the resolution problem. The dithering algorithms used today are highly advanced and the sonic benefits of their use far outweigh any objections regarding "extra" noise.

A/D and D/A

Any piece of digital equipment that has analog inputs or outputs has "Analog to Digital converters" or "Digital to Analog converters". An A/D Converter is a device or electronic circuit that takes the samples of an analog sound that will be stored in binary format. A D/A Converter is a device or electronic circuit that interprets binary information and gives you back your analog sound. So high quality converters on your audio equipment will mean better and more accurate recording and reproduction of your digital audio. Many pieces of equipment today have converters with higher bit resolutions than their binary storage format can handle. For example a digital tape recorder could have 20 or 24 bit converters while storing the digital information in 16 bit format. This "overkill" in the converters squeezes as much resolution as possible out of those 16 bit binary words.

CD's and CDR Media

First, let's understand the differences between the soundtrack CD you bought at your local music store, a recordable CD or "CDR", a rewritable CD or "CDRW" and a CDR labeled "For Consumer Use":

The pits on the soundtrack CD are physically stamped into a thin layer of metal to be read by the laser in your CD player. The equipment to make this kind of CD is large and expensive requiring a controlled environment and trained operators to function. Companies that make these CD's usually have minimum orders of 500 to 1,000 pieces.

The CDR

The "pits" on a CDR are really holes burned into a layer of dye by the laser in a CD recorder. Behind this layer of dye is a layer of reflective metal so that the reflections of the metal through the holes in the dye can be read by the laser in a CD player. Once these holes are burned by the laser they cannot be "unburned". It is not possible to erase or re-record onto a CDR.

The CDRW

A CDRW (CD-ReWritable) is a special kind of CDR that allows a CDRW compatible recorder to "re-burn" the holes! It does this by alternately melting and cooling tiny spots in the layer of dye in order to create different reflective surfaces that the laser in a CDRW compatible player can interpret as "holes" in order to read the binary information. Because of the special character-istics of a CDRW an ordinary CD player will not play back a CDRW. A machine such as the TASCAM CD-RW5000 is capable of both recording and playing back a CDRW.

A CDRW may be used in a way similar to a DAT tape for re-doing mixes until it is "just right" or for keeping copies of works in progress.

"For Consumer Use"

A CDR or CDRW that is labeled "For Consumer Use" or "For Audio Only" or "For Music Only" or any other similar phrase is physically the same as a regular CDR or CDRW but with the addition of special encoding required by consumer CDR recorders usually found at stereo stores in order for recording to occur. These machines also record Serial Copy Management System (SCMS) encoding with the audio which makes it more difficult to make a digital copy of such a CD. A regular CDR or CDRW will not work in these machines. Consumer discs also carry a higher price tag due to a royalty paid to performing rights organizations.

Some CD recorders like the TASCAM CD-RW5000 can use either a regular low-cost CDR or a consumer CDR. This can be useful if you wish to make a CD for someone and restrict their ability to make digital copies of it.

What Do All Those Colors Mean?

Often in the discussion of CDR media the question of Red Book, Orange Book, Blue Book, etc. comes up. This is more a question of software and hardware but since it is so closely associated with media let's cover it here:

Red Book

The Red Book standard defines the format in which an audio CD must be recorded to be recognizable by a standard CD player. When a CD pressing plant accepts a CDR master to begin the duplication process they will require that such a CDR conforms to the Red Book Standard. It is advantageous to present such a CDR to a pressing plant because they will be able to generate a "glass master" for pressing directly from your CDR without the need to load your mixes from DAT or other source into a workstation to generate a Table of Contents. This reduces cost and skips the need for another generation of digital copying.

The Red Book format requires that a TOC (Table of Contents) is encoded at the header of the disc. The TOC encodes information pertaining to subcode data, index numbering, timing information, emphasis, copy prohibit data, etc. This TOC is what distinguishes Red Book format from Orange Book.

Orange Book

All audio CD-R's contain Orange Book data, which can be read by a Red Book compliant player once "finalized". Finalizing is the process of writing a permanent TOC on the CDR to be read by a CD player. Until a CDR is finalized it can only be played back by a CDR recorder (yes it can be just a player too!). The TOC written to a CDR that has not been finalized is a temporary TOC and cannot be played back on a standard CD player or used by a pressing plant for duplication. Once a CDR is finalized further recording on it is not possible. (Unless is it a CDRW.)

Blue Book:

This format is used for Enhanced CD's (also called CD Extra). Enhanced CDs are recorded in two steps. Step One is the recording of the audio portion of the CD which by itself would conform to the Red Book standard.

Step Two is the recording of computer data that will not be recognized by your audio CD player, however it will be recognized by your computer CD-ROM drive. This could be pictures, lyrics, video clips, computer software etc. included by the producers of the CD to enhance your experience of the artist's music. Todd Rundgren's enhanced CD "The Individualist" is an excellent example of this format by a pioneer in the field.

Now you want to make a CD.

We're musicians and there are instruments we use in our craft to make music. There are also tools we can use to record our music, tools that are now available to us thanks to advances in technology benefiting many industries including, most importantly to we musicians, the recording industry.

Technology is your friend.

You've heard all the buzz about people making their own CD's and you've got some songs in your head that you need to get out. Let's outline a few steps you'll need to take before you have that shiny little disc in your hand...

A CD is made from a two-track mix of stereo audio.

This may seem obvious but with the integration of computers, highly advanced keyboard workstations and more computers it can be easy to lose track of this minor detail!

There are a couple of ways you can end up with a stereo mix of your music. You can record instruments and musical parts onto separate tracks of an analog or digital multi-track recorder, then mix them through a mixing console onto an analog or digital two-track recorder. Or you can record your music through a mixing console directly to a two-track recorder.

Now you have your music all mixed and on two-track.

You have some decisions to make. Never fear, they're not difficult ones! Armed with the answers to some easy questions we'll go on to the "how-to's".

1. **What is this mix for?**

   A finished masterpiece? A rough mix to give to a musician to learn parts or arrangements? A reference to hear your work outside of your studio? An archive or backup of last year's or last month's work?

2. **Who's hand will be the next to touch the CD you're about to make?**

   A mastering engineer? A CD manufacturing plant? Another musician? A friend or relative? A buddy with a computer who can "run some copies for you"?

3. **Does your mix need a little help?**

   Editing? EQ, compression or overall level adjustments?

To Master or Not To Master?

(And what is Mastering anyway?)

Mastering is the process whereby your mix is prepared for being heard by the general public and transferred to a physical format used by a duplication plant for making a "glass master" from which multiple copies can be pressed. During this process EQ and level adjustments are made in addition to more specific processing such as compression and sibilance control (de-essing). The goal of all this processing is to create a smooth flow from song to song as well as to make the recording sonically competitive with other recordings in the marketplace. The processing added during mastering will most likely be subtle, meant to enhance the mix you have, not change it drastically. However there may be situations where extensive processing is required to correct technical problems such as left/right balance, phase, hiss, crackle or excessive treble or bass frequency content.

Editing of your final mix may be required to remove count-ins, smooth fade outs or change the structure of songs. Putting the songs in the order you want with the amount of space between them you want (if any) and adding additional sound effects (if any) will also be part of the editing process.

There will be times when you will want to master, times when it will not be necessary and times when something between full mastering and not mastering at all will be appropriate. Let's look at these three possibilities more closely.

Full Mastering

This is something you'll want to do before releasing a CD full of your finished masterpieces. If you have the expertise, equipment and objectivity you can do it yourself or you can hire a mastering engineer who has the specific equipment and training needed to do the job. Not to be overlooked is the value of a perspective other than your own at this point. You've lived with these songs and mixes for quite some time and someone with a fresh set of ears may prove invaluable by catching something you've overlooked.

The specific equipment a mastering engineer or mastering studio may have will vary but in general things to look for are: a high quality, accurate monitoring system including a well-designed, neutral listening room; signal processors such as EQ and compressors specially designed for mastering; equipment necessary for producing a digital master acceptable to the CD pressing plant you've chosen (this will likely be a CDR but could also be a DAT or 1630 tape).

Be sure to listen to the work of a potential mastering engineer both in their studio and, if possible, in your own environment. You'll want to compare their work to other CD's of a comparable style to your own, listening for overall volume and sonic quality. Also be sure that a potential mastering engineer understands your style of music and does not specialize in some other style.

No Mastering Required

You may need to make a CD for other musicians to learn parts or simply to demo your songs or musical tastes and abilities to potential band members or songwriting partners. This is also a way to reference your mixes on several stereo systems before they are mastered.

Using a CD for this purpose ensures stability of pitch and tempo for other musicians while providing full range "CD quality" sound in order to make sonic judgements needed to fine tune your mix. The less that needs to be done during the actual mastering process, the better.

Unprocessed CD copies of your mixes is a very good way to archive and create backup copies of your work to have in addition to your original master DAT's or 2-track tapes. DAT tapes sometimes fail and analog tape will deteriorate over time. CDR is a cost effective insurance policy that will last a long time (CDR's will archive up to 100 years!) and will be priceless the first time a DAT tape turns up missing or simply won't play anymore and you have a pristine copy available on CDR.

Not Quite Mastering

Suppose you are in the middle of mixing and someone (a record company A&R person, a producer or radio DJ) wants to hear what your stuff sounds like. You don't have the time or perhaps the available funds to schedule a mastering studio but need to make a CD that will be impressive to listen to and not suffer too much in comparison to an actual mastered CD. This is a "good problem" and one that is easily solved with the technology available to us today. Let's look at this option closely since it is probably the most common scenario out there in "the real world".

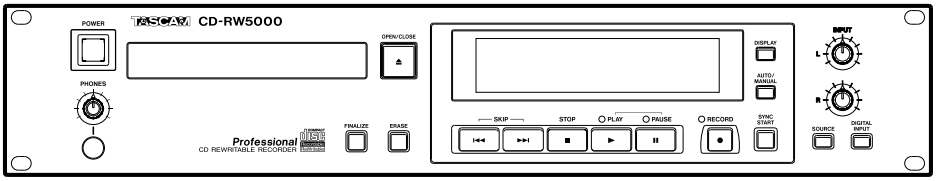
THE STAND ALONE CDR RECORDER

There are two ways to record audio onto a CDR: using a "Stand Alone" CDR recorder or using a computer system with a CDR burner.

This is a machine that operates in a way very similar to a DAT machine combined with a CD player that records CDR's in real time. We'll use the TASCAM CD-RW5000 in our examples. It is convenient for the songs to be in their correct order and properly spaced on DAT or analog two-track before recording to a stand alone CDR recorder. That means that any editing needed should be completed before recording the CDR in addition to making sure that there are no occurrences of digital clipping which could cause distortion.

Two-track analog editing is done with a razor blade by scrubbing the tape manually over the playback head of a two-track machine, marking a spot with a grease pencil or china marker and actually cutting the tape with the blade! You know who you are...

If your mixes are on DAT you could edit and arrange your songs in a computer workstation using software such as Pro Tools. You could also make a DAT to DAT copy to put the songs in order, but this method doesn't allow for editing or precise spaces of silence between songs.



With the TASCAM CD-RW5000 you can record each song one at a time by pausing the TASCAM CD-RW5000 and locating the next song on your DAT or two-track and continuing to record. You can even take the unfinished CDR out of the TASCAM CD-RW5000 to add more songs another day as long as the disc is not finalized.

(Repeat of an Important Note): Finalizing is the process of writing a permanent TOC on the CDR to be read by a CD player. Until a CDR is finalized it can only be played back by a CDR recorder. The TOC written to a CDR that has not been finalized is a temporary TOC and cannot be played back on a standard CD player. Once a CDR is finalized further recording on it is not possible.

Analog Hookup

Now that you've got your songs in order let's see how to hook it all up and make it work, we'll look at both analog and digital hook ups.

There are some important things to remember about recording a CDR from an analog source as in the diagram on the previous page. Complex sound such as music contains "transients" (instantaneous spikes of amplitude like a snare drum hit or bass slap). These transients must be controlled by a peak limiter or they can overload a digital input causing distortion. With the transients "smoothed out" the overall level of signal recorded onto the CDR can be higher. Perhaps a picture will help:

The graphic on top represents sound before peak-limiting while the graphic on the bottom represents sound after peak-limiting and volume adjustment. Don't be alarmed by the term "limiting". All CD's produced today have some type of peak-limiting applied to them and if done well the only thing you'll notice is the increased overall volume of your music. If it sounds "compressed" or distorted then the peak limiter is being pushed too hard.

Remember we're still in the analog domain where input and output levels are adjustable with the twist of a knob. If the meters on the CDR recorder are showing "overload" then the signal coming into the recorder must be trimmed down. Digital distortion is not pretty!

When recording a CDR from an analog source the CDR recorder will add a new track ID when sound is detected above a preset threshold after 3 seconds of "silence" and

the CDR recorder is set to "automatic ID mode". Silence occurs anytime the sound drops below a preset threshold for a preset number of seconds. If silence continues for 20 seconds then the CDR recorder will stop. In the case of the TASCAM CD-RW5000 this threshold is -36db. These specs may vary from manufacturer to manufacturer.

If the dynamic of your music contains soft passages of 3 seconds or more such as in classical music then you will need to manually insert track ID's on the fly or record each song separately which will insert an ID each time the recorder is taken off pause. This is very similar to the "Auto ID" and "Manual ID" functions on a DAT machine.

If you've been following along then you've just made your first CDR, even converting analog to digital and it didn't hurt a bit! Just remember to finalize it before trying to play it in your home or car CD player.

NOTE: The laser tolerances required to play back a stamped CD are more forgiving than those required to play back a burned CDR. Because of this your disc may not play properly in every player, especially older players, some car players and players that have been "used extensively". You may have to try another player and/or experiment with different brands of media.

Digital Hookup

Recording to a CDR recorder digitally is a little easier than from an analog source because generally digital levels are preset within the digital domain. However we'll still need to use peak-limiting to get the most level onto the CDR. The concept is the same as in the analog example above except that we can use a peak limiter specially designed to work within the digital domain such as the TC Electronics Finalizer Express which includes EQ and compression functions in addition to peak-limiting all within one unit.

S/PDIF

There are two types of digital protocol available for stereo audio that we'll be dealing with here. The first one is S/PDIF (developed by Sony and Philips) carried by a specially shielded 75 ohm coaxial cable (like a video cable, not a standard RCA audio cable) or digital audio optical cable called a Toslink cable (developed by Toshiba). Be careful with optical cables, if they get bent sharply they will break. S/PDIF is the protocol found most on consumer audio equipment with digital

AES/EBU

The other digital protocol is AES/EBU (a professional standard agreed to by the Audio Engineering Society and the European Broadcast Union). AES/EBU or simply AES as it is commonly referred to in the United States, is carried by specially shielded 110 ohm cable with XLR connecters.

NOTE: Both protocols require only one cable to carry both channels of a stereo digital audio signal.

When recording from a digital source using the S/PDIF protocol most CDR recorders including the TASCAM CD-RW5000 will record any DAT ID's or CD track ID's present in the source recording as long as the CDR recorder is in "Auto ID Mode". These ID's are not transmitted via the AES/EBU protocol. If you are transferring digitally using the AES/EBU protocol you will have to rely on the ability of the recorder to add track ID's at the beginning of audio after silence as described in the section above on CDR recording from an analog source or you can insert track ID's manually on the fly. (Usually done by pressing "record" on the CDR recorder while recording is taking place.) Unlike a DAT machine ID's cannot be inserted after the audio has been recorded.

Most CDR recorders have a switch to select which input you are using: analog, coaxial or optical. Additionally there may be a built in sample rate converter that would need to be engaged in the event that the source material was recorded at a sample rate other than 44.1k while the TASCAM CD-RW5000 automatically senses the incoming sample rate of a digital signal and converts it to 44.1k in real time.

Try it, you'll like it. Keeping your audio in the digital domain in this way ensures high sound quality without the coloration that can result from multiple conversions between analog and digital.

The Computer Based CD Burner

There are specific hardware and software requirements to be able to make CD's on your desktop computer. With the rapid advancement of computer technology and software development it would be beyond the scope of this booklet (and more than you probably want to read) to go into specifics that would be out of date soon. Below are some general guidelines for putting together a computer system capable of audio recording and CD burning. You may already own such a computer!

Software

This is the real brains of the operation. Once you've decided on what you want to be able to do (from simple editing and CD burning to full mastering) and what your budget is you can start looking for software that meets your needs. Many CD burners come bundled with software. This is the real brains of the operation. Once you've decided on what you want to be able to do (from simple editing and CD burning to full mastering) and what your budget is you can start looking for software that meets your needs. Many CD burners come bundled with software. (The TASCAM CDR bundles for Macintosh and Windows both include excellent software.)

If you want to get into more extensive editing, processing and mastering capabilities then you may want to consider software by Digidesign, Steinberg or Sek'd. There are many companies producing such software with new ones emerging rapidly, so choose wisely and look for companies with a solid reputation that are likely to be around for a while. That way you know you'll be able to get product support and upgrades in the future. Also be aware that some software packages require specific hardware to operate. With so many choices available hardware and software compatibility should be given careful consideration.

I/O Hardware (Sound Card)

Welcome back! Now that you know what software you want you may have discovered that it requires specific hardware. That makes your choice easy! Otherwise your software should have come with a list of compatible hardware. Consider how you are going to be using your new system. You may need digital ins and outs in addition to analog. The A/D and D/A converters should be of high quality. You may need multitrack ins and outs, be sure to get the kind that works with your format (TDIF, ADAT or analog). Look into how easily and reliably it will interface with your existing equipment. Always choose a trusted manufacturer to ensure product support and upgrades.

Processor Speed, RAM, Hard Drive Capacity and Speed.

Again you will need to refer to your software specifications for computer system requirements. The specs will list minimum RAM requirements, hard drive capacity and processor speed and type required for the software to run. Generally faster speed and more RAM will allow certain software to run more efficiently and to its fullest capabilities. Get more than you need and as much as will fit within your budget. In this case "less is not more"... give your system room to grow as your needs change. Consider whether this computer will be only for audio or if it will be used for other things as well. An "audio-only"computer may not need all the hardware and software extras that a typical desktop computer with many uses may need.

16 bit stereo digital audio with a sample rate of 44.1k requires about 10 megabytes of drive space per minute of audio. A full CD's worth of stereo audio will use up about 750 megabytes of drive space! Double that number if your software stores processed audio in separate files from source audio. Keep this in mind when you're wondering "Do I really need 6,000 megabytes of space (also abbreviated as 6 gig or gigabytes). You probably will! This may be a good time to think about some way to back up all your audio such as a tape drive for computer data.

In addition to capacity, hard drive speed is very important. The drive needs to be able to pull the binary information off the drive fast enough play the sound in real time. Your software will give specifications regarding "seek time" and "rpm".

CD Burner

You may have decided to go with a "bundle" like the ones available from TASCAM for Windows or Macintosh that contains the burner and the software to run it in a single package. This is a convenient way to go and ensures compatibility. However, if you chose more extensive software based on your specific needs make sure that the CD burner you get is on their list of compatible burners for the software you have.

CDR burner speed can be an important consideration. If you plan on making many CDR's at a time you may want to go with a faster burner such as a 4X or 6X. If you'll only be making CDR's occasionally then maybe a 2X will be sufficient. But always look to the future and leave yourself room to grow, faster drives aren't that much more expensive with slower speed burners being phased out by manufacturers as the technology advances.

Getting Connected

Think of your sound card as the audio interface between your computer and the "outside world". Making the audio connections should be no more difficult than connecting a DAT machine or digital multi-track. Use new, good quality cables such as those available by Cable Up.

Some computer audio hardware and software packages require or recommend the use of a SCSI hard drive for audio storage because SCSI drives are generally faster than IDE drives. SCSI (pronounced Skuzzy) stands for Small Computer Serial Interface. A SCSI drive could be "internal" (actually inside your computer's case) or "external" (outside your computer's case in its own case with power supply). If your computer doesn't have a SCSI connector built in, one can easily be added by installing a PCI SCSI card into the computer that will run internal or external SCSI devices. If your SCSI devices are to be external you will need to know some things about SCSI connections. There are more than one kind of SCSI cable available so be sure to get the right kind for your type of drive. Refer to the documentation with your drive for this information. It's very important to get high quality SCSI cables that are properly shielded. The thin, inexpensive cables are not as reliable as the thick more costly ones. Get the good stuff, it will spare you headaches later. With an external SCSI chain you will need a SCSI terminator, which is simply a blank plug that connects to the last device in your SCSI chain that ensures a correct electrical load or "impedance".

If You Are…	*Consider…*
A songwriter with a need to archive material onto a stable high-quality format. **or** A musician with a need to present ideas or "works in progress" to other musicians on a high quality universal format. **or** A recording studio with requests from clients to take home mixes on a format suitable for making decisions about sonic quality.	A stand alone CDR Recorder with balanced analog inputs along with all three formats of digital input like the TASCAM CD-RW5000.
A producer or artist with a need to make competitive sounding reference recordings for a record label or publisher. **or** A recording engineer or studio with a desire to offer limited mastering services to clients.	A stand alone CDR Recorder with balanced analog inputs along with all three formats of digital input and the addition of a hardware mastering processor: A TASCAM CD-RW5000 and a TC Electronics Finalizer Express is an example of such a setup.
A musician/songwriter using a computer system for multi-track audio production and MIDI sequencing with a need to make reference audio CD's as well as back up computer data to CD-ROM.	A computer-based CD recorder bundle that includes software for making audio CD's as well as data CD's. A TASCAM CD-R400M or CD-R400W could be added to your computer to gain these capabilities.
A recording studio or artist using a computer system for multi-track audio production with a desire to move into full mastering capabilities.	A computer-based CD recorder bundle that includes software for making audio CD's as well as data CD's along with the addition of specific mastering software, high quality digital audio I/O and accurate monitoring capabilities. A TASCAM CD-R bundle added to your mastering setup, possibly with the addition of a TASCAM CD-D4000 for making copies would be efficient.

Web Sites For Further Research:

http://www.digidesign.com/
http://www.adaptec.com/
http://www.sekd.com/
http://www.hycd.com/
http://www.apogeedigital.com/
http://www.mitsuigold.com/
http://www.tdk.com/
http://www.kodak.com/US/en/digital/cdr/
http://www.allthingscdr.com/
http://home.cdarchive.com/info/

Books For Further Research:

The CD-ROM Handbook Second Edition
by Chris Sherman

The Complete Recordable CD Guide
by Lee Purcell and David Martin

Both books available through Music Books Plus
http://www.musicbooksplus.com

Congratulations...

You now have a powerful tool for making CDR's. Just load your mixes onto the hard drive through your sound card, edit and process as needed with your software, and then make a CDR with your CDR burner. Easy right? Or if you opted for a stand alone CDR recorder then it's really easy! Since you followed all the instructions and specifications carefully you should have no problems. But if you do run into a snag then help is just a phone call or email away from your reputable hardware or software manufacturer.

Remember the techniques above have been for our "Not Quite Mastering" setup. If you went with the computer system, it's a quick jump to "Full Mastering" with the addition of more specialized mastering software such as Steinberg's WaveLab or Digidesign's Pro Tools equipped with software "plug-ins" such as those available by Focusrite and Apogee. Just remember to check your hardware and software compatibility any time you upgrade, and since you left yourself and your system room to grow this kind of step up will be easy when you decide the time is right.

If your needs fall more into the category of "No Mastering Required", then simply omit the more elaborate software packages and stick with the basic hardware for getting sound onto your hard drive in order to burn a CDR. If you have a computer already with the ability to get sound in and the space to store it, the TASCAM CD-R bunldes for Windows and Macintosh contain the burner and the software you need.

No computer? No problem. The TASCAM CD-RW5000 is a quick and easy way to make CDR "one-offs" or to archive your work.

...You've just taken your first step into a larger world.

Problem:

My stand alone CDR recorder is not showing any input!

Things to Check:

- Is there a blank disc in the recorder?
- Is the proper input selected? (Analog, Coax, Optical or AES)
- Does sample rate conversion need to be turned on? Not every CDR recorder does this automatically. (TASCAM's CD-RW5000 does!)
- Are you using the correct media? A consumer recorder requires consumer media. Rewritable media will not work in a non-rewritable recorder.
- Are you using the correct digital transfer cable? Remember analog audio cable does not have the same shielding and impedance as digital transfer cable.
- Are you trying to copy SCMS encoded material on a consumer recorder. It won't work... it isn't supposed to, Captain Hook!
- Has the disc already been finalized? No further recording is possible.

Problem:

The sound is distorted from my stand alone CDR recorder!

Things to Check:

- If you are using an analog input, try turning down the input level.
- If you are using a peak limiter, is it being pushed too hard?

Problem:

My stand alone CDR recorder is not placing track ID's where they should be!

Things to Check:

- Is the recorder set to "auto-ID" mode? The way to do this will vary with different recorders. Refer to your recorder's manual
- If you are transferring digitally remember you will need to use S/PDIF because AES/EBU will not transfer ID's.
- If you are transferring analog signal make sure there are no extra sounds between tracks such as clicks caused by editing or excessive tape hiss. These could cause an ID to be placed where it shouldn't be.

Problem:

My stand alone CDR recorder stops during recording when it isn't supposed to!

Things to Check:

- Are there long periods of low level sound that the recorder will interpret as "silence"?
- Is the recorder set to the proper mode? "Auto" or "manual" ID mode?

Problem:

The beginnings of my songs seem cut off!

Things to Check:

- If you are transferring digitally from a DAT to a stand alone CDR recorder and the DAT track ID's are too close to the actual start of audio you will need to manually insert them on the fly.
- If you are transferring analog signal to a stand alone CDR recorder the recorder may be misinterpreting the start of audio because of a fade in.
- If you are using a computer-based CDR burner check with your software's manual for a "start offset" setting and use the default. It should be around 13 frames. There is also a setting for this on some stand alone CDR recorders. Be careful when changing default values!

Problem:

The CD I made skips or won't play back at all!

Things to Check:

- Make sure you have used the correct media. If you have a CDR recorder that can record onto re-writable CDR's then they have to be played back in a player that can recognize them.
- Did you finalize the disc? A CDR must be finalized before it can be played back in a standard CD player.
- If you've used the correct type of media and the disc has been finalized, then try playing it back in another player. Sometimes a player's laser can get a little out of focus and it won't play back a CDR even though it will play back a commercially stamped CD.
- If you've used the correct type of media and the disc has been finalized, then try another brand of blank media. Some CDR recorders and CD players seem to accept one formulation of CDR over another. (Green dye vs. gold dye) You may have to experiment a little. When you find something that works in your situation, stick with it.

Problem:

The CDR I made isn't as loud as my favorite band's CD that I got from the store!

Things to Check:

- The CD you got from the store has been fully mastered. You will need to use a computer-based system with mastering software or a dedicated piece of mastering hardware.

Problem:

I installed a CDR burner on my computer but it doesn't work properly or the computer doesn't even know it's there!

Things to Check:

- You may need to install a software driver for your burner to work properly or at all. Refer to the installation instructions or any software documentation that came with your drive.
- Make sure that the drive you have is on your software's list of compatible hardware.
- Check your SCSI chain. Two devices cannot share the same SCSI ID. Make sure a SCSI terminator is properly installed on the last device in your SCSI chain. Be sure you are using high quality SCSI cables. Poor quality SCSI cables may work "some of the time" but will not be reliable. Make sure all SCSI connections are tight.

1630	Digital audio tape format that uses 3/4 inch tape. Usually found in large mastering studios.
"2X, 4X, 6X Write"	Specification that indicates speed that a CDR can be recorded relative to audio real time.
ADC	Analog to Digital Converter. Device or electronic circuit that converts analog sound to a binary format for digital storage.
AES/EBU	Professional digital protocol for transfer of stereo digital audio adopted by the Audio Engineering Society and European Broadcast Union. Transmitted via 110 ohm cable.
Amplitude	Commonly known as "volume". Measured in decibels or "db".
Archive	A backup copy of an original. The process of making a copy.
Bandwidth	The difference between the highest and lowest frequency that a piece of audio equipment can reproduce or record. Can also refer to the transfer rate of digital audio.
Binary Information	"Digital information, stored as a series of "ones" and "zeros"."
Binary Word	"A series of 8, 16, 24 or more bits"
Bit	"The smallest piece of digital information, either a "one" or a "zero". Derived from "BInary digiT"."
Bit Resolution	The number of bits in a binary word.
BLER	BLock Error Rate. The digital error rate before error correction.
Blue Book	The specification for Enhanced CD and CD Extra. These multi session CD's contain both audio and computer data.
Buffer	Memory set aside for temporary data storage.
CD	A compact disc with its digital information stamped into a layer of metal.
CD-ROM	A compact disc that contains digital information to be read by a computer's CD-ROM drive.
CDR	A recordable compact disc.
CDRW	A Re-Writable compact disc. This type of disc can be re-recorded or erased up to 1000 times.
Clipping	This type of distortion occurs when a signal exceeds the maximum amplitude that a piece of equipment can handle.
Clone	An exact binary copy of digital material.
Coaxial	A type of cable used to carry S/PDIF digital information.
Compression	A process which reduces the dynamic range of an audio signal.
Computer-Based CDR Recorder	A CDR recorder that connects to and requires a computer for operation and control.
Consumer CDR	A special type of CDR that includes copy restriction encoded into its subcode.

Copy Prohibit Bit	SCMS instruction added to the subcode of a copy protected CDR.
Copyright	Legal ownership rights granted to the original composer or producer of musical material. Literally "The Right To Copy".
Crosstalk	"Unintended signal in an audio channel from a different, usually adjacent audio channel."
Cyanine	Type of organic dye used to form the recording layer of a CDR. Referred to as "green dye" or "blue dye" depending on the type of metal layer used.
DAC	Digital to Analog converter. A device or electronic circuit that converts digital audio stored in a binary format to analog audio signal.
DAT	Digital Audio Tape. A common format for stereo digital audio that uses 4mm tape.
Data Compression	"The process of reducing the amount of disk space required for digital audio. Ususally used on MD's, not used on CD's."
Decibel	Unit of measure used for expressing amplitude.
Destructive Editiing	Method of editing that actually alters the original.
Disk At Once	The process of writing an entire CDR from beginning to end. Preferred method for creating a CDR to be duplicated.
Dithering	The process of masking distortion caused by the reduction of bit resolution during a digital transfer. Also improves perceived quality of low level signals.
Drop Out	A temporary loss of signal.
Dynamic Range	The difference between the lowest and highest amplitudes in an audio signal.
Enhanced CD	CD containing both audio to be read by a CD player and data to be read by a computer CD-ROM drive.
EQ	Equalization. Process of changing the frequency characteristics of an audio signal.
Error	Flaw in the binary information read by a CD player's laser.
Error Correction	The process of interpolating or "filling in" information caused by errors in reading binary information.
File Based Processing	"A type of processing (EQ, compression, etc.) that directly alters the digital audio file being processed."
Finalization	The process of writing a permanent Table of Contents on a CDR which allows it to be played on a standard CD player.
Frame	The smallest recordable part of a CD. There are 75 frames per second on a CD.
Frequency	Number of times a sound wave completes one full cycle per second. Expressed in Hertz (hz) or KiloHertz (khz).

Gig	"One gigabyte is equivalent to 1,000 megabytes of binary information."
Hard Drive	Mechanism used to store binary information.
Hardware	Any device that uses or processes electrical energy or digital information. Follows instructions for software or human input.
Hiss	"Background noise produced by analog tape or analog audio circuitry, Also referred to as "white noise"."
Land	Area betweeen pits on a CD or CDR.
Lead In	An area at the start of each session on a CD or CDR that contains information about track ID's.
Lead Out	An area at the end of each session on a CD or CDR indicating that session is finished.
MD	Minidisc
Media	"Any blank stock used for recording. Could be blank CDR, tape or a removable hard disk cartridge."
Meg	"One megabyte is equal to 1,048 kilobytes of binary information."
Non-Destructive Editing	Method of editing that creates a new file by referring to points within an original file without directly altering the original.
Optical	Toslink digital protocol or cable that uses a plastic fiber to transmit digital information in the form of light energy.
Orange Book	The specification for write-once CDR and CDRW.
Peak Limiting	Type of signal processing that reduces the amplitude of transients.
Phthalocyanine	Type of organic dye used to form the recording layer of a CDR. Referred to as "gold dye".
Pits	Indentations in the metal or dye layer of a CD or CDR which alter the reflections of the laser in a CD player.
PQ Data	"Subcode information on an audio CD containing track start, end and index points."
RAM	Random Access Memory. Type of computer chip used for temporary storage of binary information. May be used to describe other re-writable media.
RCA	Type of coaxial connector used for an S/PDIF cable.
Real Time Processing	"Type of processing that can occur when transfering audio while listening, leaving the original audio unaltered and creating a new audio recording."
Red Book	The specification for audio CD's.
Removable Media	A hard disk in cartridge form that can be removed from or inserted into a hard drive mechanism.

RPM	Revolutions per minute. Refers to the speed with which a hard disk spins.
S/PDIF	Digital protocol for transfer of stereo digital audio in consumer devices. Transmitted over a specially shielded 75 ohm coaxial cable or an optical cable.
Sample	"One snapshot of an analog sound wave that can be stored in a binary format. There are 44,100 samples per second of audio on a CD."
Sample Rate	Number of samples per second.
SCMS	Serial Copy Management System. A system for restricting the creation of digital clones of an original.
SCSI	Small Computer Serial Interface. Protocol for high speed transfer of binary information between pieces of computer hardware using specially shielded multi-conductor cable.
Seek Time	The time taken for a hard drive to find information.
Sibilance	High frequency sound produced by the letter "S" in vocals.
Signal to Noise Ratio	Measurement of the amplitude of the maximum audio signal before clipping compared to the amount of noise produced by the electronic circuitry.
Software	Provides a user interface and binary instructions to hardware.
Subcode Data	Non-audio data on an audio CD used for track ID and control information.
Threshold	Preset limit which when exceeded causes a process or event to occur.
TOC	Table Of Contents. Data portion of a CD containing information to be read by a CD player about the disc's contents.
Toslink	Fiber optic connection for transferring digital audio.
Track At Once	A recording process for CDR where tracks can be written separately to the disc with lead-in and lead-out information for each track.
Transient	An instantaneous increase in the amplitude of an audio signal.
WORM	Write Once Read Many. Term used to describe the method of writing to a CDR.
XLR	Type of three-conductor connector used on an AES/EBU cable. Also found on a balanced microphone cable.

NOTES

TASCAM®

Take advantage of our experience.

TEAC Canada Ltd., 5939 Wallace Street, Mississauga, Ontario L4Z 1Z8 Canada (905) 890-8008

TEAC Mexico, S.A. de C.V., Privada Corina #18, Colonia del Carmen, Coyoacan, Mexico D.F.04100 (525) 658-1943