

The image shows a screenshot of a digital audio workstation (DAW) interface, likely Pro Tools. The top section features transport controls (play, stop, record, etc.) and a digital display showing '1 | 1 | 000' and '0:00:00:00'. Below this is a track list with columns for 'REC', 'INPUT', 'MTO', 'PLAY', and 'OUTPUT'. The tracks include 'Analog 1-2', 'Analog 3', 'Analog 8', 'Analog 1', 'Analog 7-8', 'Analog 3-4', 'bus 1-2', and 'bus 1'. A central pink box contains the title 'Unit One: Introduction to Recording'. The bottom section shows a mixer with multiple channels, each with a fader, a pan knob, and a solo button. The channels are labeled 'Pete', 'Organ', 'greg', and 'dawn'. A bottom text box provides an overview of the unit's content.

Unit One: Introduction to Recording

In this unit, you will learn the basics of how sound is recorded for later playback. We'll learn how sound waves can be recorded on tape in Lesson One and into computers in Lesson Two. In Lesson Three, we'll learn about some of the things that we can do to sounds once they have been recorded into a computer. Lesson Four teaches us about extra pieces of software called plug-ins which allow us to do lots of other cool things to sounds.

Tape Recorders 101

After completing this lesson, you should be familiar with the following concepts:

- It is important to learn about tape machines because many of the techniques pioneered on tape apply to other more modern forms of recording.
- As tape moves through a recorder, it starts at the supply reel, moves through tape guides, over the erase, record, and reproduce heads, and is pulled through the entire system at a very steady rate by the capstan and pinch roller. After passing through a few more tape guides, the tape goes to the take-up reel.
- The tape path must be cleaned periodically to keep tape particles from building up on the various parts of the tape path.
- The tape transport contains the familiar controls (play, record, stop, rewind, fast-forward) which allow the user to interact with the tape machine.
- Multitrack recorders allow you to record on just part of the tape called a track. By recording on separate tracks, one user can appear to play several instruments at once. Similarly, each instrument is kept separate for later processing and mixing.
- Which track is recorded on is determined by the safe/arm controls. You can only record on a track when you have armed it.
- Overdubbing is an important multitrack technique in which additional recordings are added to the first recording. All of these recordings can then be played back together.
- Bouncing or ping-ponging is another important multitrack technique. In bouncing, tracks which were previously recorded are combined and recorded to an empty track. The original tracks are then erased and used again. Using this technique, it is possible to overcome the limits of the number of tracks a particular multitrack recorder offers. However, some signal degradation results, and the mix of the instruments is permanently set.
- In layering, the same musical part is recorded over and over again to achieve a very full and rich sound.

SUPER STUDENT

This book is more challenging than *Basic Music Tech I*. The lessons are longer, and present more material. It is very important that you are very well prepared for each lesson. Be sure to read each lesson before it is presented in class. This will help you to get the most out of each lesson and make sure that you understand all of the concepts being presented. It is also important, because the second time you go through something, chances are that you will remember the information even better and will know what questions to ask your teacher regarding things you don't understand.

Glossary for this Lesson:

Armed- You specify which track or tracks you want to record on by arming them using special controls. A track is armed when the control is not in the safe position. When you are finished recording on a track, it is important to switch the track to safe mode so that it won't accidentally get recorded over.

Bouncing- After you have recorded several tracks, you can record all of these tracks to one other track. You can then erase the original tracks and use them again. This technique which allows you to use more tracks than you really have is called bouncing.

Capstan- The capstan is a metal pole or which spins at a very steady rate. Along with the pinch roller, it is responsible for pulling tape through the machine.

Capstan Roller- The capstan roller is a wheel which is covered in rubber. When the tape machine is playing or recording, it presses up against the capstan and pulls tape through the tape machine.

Erase Head- The erase head is an electromagnet which is turned on when you push the record button. Any tape that touches it while it is on is permanently erased. On a multitrack recorder, only part of it may be activated at once, allowing you to just erase one track on the tape.

Fast-Forward Button- This part of the transport controls pulls the tape away from the tape heads and then moves tape rapidly from the supply reel to the take-up reel.

Layering- Layering is a multitrack technique in which the same musical part is performed over and over again on different tracks. The (hopefully) slight differences between different performances gives a very thick and rich sound. This technique is particularly effective on vocals.

Multitrack Recorder- A multitrack recorder is a recorder which can record on individual parts of a tape (tracks) at different times.

Overdubbing- A multitrack technique in which additional recordings are made along with an original recording.

Pinch Roller- Another name for the capstan roller.

Ping-Pong- Another name for bouncing.

Play Button- A part of the transport controls which starts the tape moving slowly through the tape path. The capstan and pinch roller pull the tape past the tape heads, but only the reproduce head is active.

Playback Head- Another name for the reproduce head.

Punch In- Starting recording in the middle of a track to fix an error.

Punch Out- Stopping recording after punching in. The transport doesn't necessarily have to stop when you punch out.

Record Button- The record button is part of the transport controls. When it is pressed, it activates the erase and record heads for any tracks which are armed.

Record Head- The record head is a tape head which is responsible for putting sounds on tape. On some lower-cost tape machines, the playback head also functions as the record head, but then you must rewind the tape before hearing what you recorded to it.

Reels- Reels hold tape before and after it has gone through the tape machine.

Reproduce Head- The small metal head which collects magnetic information from the tape's tracks and sends it to the tape recorder's outputs.

Rewind Button- This part of the transport controls pulls the tape away from the tape heads and then moves tape rapidly from the take-up reel back to the supply reel.

Safe- On a multitrack recorder, you use the arm/safe controls to tell the recorder which track or tracks you want to record on. A track is safe when the control is not in the armed position. When you are finished recording on a track, it is important to switch the track to safe mode so that it won't accidentally get recorded over.

Stop Button- The stop button is part of the transport controls. It stops the tape from moving through the tape machine and pulls the tape away from the tape heads.

Supply Reel- The reel which holds the tape before it has gone through the tape recorder.

Take-up Reel- The reel which collects tape after it has gone through the tape recorder.

Tape Path- The route the tape follows as it winds through the recorder.

Track- A track is a section of tape. The tape is divided up like the lanes on a freeway. Multitrack recorders can record on these individual parts of a tape and record different instruments at different times. All of the sounds are kept separate so that they can be processed at a later time.

Transport Controls- The record, play, fast-forward, rewind, and stop buttons.

DID YOU KNOW?

The first tape recorders were invented in the early 1940's in Germany. They were originally called magneto-phones and were used to record political speeches made by German leaders for later replay over the radio during World War II. Two magnetophones were brought to the U.S. after the war. It wasn't long before several companies were making tape recorders for music recording.

Tape Recorders 101

WHY LEARN ABOUT TAPE?

There was a time, not too long ago, when reel-to-reel tape machines could be found in every studio across the land and computers were used for keeping track of the studio's accounts, and maybe for programming the studio's synthesizers. All of that changed in the 1990's however. Although many studios use tape machines, most use digital tape machines. Many studios use computers as their main recorder. Studios have gone to using computers because they are a highly cost-effective recorder, and much more flexible and powerful when it comes to editing sounds (as we will see in Lesson Three).

If computers are very powerful and found in most studios, why should we bother learning about tape machines? The answer is simple: when modern recording programs for computers came out, they tried to make those programs look and feel like

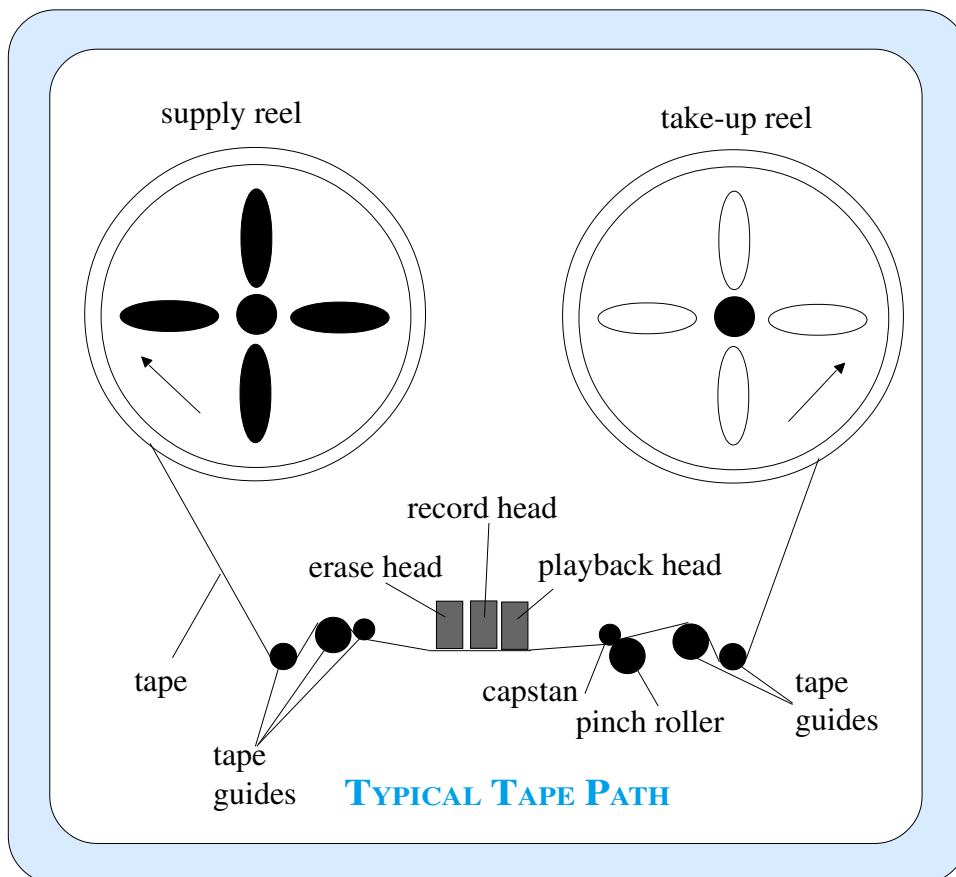
something that engineers were already comfortable with: tape machines. The programmers used terms and ideas which had been used in the world of tape for over 40 years. So, when you learn how a tape machine works, you are also learning about how computers work when they record sounds. Of course, both tape machines and computers do certain things which are very different from each other, they have many things in common.

THE TAPE'S PATH

Reel-to-reel tape machines are tape recorders whose tape is stored on large open **reels**, much like the reels used on movie projectors. Tape is pulled through the recorder whenever we want to record sound or play it back. The route the tape takes through the tape recorder is called the **tape path**. The tape path begins with the supply reel. It is important to

learn about reel-to-reel tape machines since all machines that use tape from cassette recorders to the most cutting edge digital tape recorders all have many of the same parts.

The supply reel is a tape reel which is placed on the left side of the machine. When we start to record or play back a tape, the supply reel is full of tape. (This reel holds our supply of tape, hence the name supply reel.) As we play the tape, or record onto it, tape is pulled off of the supply reel and travels through the machine. As tape is taken off of the supply reel, the supply reel spins in a counterclockwise direction. However, the supply reel would actually spin



the other way if we let it. This is because the supply reel needs to keep pulling on the tape to keep it tight. If the supply reel didn't keep the tape taught, the tape would not pull smoothly through the machine, and the tape machine wouldn't work.

HEAD THEM OFF AT THE PASS

After leaving the supply reel, the tape usually passes through some **tape guides**. Tape guides are usually nothing more than a smooth metal pole which helps the tape change direction as it moves through the machine. On a machine that uses a cassette, these guides are actually located inside the cassette. On an open reel machine, you actually have to thread the tape through these guides manually each time you put a new tape on a machine.

Once the tape has gone through the tape guides, it passes over two or three tape heads. The first of the heads is the **erase head**. The erase head performs a simple job: when it is turned on, any tape that passes by it gets erased. The erase head is automatically turned on when you push the record button. (We'll talk more about the transport controls in a moment.)

The next head is the **record head**. The record head actually puts sounds in electrical form on tape. The record head magnetizes the tape in a way which represents the sounds in electrical form. Like the erase head, the record head is turned on when you push record.

The final head is the **playback** or **reproduce head**. The reproduce head reads information off of the tape. These sounds in electrical form can then be connected to a mixer and speakers so that they can be heard, processed through effects, etc. The reproduce head is active when you are playing and when you are recording. This means that when you are recording, it is possible to hear what you just recorded on a tape recorder which actually has three heads.

THREE HEADS ARE BETTER THAN TWO?

Not every tape deck has the same number of heads. Full-featured and very fancy machines have all three heads, but many tape recorders are made with only one or two heads to keep their price low.

Most consumer-level tape recorders have a single head which performs the record and reproduce tasks. This arrangement works pretty well, but the head can only do one job at a time. This means that you can't listen to the tape as you record it. You actually have to rewind the tape and listen to it at a later time.

Some tape machines (especially those found on dual-well cassette decks) have only one head. They only allow you to play back.

SOMEBODY PINCH ME PLEASE

The capstan and pinch roller are the next thing in the tape's path. The **capstan** is a small pointed metal rod which spins around and around at a very steady speed. The **pinch roller** or **capstan roller** is a black rubber roller which presses the tape hard up against the capstan when the tape recorder is playing or recording. The capstan serves a very important purpose in a tape machine; the capstan determines the rate at which tape is pulled through the machine. It is very important that this rate stays steady, or else sounds recorded on the tape will sound warbly when they are played back.

After passing between the capstan and pinch roller, the tape rolls through more tape guides and back into another reel. This reel is called the **take-up reel** because it takes up the tape after it has been played or recorded. The take-up reel spins in a counter clockwise direction, and would spin pretty rapidly if it was allowed to. It tries to spin faster than the capstan because it is important that a small amount of tension is placed on the tape to keep it wrapped evenly on the take-up reel.

TAPE HYGIENE

One of the worst things about working with tape is that it sheds black dust. This black dust is actually some of the magnetic coating of the tape coming off as it rubs against parts of the tape machine like the capstan and pinch roller. If enough of this dust builds up on the pinch roller, the tape passing through can actually get stuck to it and wind around. When this happens on a reel to reel machine, you have a total disaster as you will have a pile of tape on the floor in

only a few seconds. On a cassette recorder, the symptom is familiar: the machine “eats” the tape.

It is important to use tape head cleaner on all of the metal parts that tape comes in contact with and rubber cleaner on all of the rubber parts the tape comes in contact with. It is important to clean tape machines like this every 10-20 hours of use, or before every important recording session.

TAPE TRANSPORTATION

The way we interact with a tape machine is pretty obvious: we use the start, stop, rewind, etc. buttons. These buttons make up the tape machine’s **transport controls**. Most tape machines have five buttons which make up their transport: Play, record, stop, rewind, and fast-forward. The **play button** starts the tape moving forward through the tape path, and the capstans keep the tape pressed up against the tape heads. When the tape is playing, the erase head is turned off, and the record head doesn’t do anything. The playback head picks up the magnetic signals on the tape and sends them to the tape machine’s outputs.

When **record** is pressed (most machines also require you to push play), the capstans keep the tape taught, but the erase head is turned on. Any tape which passes underneath this head will be permanently erased. The record head then puts new information on the tape as it passes by. The playback head can then play the newly recorded material if the tape machine has three heads.

The rewind and fast-forward buttons both relax the pinch roller and the tape guides (the tape guides only move on a reel-to-reel machine, but not in a cassette tape). When the pinch roller relaxes, the tape no longer touches the tape heads. We usually don’t want the tape to touch the tape heads as it whizzes by, because this can seriously damage the tape, and it really wears on the tape heads. The **rewind button** moves tape from the take-up reel back to the supply reel while the **fast-forward button** moves tape from the supply reel to the take-up reel. Rewind and fast forward move the tape from reel to reel much faster than play or record do.

Pressing the **stop button** stops tape from traveling along the tape path. It is important to press stop whenever you are changing the tape’s direction or speed. The tape can be seriously damaged if it is stretched by a sudden change in tension. Many modern tape decks have a small computer inside which prevents you from damaging the tape by automatically pressing stop for you if you do something that would have damaged the tape.

ON THE FAST TRACK

Now that we know a little bit about how tape recorders work, let’s take a moment to think of the possibilities. Let’s pretend for a moment that you can play two instruments, for instance, piano and drums. With a tape recorder, you could record yourself playing drums and then play piano along with the recording. Now let’s imagine for a moment that you are really talented and play trumpet too and you would like to add a trumpet line to the drums so you can play piano along with both. So, you rewind the tape to the beginning, and start recording your trumpet playing. However, you will soon notice that all of the drum parts you recorded earlier are getting erased! Wouldn’t it be wonderful if you could somehow record more sounds to a tape without erasing your previous recording?

Track 1: Lead Vocal
Track 2: Piano
Track 3: Drum Machine
Track 4: Rhythm Guitar
Track 5: Bass Guitar
Track 6: Backup Vocals 1
Track 7: Backup Vocals 2
Track 8: Lead Guitar

Many tape recorders are multitrack recorders. A **multitrack recorder** is one which can record, erase, or play back just a part of the tape at a time. A multitrack recorder divides the tape into strips which are called **tracks**. You can see how the tracks might be laid out on the piece of “tape” above. You can’t actually see the tracks on tape, but the tape machine can work with the different tracks individually. Multitrack recorders have special heads which are divided into several parts. Special controls on the recorder allow you to specify which track will be recorded on. When you tell the machine which track to record on, we say that that track is **armed**. When you tell the machine you don’t want to record on that track any more, we say the track is **safe**.

Because a tape recorder's quality depends on how wide each track is, some tape machines use tape as wide as 2". Tape usually comes in 1/4", 1/2", 1", and 2" sizes. Multitrack recorders usually offer 4, 8, 16, or 24 tracks, although there are exceptions. Usually, the more tracks a multitrack recorder has, the wider the tape it requires. The price of the recorder also usually goes up with the number of tracks.

MULTITRACK TECHNIQUES

Having multiple tracks to work with opens the doors to several new and wonderful possibilities. The first is overdubbing. **Overdubbing** is adding more recordings to your original recording on separate tracks at a later time. This is a great technique for the home studio musician. This means you can record a piano part on one track, then go back and record yourself playing guitar on another track. On the next track, you could play drums, and on the fourth track, you could sing. On a simple four-track recorder, one musician can sound like four by overdubbing herself several times. This allows one multi-talented musician to flesh out song ideas quickly and economically.

Another really cool technique is **punching in and out**. Punching in and out allows you to record over a part of a track to fix an error in your performance. Let's say you made a fabulous recording of you piano part, but right at the end you missed and hit D# instead of E. You could punch in and play the E you meant to play. When you are ready to stop recording, you punch out. It is very important to be careful while punching in and out, because if you are punched in too long, you will permanently erase any good material after the things you just fixed.

Some tape machines can automatically punch in and out for you at times you preset. On other recorders, it is as simple as pressing the arming buttons for tracks or pushing the record button while the tape is already playing. (Remember that on a multitrack recorder, only tracks which are armed get recorded on. If no tracks are armed, you can still start the machine recording, but it isn't really recording or erasing any tracks until you arm one of them.)

WANNA PLAY SOME PING-PONG?

Are you beginning to see that it is a really cool thing to have a whole lot of tracks at your disposal? Do you see that no matter how many tracks you have, it will probably never be enough? There is a way to get more tracks from your multitrack recorder without ever spending a dime. You can use a technique called **ping-ponging** or **bouncing**. Let's pretend for a moment that you have an 8-track recorder. Let's say you have recorded music on tracks 1-7. You have only one track left. To ping-pong, you just connect outputs 1-7 from the tape recorder to a mixer and mix all of the sounds and record them back on track 8. Now you can erase tracks 1-7 and record something else on them but you still have all of those sounds which will play back from track 8. You could record tracks 1-6 this time around and then bounce them to track 7. Next you could record 1-5 and bounce them to track 6. You can keep going like this for quite some time and instead of getting 8 tracks, you will end up with 28 tracks!

There is a trade-off, however. When you bounce all of these tracks together down to one track, you have to set the level of each one. Because the tracks will be mixed together, you can't adjust the mix later on. This can be a huge disadvantage. The second bad thing about bouncing is that on most tape machines, each bounce loses some quality. This means that the sounds won't be as clear, and there will be more tape hiss.

THE LAYERED LOOK

The final multitrack technique we will talk about today is **layering**. If you have enough tracks available (and you had better have quite a few to try this) you can attempt a technique called layering. In layering, the same part is performed over and over and over again. The slight differences in each performance give a very thick and rich sound. Layering is particularly effective on vocals. Several performers have built a career around this sweet sound. Of course, you can make the most of your tracks by ping-ponging a few tracks around, but you will lose quality quickly like this.

Student Tips

Basic Music Technology II has a lot more material in every lesson than the first book in this series. Because you have to learn a lot more material in the same amount of time, you need to have a great study method. This is one method that helps many students:

Keep a spiral notebook handy as you read through the text before you come to your lesson. Each time you come across a fact in the book, write a question that asks about that fact. On the line below the question, write the answer. This helps many people because it forces you to put the information in your own words, and it also helps people who need to do something hands-on to remember facts. This method is also really helpful when it comes time to review for the quiz. All you have to do is place another sheet of paper on top of your first page in the notebook. Slide it down just far enough so that your first question shows but the answer is still hidden. Answer the question in your mind, and then slide the cover sheet down a little bit to check if you are correct. Keep practicing until you can answer all of the questions you have written correctly. This method may take a little time, but you are almost guaranteed a great score on your next quiz!

Words To know:

Armed	Layering	Playback Head	Rewind Button
Bouncing	Multitrack Recorder	Punch In	Safe
Capstan	Overdubbing	Punch Out	Stop button
Capstan Roller	Pinch Roller	Record Button	Takeup Reel
Erase Head	Ping-Pong	Record Head	Tape Path
Fast-Forward Button	Play Button	Reels	Track
		Reproduce Head	Transport Controls

On the Web:

Check out the following sites for more information about tape recorders and tape:

<http://www.tascam.com>
<http://www.fostex.com/>
<http://www.alesis.com/>
<http://www.otari.com/>
<http://www.sony.com/>
<http://www.quantegy.com/>
<http://www.maxell.com/>

DID YOU KNOW?

Multitrack recording and the ping-pong technique were invented by Les Paul of Waukesha, Wisconsin in the 1950's. He created the first multitrack tape recorder by piling the heads from several tape machines on top of each other. One of his earliest recordings involved the sounds of ping-pong balls dropping on a table, hence the name of the technique "ping-pong".

Let's Review

1. Why is it important to learn about tape recorders?
2. What are the parts of the tape's path, and what does each part do? How do they all work together to move the tape through the recorder?
3. What are some of the things that should be done to maintain tape decks? How often should this be done?
4. What is the tape transport and what are its parts? What does each control do?
5. What is a multitrack recorder and what does it allow you to do?
6. What do the arm/safe controls do?
7. What are the four multitrack techniques we learned about in this lesson, and what does each one allow you to do?

Experiments:

1. Look at a cassette tape recorder. Can you find the transport controls? Are they computer controlled or not? How can you tell?
2. Open the door of the cassette recorder and look inside. Can you see the parts of the tape path?
3. Look at a multitrack tape recorder. Can you find the transport controls and track arming switches/buttons? Look at the heads. Can you see how they are divided to just use part of the tape?
4. Can you find the inputs and outputs of the tape recorder?
5. Try recording your voice on a stereo cassette deck. Is it possible to hear the material you have just recorded? Why or why not? Now rewind and play your recording back.
6. On a multitrack recorder, arm track 1 and start recording some sound. Now stop, rewind, and safe track 1. Now arm track 2, and record some sound to it. Stop the recorder, safe the track, rewind and play back your recording. What is this an example of?
7. Now try layering, bouncing, and punching in and out.