# User's Guide for

# Spruce DVD Encoders

**Part Number 03834-02**

# Copyright Notice



All features and specifications subject to change without notice.

Version 2.8 Release,  February, 2001

# Table Of Contents

*Blank Page*

*(mostly)*

## How to Use this Encoding Guide

This Encoding Guide is a companion manual to your Spruce Technologies User's Guide. In the coming pages, we'll be discussing concepts and features that are introduced and detailed in User's Guide, so we suggest you keep it close at hand for reference. Furthermore, as we'll cover later in this Encoding Guide, since some encoding procedures take place directly from within DVD Movies, you may want to review Chapter 6 *Working With DVD Movies* of the User's Guide before reading this Encoding Guide.

> *Note: This Encoding Guide does not describe how to install or connect Spruce encoding and decoding hardware. For such information, be sure to read the User's Guide, as well as any other documentation that may have accompanied your hardware. (Spruce turnkey authoring systems come with encoding and decoding hardware installed.)*

### Who Should Read this Encoding Guide?

This Encoding Guide is for anyone performing encoding using Spruce Technologies software and hardware. Specifically, if you use our encoding hardware (which includes our MPX3000 and ACX5100 encoders) — and will be encoding video or audio assets for use with DVDMaestro or DVDConductor running version 2.8 software — this Encoding Guide is for you.

> *Note: Most Spruce turnkey DVD authoring solutions are equipped with Spruce Technologies encoding hardware. If you're unsure if your authoring system is equipped with our encoding hardware, feel free to contact Spruce Technologies Technical Support.*

We encourage you to read this Encoding Guide carefully, and to allow yourself plenty of time to practice encoding before you embark on any major Projects.

### Who Can Skip this Encoding Guide?

It's possible you may never have to encode video or audio. For instance, you might work with an encoding specialist who always provides you with pre-encoded video and audio files — so that you can concentrate on the authoring process. If this applies to you, feel free to skip this Encoding Guide. However, please be aware there are some encoding related procedures described in this Guide, such as segment based re-encoding, that may still be of interest to you, even if someone else is responsible for the preliminary encoding of your files.

Also, if you are using a third-party encoding system, you can skip this Encoder Guide — although it is an excellent guide to some of the very powerful and integrated encoding features you'll be missing by not using Spruce encoding hardware!

*Note: All Spruce authoring software also works with any MPEG-2/MPEG-1 encoding system conforming to the requirements of the DVD-Video Specification; that is, as long as your encoding system is able to produce DVD-V-compatible files, your Spruce authoring software will be able to integrate them perfectly into your Project.*

## A Fully Integrated Approach to Encoding

DVDMaestro, DVDConductor, and DVDVirtuoso have a software feature called the Encode/Decode Control Panel — which delivers built-in, direct support for high-quality video and audio encoding (also known as "capturing" or "digitizing").

When used with Spruce Technologies MPX3000 and ACX5100 encoding hardware, the Encode/Decode Control Panel provides a complete solution to MPEG and AC-3 encoding that is fully integrated into the DVD authoring process. As we'll see, this "integrated encoder control" approach provides many benefits.

As an alternative approach, some facilities may wish to configure MPEG/AC-3 encoding and DVD authoring in separate workstations, connected by a fast network — so that one or more people can be capturing video and audio, while others are strictly authoring titles. This approach is ideal for high-throughput, even around-the-clock, operation. Spruce authoring software and hardware fully support this mode of operation.

### The Workgroup Encoder Option

A common desire is to be able to setup the encoding function on a separate computer, allowing simultaneous encoding and authoring to take place. The Workgroup Encoder Option provides the additional hardware required for this to work, including a DVD Decoder card (required to see the results of the encode) and an advanced encoding software protection device ("dongle"). This option makes it possible for you to configure an encoding station separate from the authoring station — without having to purchase a second copy of DVDMaestro or DVDConductor for the encoding station.

The Workgroup Encoder Option runs Spruce Technologies' standalone encoder application — known as "MpegEncodingStation" — on the encoder station. This application presents exactly the same interface as DVDMaestro's or DVDConductor's integrated Encode/Decode Control Panel feature.

*Note: For efficient operation, both stations should be connected on a fast switched network, either 100base-T Ethernet or higher performance network such as Fibre Channel. Alternately, some facilities may choose to pass files from the encoding station to the authoring station using removable hard drives or other portable media.*

## Basic Encoding Concepts

Before we look at the Encode/Decode Control Panel's many functions and parameters in detail, let's take a quick overview of how to encode video and audio.

> *Note: This overview assumes you have a suitable video/audio source tape deck connected to your authoring system. This can be a single tape deck, digital or analog, that supports full serial ("9-pin") machine control, such as a Digital Betacam™ or Betacam SP™ video tape recorder, or a 9-pin compatible DAT audio recorder. Should your source tape deck lack serial control capability, we've also included notes for performing manual-controlled encoding. See the* ***General Installation Guide for Spruce Hardware*** *for information on connecting a VTR's remote control port and a list of supported VTRs, as well as information on connecting analog sources to the MPX3000.*

### The Big Picture

Here are the basic steps of the encoding process that we'll be reviewing in this section:

- First, you'll open the Encode/Decode Control Panel and verify that your source tape deck is properly connected, not only for video and audio signals, but also for machine control. Using machine control and the supplied cable, you'll be able to control your source tape deck directly from your Spruce authoring software, which, as we'll cover, offers many advantages.
- Next you'll establish (and verify) the video and audio I/O (in and out) connections to and from your authoring system. You will perform a preview encode to verify the source, encoder, and decoder are all working properly.
- Then you'll define the timecode in and out points for the source tape. This way, your Spruce authoring software can effectively automate the process of cueing up the source tape to the exact location where you want to begin the encoding process, and stopping the tape at the exact location where you want to end encoding.
- Next, you'll set the encode mode and bit-rate. Since higher bit-rates require more storage space (on both your hard drive and the final, replicated disc), we'll introduce some basic calculations you'll need to perform in order to set the correct bit-rate.
- Once these parameters are established, you can start encoding.
- When encoding is complete, you'll want to review the results.
- Finally, once you're happy with the encoded file, you can open it in DVDMaestro, DVDConductor, or DVDVirtuoso and begin (or continue) authoring.

## Opening the Encode/Decode Control Panel

Your Spruce authoring software's Encode/Decode Control Panel is what you'll use to perform encoding. In addition to MPEG encoding of video and audio signals onto your authoring system's hard drive(s), the Encode/Decode Control Panel supports many features designed to speed the encoding process, including machine control, timecode in and out points, and more.

To open the Encode/Decode Control Panel:

1. From the Tools pull-down menu, select ***Encode***.

   – or –

   Press ***Alt - N*** on the keyboard

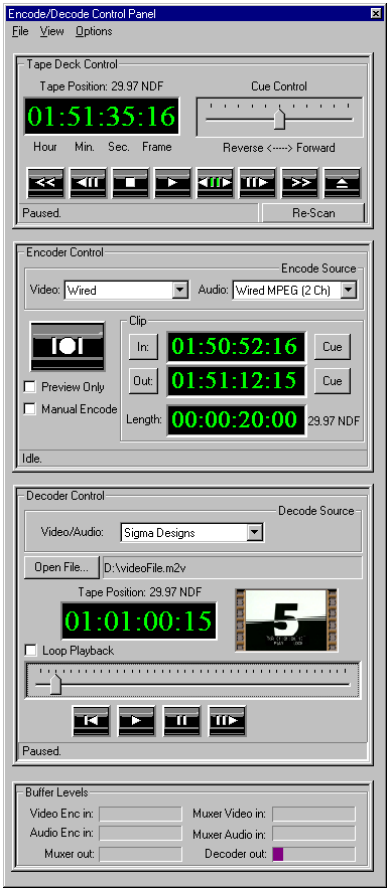
   – or –

   Click once on the ***Encode*** icon in the Toolbar

*Encode button from the toolbar.*

The "busy" icon appears as the encoder control software starts up. After a few seconds, the Encode/Decode Control Panel appears.

You may also see error messages relating to the VTR being in local mode. These are discussed in the following section. For now, click ***OK*** on them to continue loading the Encode/Decode Control Panel.




*The Encode/Decode Control Panel provides all functions required for MPEG-1 and MPEG-2 video, and AC-3, MPEG-1 layer 2, and PCM audio.*

The Encode/Decode Control Panel can be broken down into the following sections:

**Menu Bar**

The Menu bar contains the pull-down menus that provide access to a number of encoding functions. See the *Other Encoding Functions* section towards the end of this manual for a description of each selection.

**Tape Deck Control**

This section applies to systems with a VTR that is serially controlled by the encoding/authoring system. Its use is detailed in the *Verifying Serial Control* section that is next.

### Encoder Control

The Encoder Control section provides the controls to set up the encode, choosing the type and contains the actual Encode Start button.

### Decoder Control

The Decoder Control section provides the controls to play encoded files. The typical use of this section is to play files you have just encoded, but it can be used to play other files as well. See the *Reviewing the Results of Encoding* section for details.

### Buffer Levels

The Buffer Levels section provides some resource feedback while encoding or playing an encoded file with the Decoder Control section.

The ***Video Enc In*** and ***Audio Enc In*** sections show the activity of the actual Encoding part of the process. The ***Muxer*** settings show the activity of the multiplexing part of the process, where the encoded elementary streams are multiplexed (in real-time) into DVD compliant streams for the decoder. The ***Decoder*** setting shows the activity of the decoding part of the process.

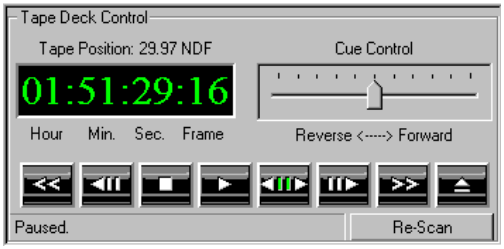
Both the ***Muxer*** and ***Decoder*** settings are active only if ***Sigma Designs*** or ***Quadrant*** is selected in the Decoder Control section.

## Walking Through an Encode

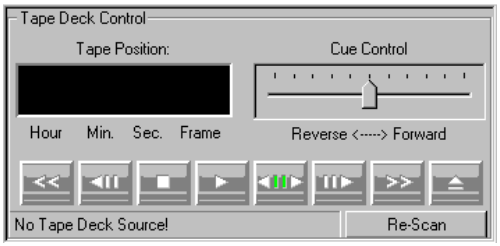
This section steps through setting up and performing an encode, as well as loading the encode into your Spruce authoring system.

### Verifying Serial Machine Control

While opening the Encode/Decode Control Panel, Spruce checks for a VTR connected to one of the system's serial ports. If one is located and it is in remote control mode, then it is started and the tape plays for about five seconds. This is so the encoder can verify the frame rate of the source video. In this case, the Tape Deck Control portion of the Encode/Decode Control Panel looks similar to this:



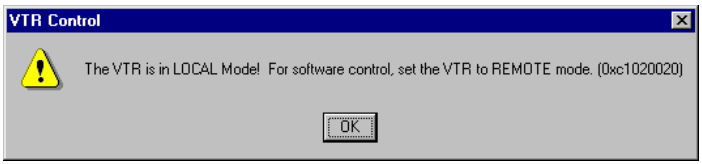

If no VTR is located, the Tape Deck Control portion of the Encode/Decode Control Panel looks like this:

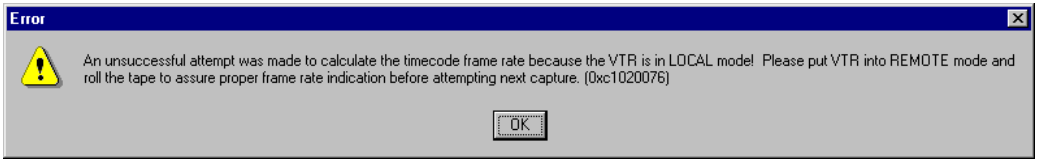



*Note: If you are not using a serially-controlled tape deck, then proceed to the section* ***Setting the Decoder Control*** *following.*

If you do have a VTR connected and had expected it to show up, verify that it is powered on and that you are using the VTR remote control cable supplied by Spruce (Spruce part number 03792-01).

If a VTR with a tape inserted is detected, but it is in local control, then the following error messages display:

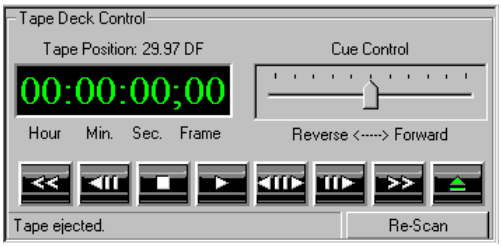





The Tape Deck Control portion of the Encode/Decode Control Panel looks like this:


If the VTR is in Remote, but no tape is inserted, the following error displays.


The Tape Deck Control portion of the Encode/Decode Control Panel looks like this:




### The Re-Scan Button

The ***Re-Scan*** button causes Spruce to once again check the system's serial ports for a suitable VTR. Press this if;

- Spruce was unable to detect the VTR when the Encode/Decode Control Panel was first opened, and you have since corrected the problem.
- The VTR was detected, but was in local control. Switch the VTR to remote control and press Re-Scan to have Spruce roll the VTR to determine the frame rate.
- You have changed tapes in the VTR or the tape was initially ejected. This is particularly true with NTSC systems where you may have some tapes with drop-frame timecode and some with non-drop frame.

### The Tape Deck Controls

Once the source tape deck is properly recognized, you may wish to test the system's control via the tape deck controls.

To verify operation of the tape deck:

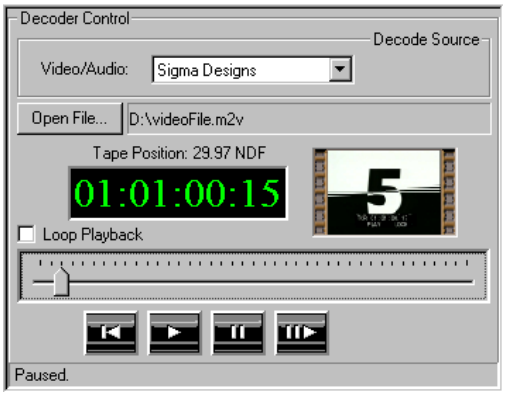
1. Insert a tape into the tape deck.
2. Click the ***Play*** button in the tape deck controls in the Tape Deck Control portion of the Encode/Decode Control Panel.
3. You should see the number moving in the Tape Position window.

If you have a video and audio monitor system connected directly to the tape deck, you should see and hear the program material. You will not be able to monitor the material from your Spruce decoder card's video and audio outputs, however, until you begin a preview encode or an actual encode.

If you wish, you can try the other tape deck controls in the Tape Deck Control section, including the ***Cue Control*** slider.

## Setting the Decoder Control

The same decoder used by DVDMaestro and DVDConductor for the RealView and the Navigation Simulator can be used for monitoring the Encoder output. The Decoder Control section of the Encode/Decode Control Panel contains the selection of the decoder.



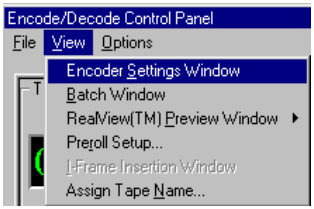

This is set to ***None*** by default. Clicking on the arrow next to the ***Video/Audio*** setting allows you to choose to use the ***Sigma Designs*** decoder (this is the one supplied with current DVDMaestro and DVDConductor systems). Choose ***Quadrant*** if your system uses the Ravisent Cinemaster decoder card, or choose ***None*** if you do not want to preview the encode process.

As covered in Chapter 2 of the User's Guide, the authoring system's Program Preferences dialog contains a ***Decoder*** tab to configure the Sigma Designs decoder. By default, the

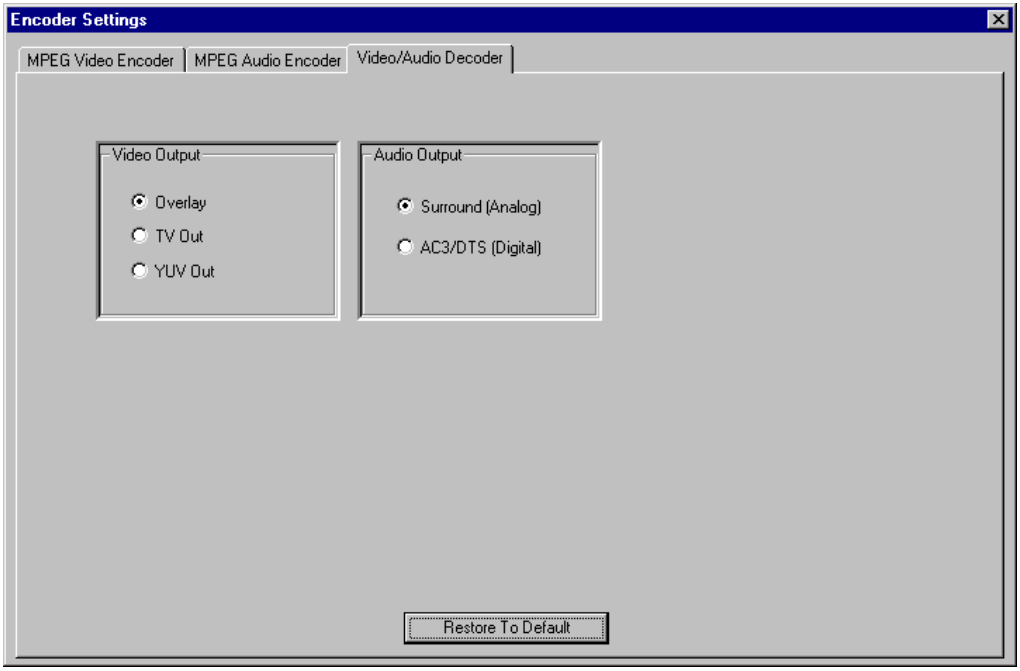
Encode/Decode Control Panel uses the same configuration, but provides a menu where you can change them.

To verify and/or change the decoder's settings:

1. Within the Encode/Decode Control Panel, click on ***View*** then select ***Encoder Settings Window***.




2. This opens the Encoder Settings Window. This window has several tabs (depending on encoder selections) – for now, select the ***Video/Audio Decoder*** tab.



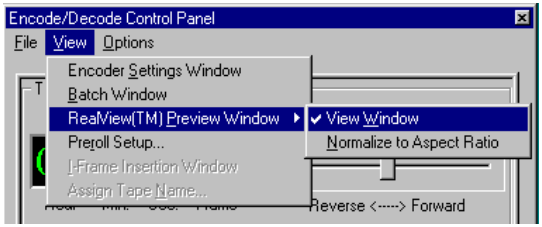

3. These are the same settings as found in the ***Decoder*** tab of the Program Preferences dialog. Configure them as needed to match your system.

4. Select ***Overlay*** if you do not have an external video monitor connected to your system. Select either ***TV*** (for composite or S-Video) or ***YUV*** (for component) to match your external monitor (if one is connected).

5. Select the ***Surround (Analog)*** or ***AC3/DTS (Digital)*** setting, depending on the audio monitoring equipment connected to the system.

To ensure the RealView™ window displays when Overlay is selected:

1. Within the Encode/Decode Control Panel, click on ***View*** then select ***RealView Preview Window***.




2. Click ***View Window*** to ensure a checkmark appears in front of it. The window does not immediately appear, but instead displays whenever an encode is in process.

We will explain the other bits in the Decoder Control area of the Encode/Decode Control Panel later on in this section.

## Verifying Video & Audio Inputs

Next, you'll want to verify that video and audio data are reaching the encoder board.

> *Note: This step should be performed whether you're performing machine-controlled or manually controlled encoding.*

If you are using digital video and audio sources with professional-format outputs (SDI for video, AES/EBU or S/PDIF for audio) — such as Digital Betacam — then the source outputs are connected directly to the inputs of the encoder card. If, however, you are using analog source devices, these are routed to either a Spruce Technologies Digital Connect Box (DBH100), or your own analog to digital converters (A-to-Ds), which convert them to digital format. The outputs of the Digital Connect Box or A-to-D then feed the converted signal directly to the encoder card. See the *General Installation Guide for Spruce Hardware* manual for information on A-to-D configurations.

> *Note: The Spruce Digital Connect Box is no longer available. See Appendix A for information on the Digital Connect Box (if you have one). See the* ***General Installation Guide for Spruce Hardware*** *manual for information on using other A-to-D solutions.*

### Quality of the Source Video

The quality of the source video is critical in determining the quality of the final encode. Noisy video results in poor encodes, since a lot of effort can be spent trying to faithfully reproduce the noise in the source!

Use the best quality source you can. Digital sources are the best. Among analog sources, Component (YUV) is the best choice, requiring far less processing than the S-Video and Composite sources. Composite sources should be used as a last resort - and then only from a stable time-base corrected source.

> *Note: In addition to being converted from analog to digital, consumer VHS VTRs must be time-base corrected before being connected to the encoder's input.*

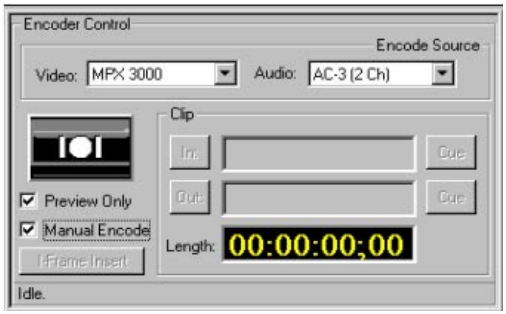
Lower bit-rates are more sensitive to video stability issues – if you have trouble encoding video at a low bit-rate (3 Mbps or less), try raising the bit-rate or selecting the ***1/2 D1*** Video Scaling setting.

## Performing a Preview Only Encode

At this point, it is a good idea to verify that video and audio data are reaching the encoder, and the encoder itself is working correctly. To do this, we will operate the encoder in its Preview mode, with Manual Encode engaged. This allows us to run the encoder end-to-end, including decoding to video and audio outputs, without actually writing data to the hard disk.

To test video and audio input and encoder throughput:

1. Set up the Encoder Control section of the Encode/Decode Control Panel exactly as shown below:




2. Confirm the following settings:
   - ***Video*** is set to ***MPX3000***.
   - ***Audio*** is set to ***AC-3(2 Ch).***
   - The ***Preview Only*** checkbox is selected.
   - The ***Manual Encode*** checkbox is selected.
3. Ensure your video and audio encoding settings are set to the factory default by opening the Encoder Settings window if not already displayed (select ***View – Encoder Settings Window*** from the Menu Bar) then click the ***Restore to Default*** buttons in both the ***MPEG Video Encoder*** and ***AC-3 Audio Encoder*** tabs.

4. Start your source tape deck by clicking on the Play button in the Tape Deck Control section (if serial control is available) or by manually pressing the VTR's ***Play*** button.

   *Note: Ensure that your source material has both video and audio content, and that your source tape deck is set to reproduce both the video and the appropriate audio track(s).*

5. Click on the large ***Encode Start*** button in the Encoder Control section.

*The Encode Start button.*

6. You will first see the message ***Downloading Encoder Parameter*** in the Status field at bottom of the Encoder Control section, followed in a few seconds by the message ***Capturing***. In a few more seconds you should see video from the decoder card and hear the audio from your audio monitoring system.

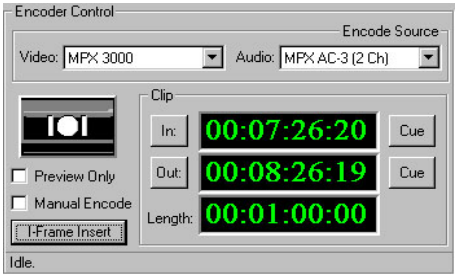
In the event that you do not see and hear picture and sound from the decoding hardware, first verify that your video and audio monitoring system is properly connected and switched to receive the output of the Spruce decoder. Then verify that the source signal is properly connected, and the correct inputs to the Digital Connect Box (if used) are selected. If you still cannot locate the fault, please contact Spruce Technologies Technical Support for assistance.

Once you are able to see picture and sound from the decoder, click once more on the large Encode Start/Stop button to terminate the encode Preview mode. You will need to manually halt the source tape deck.

## Setting Timecode In & Out Points

*Note: If you are performing manually controlled encoding – that is, you are not using your Spruce authoring software's machine control capabilities – then you can skip ahead to the next section.*

You can now enter the In (start) and Out (end) timecodes. These values are expressed in the standard hours:minutes:seconds:frames.




*The Encoder Control section of the Encode/Decode Control Panel, showing the In and Out fields for the start and end timecodes (respectively). The **I-Frame Insert** button, discussed later, is available with DVDMaestro and other systems with the Advanced Encoder Option.*

By entering these In and Out times, your Spruce authoring software can automatically cue up the source tape to play where you want to begin encoding, and stop where you want to end encoding (assuming you're using a tape deck that supports serial machine control).

*Note: Before you can enter these time points, you must make sure the Encoder Control section of the Encode/Decode Control Panel is not set for Manual Encode; that is, the **Manual Encode** checkbox is not selected. Also note that should the Encode/Decode Control Panel be closed while the **Manual Encode** checkbox is selected (i.e., without serial machine control enabled), it will default to Manual Encode mode once restarted. In this case – even if a compatible source tape deck is found via re-scanning – should you want to perform machine-controlled encoding, you'll need to ensure the Encode/Decode Control Panel is not set for Manual Encode.*

You may enter timecodes into the In and Out fields directly by typing in the window, or you can "grab" timecodes by cueing the source deck and clicking on the corresponding button to the left of the In or Out field. You may also define a section to encode by entering the In point only, then entering an interval of time into the Length field. When you press ***Enter***, the system will calculate an Out time based on the In point and the specified Length.

For your first encoding exercise, we recommend using a very short segment, perhaps one minute or less. This way you can experiment without waiting a long time for each encode to complete.

To enter encoding In and Out times:

1. Click on the In time field and type in a timecode that matches a point on the source tape you are using, and press ***Enter*** on the keyboard or press ***Tab*** to both enter the value and move to the Out field.

– or –

Cue the source tape to a point you want to use as the start of encode, and click on the ***In:*** button. The timecode at which the deck is cued appears in the ***In*** field.

2. Enter the desired ***Out:*** point in the ***Out*** field by typing, then press ***Enter*** on the keyboard or press ***Tab*** to both enter the value and move to the Length field.

   – or –

   Cue the source tape to a point you want to use as the start of encode, and click on the ***Out:*** button.

   – or –

   Enter a time interval (such as 00:01:00:00) in the ***Length*** field, and press the ***Enter*** key on the keyboard. A value calculated from the previously entered ***In*** time and the ***Length*** will appear in the ***Out*** field.

## Setting the Encoding Mode & Bit-Rate

After verifying the source video connection and operation using the Preview mode, you will want to define the video encoding mode as CBR (Constant Bit-Rate). (The alternative modes are 1-pass or 2-pass Variable Bit-Rate, or VBR, but we will explore these modes later.) You will also want to make sure that the encoding bit-rate is set appropriately.

There are a number of parameters that can be set in MPEG encoding but in most situations these two parameters — encoding mode and bit-rate — are the two key items. You should never encode video for any serious undertaking without verifying that these are appropriately set for the conditions and use at hand.

Encoding mode and bit-rate are specified in the Encoder Settings window — which, you opened previously when you defined the decoder settings and accessed the ***Restore to Default*** buttons. This dialog includes settings for all of the variable parameters of video and audio encoding.

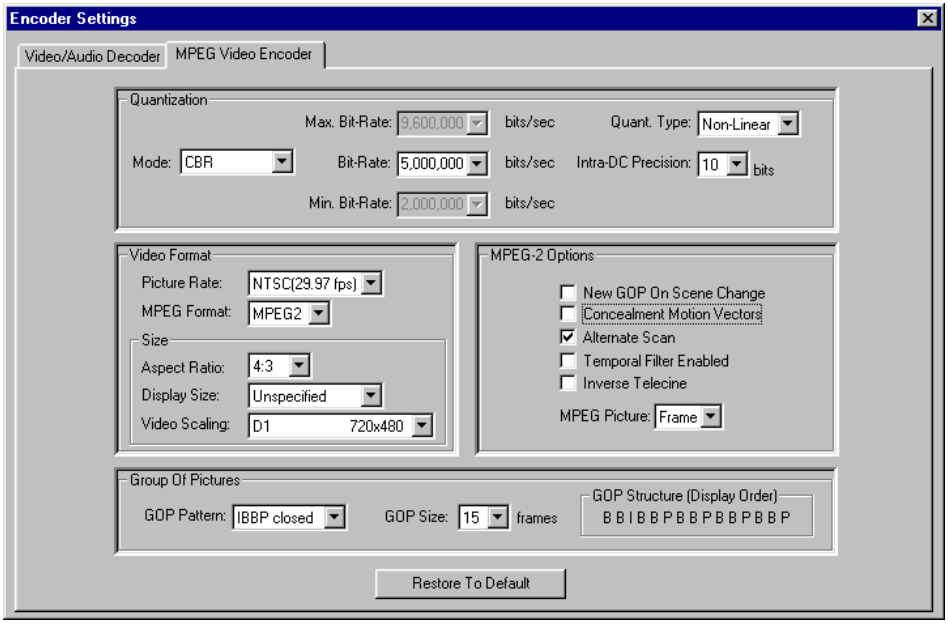
To display the MPEG Video Encoder tab:

1. If the Encoder Settings window is not already open, select ***Encoder Settings Window*** from the Tools pull-down menu (keyboard shortcut: ***Alt - V - S***).

2. In the Encoder Settings window, select the tab labeled ***MPEG Video Encoder***.

   *Note: You must select a video encode source in the Encoder Control section for the MPEG Video Encoder tab to display in the Encoder Settings window.*

3. The settings for MPEG encoding parameters appear as shown following:




4. To ensure the parameters are set to typical values, click on the ***Restore to Default*** button.

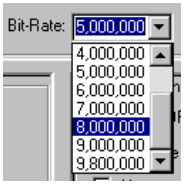
5. Ensure the ***Picture Rate*** setting matches the video standard (NTSC or PAL) of your tape deck.

The settings we are interested in now are found in the left-hand portion of the Quantization section at top of the dialog.

The first parameter to set is the encoding mode. For this encoding exercise, set this to CBR (Constant Bit-Rate). This is the most straightforward encoding mode, and for many purposes it is the superior choice. Later, we will explore the considerations and conditions under which you may wish to use Variable Bit-rate (VBR) encoding.

Next, you'll set the Bit-Rate field to 8,000,000, or 8 Mbps (megabits per second).

> *Note: 8 Mbps is the maximum rate recommended for CBR encoding. The DVD-Video Specification implies that slightly higher video bit-rates can be used, but real-life experience shows that many consumer DVD players have problems with sustained video bit-rates higher than 8 Mbps. We have also found that little or no improvement can be realized by increasing the bit-rate above this figure. Therefore, for DVD authoring purposes, we recommend you limit encoding bit-rate to 8 Mbps.*




*Setting the bit-rate.*

To set the video bit-rate to 8 Mbps:

1. Click on the Bit-Rate pull-down menu, in the Quantization section of the Settings window, as shown immediately above.
2. Select 8,000,000 from the menu.

– or –

1. Select the numeral area of the Bit-Rate field.
2. Type in the number ***8000000*** (no commas).

Typing figures lets you set a more precise video encoding bit-rate — but in this case, the desired figure is available by either method.

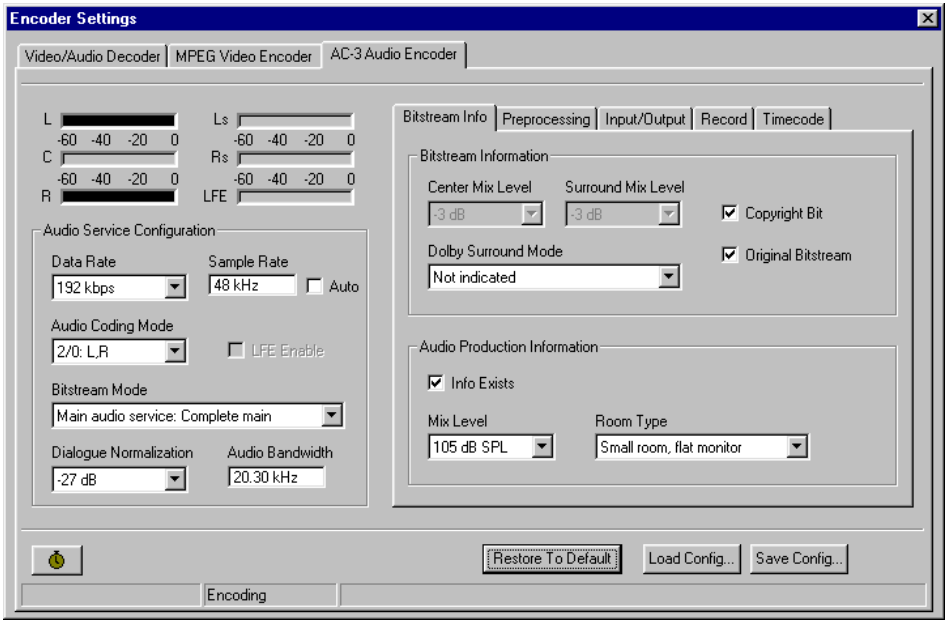
In DVD production, there are a number of considerations that go into selecting the right encoding mode and bit-rate for a given project or section of video. However, the settings we have given here, CBR at 8 Mbps, represent a very good default position. Constant Bit-Rate encoding at this high bit-rate yields excellent results on nearly all source material, and makes encoding very time efficient.

Depending on the DVD format used and the type of audio, you can carry quite a bit of video on the disc — even when the encoding rate is set to the maximum available rate for CBR.

Again, we recommend that whenever the length of program and disc size allow, encode your video at a Constant Bit-Rate setting of 8 Mbps (8,000,000). This will yield the best results with the minimum of hassle. Of course, there are many situations where it is not possible to encode at this high rate CBR. Later in this chapter, we will give you the formulas to optimize bit-rate and encoding mode for any DVD production situation.

## Selecting the Audio Settings

While you are in the Settings window, you will want to also set the parameters for audio. For this exercise, we will assume you are encoding stereo audio only. For details on the other audio formats, refer to the section later in this manual.




*The Audio settings are set using the AC-3 Audio Encoder tab of the Encoder Settings window.*

To set parameters for audio encoding:

1. Open the Encoder Settings window (as described earlier) and select the tab labeled ***AC-3 Audio Encoder***.

   *Note: You must select AC-3 (2ch) as the audio encode source in the Encoder Control section for the AC-3 Audio Encoder tab to display in the Encoder Settings window.*

2. Click on ***Restore to Default***. This sets these settings to their default values. Check the Audio Coding Mode setting. For stereo encoding, this should read ***2/0: L,R***.

3. Set the Data Rate field. We recommend a setting of 224 kbps for AC-3 stereo.

   *Note: Dolby actually recommends a setting of 192 kbps, but we have found that a setting of 224 kbps improves high-end response noticeably.*

### Setting Up for "Timecode-Triggered" Audio Encoding

In the lower left region of the AC3 Audio Encoder settings tab, you'll notice the ***Timecode Control*** button — a little yellow button that resembles a watch or a clock.

*The Timecode Control button.*

This button may be selected only if you have a timecode connection from the audio source tape deck (which may be the same one supplying the video) to the timecode input of the MPX3000/ACX5100 breakout cable, and you have serial remote control of the tape deck. In that case, audio encoding will be triggered from the timecode input. Without the timecode connection, triggering for audio encode comes from the 9-pin serial control, as for video.

If the required timecode connection is available, then we recommend you always select this button, as "timecode-trigger" audio encoding is more accurate than that from the 9-pin serial control port used for video.

To set up for timecode-trigger audio encoding, assuming you have a connection for timecode from the source tape deck to the audio encoder, click once on the Timecode Control button. Its status changes to ***Time Code Control*** and the clock becomes yellow.

Audio encoding begins once your Spruce authoring software detects incoming timecode and reaches the ***Start Time Code*** setting of the AC-3 Audio Encoder tab's Timecode section.

See the *AC-3, MPEG, and PCM Audio Encoding* section later in this manual for more information on this.

## Initiating Video & Audio Encoding

Finally, we are ready to encode. Actually, although several pages have been spent describing the steps leading up to this point, in practice you'll find that you do not need to repeat most of them each time you encode, and your setup and encoding will be quite efficient. The one thing Spruce always suggests is to preview the encode.

Having set up our parameters and In/Out timecodes, all you need to do is verify your mode settings and click the ***Start*** button.

To set up and perform encoding:

1. In the Encoder Control section of the Encode/Decode Control Panel, make sure that the ***Preview Only*** checkbox is not selected.
2. If you are using serial machine control, deselect the ***Manual Encode*** checkbox.

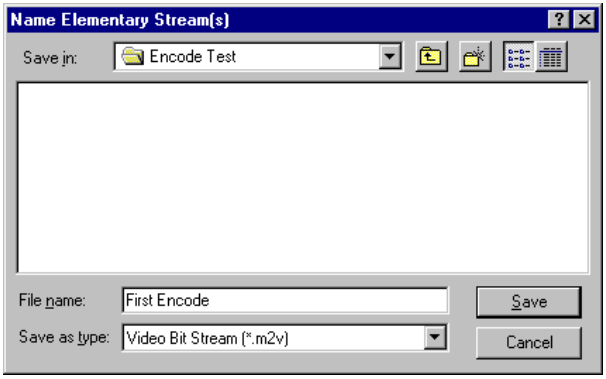
   – or –

   If you are encoding without serial machine control, select the ***Manual Encode*** checkbox (selected automatically if no VTR is connected), then enter a value of one minute or less into the ***Length*** field. This defines the length of encoding. Once the encode is started, this value counts down to 00:00:00:00, the encode stops, and the ***Length*** resets to its original value. Set the ***Length*** field to 00:00:00:00 to perform an "open ended" encode. Once the encode starts, this

value counts up and the encode continues until stopped by clicking the ***Start/Stop*** button again.

*Encode Start/Stop button.*

Now you can begin encoding by clicking once on the large ***Start/Stop*** button in the Encoder Control section. When you click this button, the following dialog appears that lets you define the filename and location of the assets to be created:




3. In the Save dialog, navigate to your main data drive (such as E: or F:). If this is your first attempt at encoding, you can use the Folder create button in the dialog to make a new folder named "Encode Test", and then open the newly created folder by double-clicking on it.
4. Enter the desired File name (such as "First Encode"), and click ***Save***.

If you are using serial machine control:

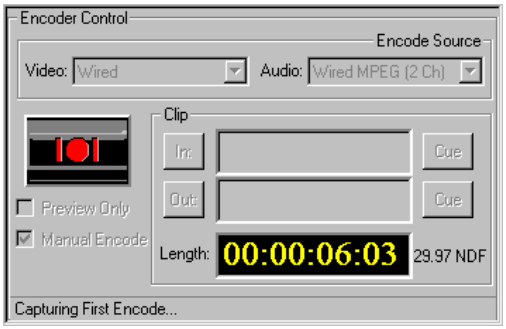
- Your source tape deck automatically cues up to a point five seconds before the In time that you entered (known as a preroll); once it reaches this point, the tape deck drops into play. Set the preroll length by selecting ***Preroll Setup*** from the ***View*** pull down menu.
- As it reaches the timecode of the predetermined In point, the Start/Stop button in the Encoder Control section changes color to red, indicating that encoding is now in progress.
- A few seconds later, the decoded preview output will begin playing back through your video and audio monitor systems; the Real-Time Previewer will also launch and simultaneously display the video on your computer display (if enabled).

– or –

If you are not using serial machine control:

- The Start/Stop button in the Encoder Control section turns red, indicating that you've initiated encoding.
- Manually start your source tape deck. The ***Option*** pull down menu has a ***Manual Prompt*** setting that can produce more accurate manual encodes. Instead of the encode starting immediately after you've confirmed the file's name, a dialog displays with an OK button you can click to start the encode once the tape deck is running and at the point you want to start encoding from. It's a good idea to have cued up the tape several seconds before the desired starting point, so that the tape deck is running stable and providing clear video playback.
- A few seconds later, the decoded preview output begins playing back through your video and audio monitor systems; the Real-Time Previewer will also launch and simultaneously display the video on your computer display (if enabled).

*Note: The Real-Time Previewer display is always created by decoding the captured and encoded input — so what you see is what you get. The image and sound in the preview always exactly reflects the results in the captured file.*




*During encoding, the status field of the Encoder Control section will indicate that you are **Capturing [File Name]**, as shown above. At the same time, the Real-Time Previewer launches and displays the encoded video in real time.*

If you are using serial machine control, once the source tape deck reaches the end of the defined segment:

- The system automatically drops out of encoding.
- The source tape deck automatically stops.
- Your Spruce authoring software prompts you to load the encoded asset into the decoder section for review.

– or –

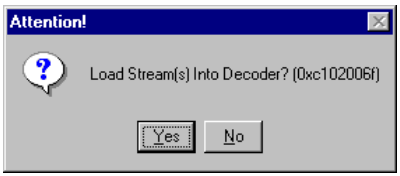
If you are not using serial machine control:

- If you entered a ***Length*** value other than 00:00:00:00, the encode will stop once the Length value counts down to 00:00:00:00.

  – or –

  If you entered 00:00:00:00 as the ***Length***, press the ***Start/Stop*** button in the Encoder Control section; this stops the encoding process.

- Manually stop your source tape deck.
- Your Spruce authoring software prompts you to load the encoded asset into the decoder section for review.

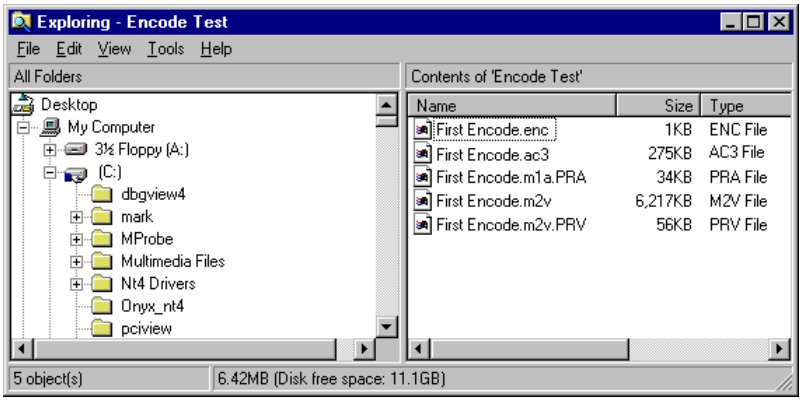



In the above prompt, select ***Yes*** to load the file into the decoder for review. The captured video and audio files are loaded into the Decoder Control section of the Encode/Decode Control Panel and automatically synchronized — ready for your review.

Congratulations! You have just encoded your first video and audio using your Spruce Technologies system.

## What Files were Created During this Encoding Session?

If you use the Windows Explorer to view the contents of the directory created previously, you will see the following items:




You will note that there is one large file with the extension ".m2v", and one much smaller file with extension ".ac3". These are the main video and audio files.

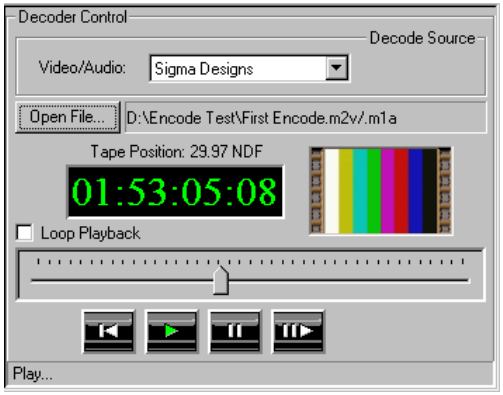
You will also notice that each of these files is accompanied by a small "parameter" file that adds extension ".PRV" (video) or ".PRA" (audio) to the name of the main file. These parameter files contain information about the contents of the main file, and are used by the authoring system.

> *Note: Do not delete any of these files, as they are required for authoring! The ".PRV" and ".PRA" files are not created during encoding if* ***None*** *is selected as the decoder in the Decoder Control section of the Encode/Decode Control Panel. These files will be created once these assets are imported into the authoring software's Asset Bin or if you ever open them with the decoder.*

There is also a ".enc" file. This is a small file that contains the all of the settings of the Encode/Decode Control Panel. This file can be opened at a later date by selecting it from the File pull-down menu's ***Load Settings...*** function.

## Reviewing the Results of Encoding

Now that you have completed encoding and loaded the resulting video and audio files into the decoder (assuming you clicked ***Yes*** at the Load Streams prompt), you can review the results using the Decoder Control section of the Encode/Decode Control Panel.




To playback encoded video loaded into the Decoder Control section:

1. Click on the ***Play*** button (right-facing arrow) in the tape deck controls of the Decoder Control section.
2. Video playback starts immediately, along with synchronized audio.
3. Playback terminates when the end of the file is reached.

Another control useful for review is the Location slider in the middle of the Decoder Control section. This can be used to cue playback from any desired point in the video track. When you move the slider, the thumbnail display to its right shows the current frame in real time. Once you park the slider, you can use the Play button to see video starting at that location.

For users with the Quadrant decoder, you have two additional controls: ***Slow Motion*** and ***Mute Audio***. If you don't wish to audition the audio during video playback, simply select the ***Mute Audio*** checkbox. The ***Slow Motion*** checkbox, and the "Single-Step" button (two vertical bars with right-facing arrow) are particularly useful in review.

> *Note: Audio playback will occur only during normal full-speed (1x) playback; with Slow Motion or Single-Step playback, audio will be muted. As noted, audio can be intentionally muted during normal playback by selecting* MUTE AUDIO.

Now that you have set up the Encode/Decode Control Panel and have an understanding of how to encode files, you may wish to encode additional segments before you proceed to the next step — which is to close the Encode/Decode Control Panel and then to load the captured files into the Spruce authoring environment.

### Playing Other Files with Decoder Control

The typical use of the Decoder Control function is to play files you have just encoded. This function is also able to play other compatible video and audio files. Click on the ***Open File*** button to open a file selection dialog. When you select a video file, the decoder automatically loads the audio file with the same root name (if it exists). Similarly, you can select an audio file and the decoder automatically loads the video file with the same root name.

> *Note: You cannot specify both the video and the audio file – the decoder only plays audio and video files with the same root name.*

Issues arise if you have multiple audio or video files with the same root name at the same location. Since the decoder cannot play multiple audio or video files at the same time, it defaults to the first one it "sees". For example, if you have encoded an audio file twice, once as an AC-3 and once as PCM (using the same root name each time), the decoder will always see the AC-3 file first and play it. The only way to play the PCM version is to put the files in separate directories or change their root names.

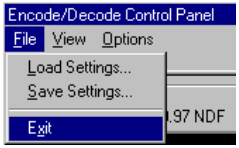
For audio files, following is a list of supported extensions and the order they are "seen" by the decoder: ***.ac3***, ***.m1a***, ***.aif***, ***.wav***, ***.abs***, ***.dts***, and ***.raw***.

The same issue exists with video files – if you encode both MPEG-1 and MPEG-2 versions and give each the same root name in the same directory, you will not be able to play the MPEG-1 version, since the MPEG-2 version is "seen" first. Following is a list of supported extensions and the order they are "seen" by the decoder: ***.m2v***, ***.m1v***, ***.vbs***, and ***.mpg***.

## Exiting the Encode/Decode Control Panel

As long as the Encode/Decode Control Panel is open, you can encode as many segments as you wish, with different parameter settings and so on. Once you finish your encoding session, and have finished reviewing the results, you're ready to close the Encode/Decode Control Panel and load the encoded files into DVDMaestro or DVDConductor.

> *Note: If you are using the Standalone Encoding application on a separate workstation, then this section does not apply. In that case, the normal procedure will be to transfer encoded files from the encoding system to the authoring system using a fast network or other means of transfer. The files are then opened into the Assets Bin as described in Chapter 5 of your User's Guide.*




To close the Encode/Decode Control Panel and load encoded files into the Assets Bin:

1. From the Encode/Decode Control Panel File menu, click ***Exit***.

   – or –

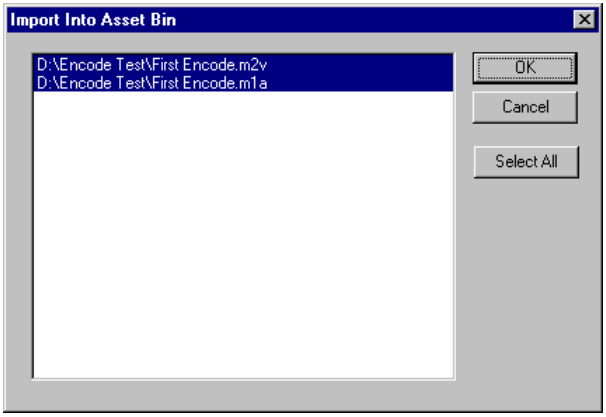
   Use the key combination (***Alt - F - X***) from the keyboard.

   – or –

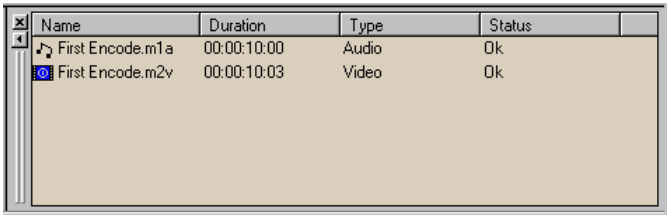
   Click on the small "***X***" at upper right of the Encode/Decode Control Panel.

   Whichever method you use, the following prompt appears:


2. In the prompt dialog, select ***Yes*** (keyboard shortcut: ***Alt - Y***). The following dialog now appears:




3. This dialog lists the files that you captured during your encoding session. All selected files will be loaded into the Asset Bin when you click ***OK*** or hit ***Enter*** on your keyboard. You may de-select any files you do not wish to load by holding down the ***Ctrl*** key on your keyboard and clicking on the files to be de-selected.
4. Click ***OK*** or hit ***Enter*** on your keyboard. The selected files appear immediately in the Asset Bin, as shown here:



| Name | Duration | Type | Status |
|---|---|---|---|
| First Encode.m1a | 00:00:10:00 | Audio | Ok |
| First Encode.m2v | 00:00:10:03 | Video | Ok |

From here you can load these files into DVD Movies or DVD Menus as normal, and resume authoring.

## Optimizing the Bit-Rate

As described in the previous section on basic encoding, the two most important parameters of MPEG encoding, by far, are the encode mode and bit-rate. In this section, we will detail how you can calculate the optimal bit-rate for video encoding to suit the project at hand. In the next section, we will describe how to use Variable Bit-Rate (VBR) encoding and under what circumstances you can benefit from its use.

Optimizing the bit-rate for video encoding is a matter determining how much storage space is available, then dividing that by the playtime of video you need to put into that space. It's as simple as that. Spruce has available a Microsoft Excel format spreadsheet to speed these calculations. Visit the Spruce support web site for details.

To make this calculation accurately, you need to consider all of the following:

- The total play time for the video material to be included in the title.
- The DVD format on which it will be mastered (single or dual layer, single or dual side, DVD-R or replicated disc).
- The total play time and track configuration(s) for all the required audio material.
- The disc requirements for all required ROM assets (all non-DVD-Video assets) — this applied to standard DVD-Video titles as well as Hybrid (DVD-Video plus DVD-ROM) titles.
- Any special characteristics of the Project that will affect the video storage requirements or transfer rate (required throughput) — such as large numbers of subtitles or still pictures;
- And finally, the limits of video bit-rate — as defined by the DVD-Video Specification and by the performance of real-life DVD players — including a small margin of "overhead."

In the coming pages, we'll review all of these factors. Let's begin by calculating the total play time. . .

### Calculating the Total Video Play Time

To calculate the optimal settings for video bit-rate, it's important to know the total play time of all A/V material to be included on disc, including not only the main video feature and "value-added" materials such as trailers, interviews, etc. If the project you are working on is to use motion menus, include the length of these in your calculations (if you don't have an accurate number, make an estimate).

Once you have all the play times, convert these to seconds then add them all together. (For calculation, you will need the number in seconds, and it's easier to add raw anyway). If there is an odd number of frames left over, round up to the next second.

For example, let's consider a hypothetical project that includes the following video segments:

- One main feature (126 minutes, 17 seconds in length).
- An interview segment (12 minutes, 4 seconds).
- Several original theatrical trailers (totaling 3 minutes, 12 seconds).
- Several trailers for coming attractions (totaling 6 minutes, 39 seconds).
- Six "dynamic" or "motion" DVD Menus (each using a loop of video no more than 20 seconds in length).

First we convert each of these to seconds:

- Main feature = (126 x 60) + 17 = (7560 + 17) = 7577 seconds
- Interview = (12 x 60) + 4 = (720 + 4) = 724 seconds
- Trailers = (3 x 60) + 12 = 180 + 12 = 192 seconds
- Coming Attractions = (6 x 60) + 39 = 360 + 39 = 399 seconds
- Dynamic DVD Menus = 6 x 20 = 120 seconds

Then we total these together:

- 7577 + 724 + 192 + 399 + 120 = 9012 seconds

(It goes without saying that a calculator or spreadsheet program is vital in this process!)

Now we have the first piece of information we require in order to compute the optimal bit-rate for video encoding, and we can move onto the next consideration…

## DVD Formats & Disc Capacities

The size of the "bucket" that will end up carrying your program is the next most-crucial element in your calculation. As you probably know, DVD discs come in any of several "flavors":

| DVD Format | Description | Capacity | Comments |
|---|---|---|---|
| DVD-5 | Single-sided, single-layer | 4.7GB | Lowest cost replicated disc |
| DVD-9 | Single-sided, dual-layer | 8.54GB | Higher cost than DVD- 5 |
| DVD-10 | Dual-sided, single-layer | 9.4GB | Requires user to flip disc |
| DVD-17 | Dual-sided, dual-layer | 17.08GB | At this writing, marginally available |
| DVD-R (A) | 1st generation DVD-R | 3.9GB | High-cost, suitable for QA and one-off |
| DVD-R (B) | 2nd generation DVD-R | 4.7GB | |

As you can see, the capacity of the different formats varies widely. In practice, the decision of which format to use is most often determined by factors other than storage capacity (especially cost). Note also that in the case of dual-sided and (to a lesser extent) dual-layer formats, you may find yourself forced to distribute the content unequally on the two sides of the disc, complicating your calculations.

Since disc capacities are expressed in gigabytes, and video encoding bit-rates are expressed in bits-per-second — rather than bytes — it is necessary to convert the disc capacities to raw bits. The chart below shows the capacity of each format converted to bits (and also expanded out to the full number for easier calculations).

| DVD Format | Capacity in Bytes | Capacity in Bits |
|---|---|---|
| DVD-5 | 4.7GB | 37,600,000,000 |
| DVD-9 | 8.54GB | 68,320,000,000 |
| DVD-10 | 9.4GB | 75,200,000,000 |
| DVD-17 | 17.08GB | 136,640,000,000 |
| DVD-R (A) | 3.9GB | 31,200,000,000 |
| DVD-R (B) | 4.7GB | 37,600,000,000 |

With this information in hand, we can make a preliminary calculation for the required video bit-rate for the hypothetical project we described in the previous section. (For the moment we won't factor in the audio files, etc.)

As you may recall, the total duration of video in that project ended up being 9012 seconds. To translate this play duration into a first-cut video bit-rate for each of the designated formats, we simply divide the capacity in bits by the play time in seconds, as follows:

**DVD-5**: 37,600,000,000 ÷ 9012 = 4,172,000 bps

**DVD-9**: 68,320,000,000 ÷ 9012 = 7,581,000 bps

**DVD-10**: 75,200,000,000 ÷ 9012 = 8,344,000 bps

**DVD-17:** 136,640,000,000 ÷ 9012 = 15,162,000 bps

**DVD-R (3.9GB)**: 31,200,000,000 ÷ 9012 = 3,462,000 bps

*Note: Bit-rates are rounded to the nearest thousand.*

At this point, the calculation of video bit-rate is mostly useful in helping guide decisions about which DVD format to use. The values derived from this first-cut calculation will be reduced somewhat as we allow for audio tracks, any ROM materials included, allowances for disc overhead, etc. However, what we want to check now is whether the figures for our target format are likely to be able to reproduce material satisfactorily.

The bit-rate required for acceptable quality MPEG encoding is very much dependent on the source material. However, in general, very good quality can be obtained with minimal effort at bit-rates of 6 Mbps (6,000,000 bps) or higher. Between 4 and 6 Mbps, variable bit-rate techniques are needed to get acceptable results for most general market material, although special-purpose materials may be okay with CBR. At bit-rates lower than 4 Mbps, you may end up spending a lot of time refining the encoding process and parameters before obtaining a good result. And below about 3.5 Mbps much of the material in the feature film realm simply cannot be rendered acceptably.

With these figures as a guide — and keeping in mind the bit-rate available for video will likely to be pushed lower than the numbers above (thanks to the required audio files and other possible elements) — which would be the appropriate DVD format to use? Well, a DVD-5 format could possibly work for this Project , but might require special attention to encoding. DVD-9 would fit everything quite comfortably. DVD-10 or DVD-17 would be fine as well, but considerations of user convenience — and disc replication cost — are likely to rule these out. As for DVD-Recordable, a first-generation DVD-R (3.9GB) clearly will not carry the full program (but may serve as to test a truncated version; a second-generation DVD-R (4.7GB), being the same as DVD-5, might be used in a full version.

## Calculating the Audio Allowances

The next stage of the calculation is to make allowance for the audio content on the disc. Bit-rates for audio encoding are fairly closely defined for a given format of compressed or uncompressed audio, making the calculation somewhat simpler. On the other hand, the configuration of audio may be different in different portions of the program, making things a little more complicated.

The following chart list the bit-rates for a single stream (track) of audio in each of several different compressed and uncompressed formats commonly used in DVD. The DVD disc may have as many of 8 individual tracks, each of which may be in one of these formats.

| Audio Format | Bit-Rate |
|---|---|
| AC-3 stereo | 192 or 224 kbps |
| AC-3 5.1 surround | 384 or 448 kbps |
| DTS 5.1 surround | 1536 kbps |
| Stereo PCM @ 16-bits/48kHz | 1536 kbps |
| Stereo PCM @ 24-bits/96kHz | 4608 kbps |

In the case of both AC-3 formats (stereo and 5.1 surround), the lower bit-rate represents Dolby's recommendations, while the higher number represents practice of a substantial portion of engineer's in the field. In general we recommend using the higher rates for AC-3 encoding for better fidelity.

You'll notice that there's quite a wide range of bit-rates for the audio formats supported

in DVD. However, most feature film application is centered on the use of AC-3 audio, either in surround or stereo format. DTS sound represents a small (but growing) share of the market. Uncompressed PCM audio, especially high-resolution/high-sample rate PCM, is generally restricted to titles of special audio interest, such as music video.

For the hypothetical Project we have been working with, let's assume the various elements use the following audio configurations:

| | |
|---|---|
| **Main Feature:** | 2 tracks AC-3 5.1 (French and English), 1 track stereo (Spanish) |
| **Interview:** | 1 track AC-3 stereo |
| **Theatrical Trailers:** | 3 tracks AC-3 5.1 |
| **Coming Attractions:** | 3 tracks AC-3 5.1 |
| **Motion Menus:** | 1 track AC-3 5.1 |

You can see that in this Project — which resembles many DVD feature film releases — the audio configuration is quite varied. There are two approaches we can take to the calculation: either compute the contribution for each section, or use the configuration of the main feature and hope that other factors balance out. For comparison, we will do both.

Using the duration figures for each section, along with the audio track bit-rate figures listed previously, we can compute the total storage required for audio as follows:

| Section | Duration (seconds) | Bit-Rates | Total Bit-Rate (bps) | Storage Required (bits) |
|---|---|---|---|---|
| Main Feature | 7577 | 448 + 448 + 224 kbps | 1,120,000 | 8,486,240,000 |
| Interview | 724 | 224 kbps | 224,000 | 162,176,000 |
| Theatrical Trailers | 192 | 3 x 448 kbps | 1,344,000 | 258,048,000 |
| Coming Attractions | 399 | 3 x 448 kbps | 1,344,000 | 536,256,000 |
| Motion Menus | 120 | 448 kbps | 448,000 | 53,760,000 |
| | | | Total | 9,496,480,000 |

This gives us a figure for total audio storage that can be subtracted from the volume size, to give partially refined result for optimal video bit-rate. For comparison, lets do the calculation for total program based on the configuration in the main feature:

| Section | Duration (Seconds) | Bit-Rates | Total Bit-Rate (bps) | Storage Required (bits) |
|---|---|---|---|---|
| Total Program | 9012 | 448 + 448 + 224 kbps | 1,120,000 | 10,093,440,000 |

In this case the result is a little higher than then detailed result, meaning that we any error would be on the side of safety. This may not always be the case, however, and it can be somewhat dangerous to try to simplify calculations in this way.

Let's revisit our bit-rate calculation from the previous section, making allowance for audio, using the more precise figure of 9,496,480,000 bits required for audio storage in our example project. We will perform the calculation only for DVD-5 and DVD-9, the other formats having previously been eliminated as candidates for delivery to market:

**DVD-5**

(37,600,000,000 – 9,496,480,000) ÷ 9012

= 28,103,520,000 ÷ 9012

= 3,118,000 bps

**DVD-9**

(68,320,000,000 – 9,496,480,000) ÷ 9012

= 58,823,520,000 ÷ 9012

= 6,527,000 bps

Based on the calculation including allowance for audio, it appears that DVD-9 is the only delivery option likely to support acceptable encoding quality — since 3.1 Mbps is simply too low for use for a feature film for general market.

## Calculating the ROM Allowances

To continue our calculations, we need to subtract any storage allotted to ROM assets, and then provide allowance for general DVD formatting, which includes menus, subtitles, and navigation files. Furthermore, if you are creating a Hybrid DVD disc (DVD-Video and DVD-ROM), all files related to the ROM portion of the disc would be included in these calculations.

For this example, we'll assume that there are ROM assets such as Web-link software and other files, totaling 36 megabytes of data.

Note that ROM assets are normally expressed in computer megabytes (MB), equal to 1,048,576 bytes, rather than the exact bit and byte quantities used in expressing DVD

capacity and encoding bit-rates. Therefore, to factor these assets into our calculation, we need to convert the "megabyte" capacity into raw bits, then subtract this from the storage capacity left after making allowance for audio. Then we can calculate a new figure for optimal bit-rate.

Multiplying 36 MB by 1,048,576 bytes yields a result of 37,748,736. Then we multiply this by 8 to give a figure in bits, which we round off to 301,990,000.

Including this into the DVD-9 calculation from the last section, we get:

**DVD-9**

(58,823,520,000 – 301,990,000) ÷ 9012

= 58,521,530,112 ÷ 9012

= 6,493,000 bps

In this case, the effect of allowance for ROM content on encoding bit-rate has been small, in part because DVD is such a capacious storage medium for ordinary computer assets.

## Factoring for DVD 'Overhead'

As the last stage of our calculation, we need to make an "overhead" allowance for several less-easily quantifiable factors, including the size of DVD navigation files that will be created during compilation (for still DVD Menus and subtitles), and for variances in encoding that may give us a less-precise result than we have calculated.

The amount of this margin may vary with Projects, but for most we recommend you allow for an overhead of 5%. Factors that might increase this margin would be large numbers of subtitle tracks, numerous still images, a very complex navigation structure, and so on. In this area, it is nearly impossible to make hard and fast rules, but these guidelines should allow you to optimize encoding bit-rates without running out of space on the target DVD format.

> *Note: Important! Always remember to allow for overhead. If you don't, the likely result is that you'll be far into your Project before discovering that it will not fit on the target disc. This is a very expensive mistake to make in production!*

To calculate the required overhead, simply multiply the result of the last calculation (after allowance for audio and ROM content) by the inverse of the percentage margin. In this case, we will use a margin of 5%, which translates to multiplication of the last result by 0.95. Hence:

**DVD-9**

6,493,000 bps x 0.95

= 6,168,000 bps

The end result of our calculation, and a good figure to use for video encoding in this Project is:

6,168,000 bps, or 6.18 Mbps

Therefore, we may encode this Project in CBR mode at a rate of 6.18 Mbps — with confidence that the resulting files will be able to be delivered in the DVD-9 format, with all accompanying audio, ROM, menu, and navigation assets.

> *Note: In some cases, you may want to round this downward to allow for any errors of calculation, such as not applying enough margin at the end. There will be little perceived difference between encoding at a rounded-down value of 6 Mbps and encoding at 6.18 Mbps. The important thing to remember here is to round down — not up.*

## Summary of Video Bit-Rate Calculations

We've already examined how to calculate optimal video bit-rates in some detail, and by now you may be feeling as though your head is spinning. However, you'll find that in practice, these bit-rate optimization calculations are not so difficult. In simple form, the procedure is:

1. Determine the total play time of all video assets in the Project. Convert this to seconds.
2. Determine the size of the target DVD format (or possible formats) and convert this to bits.
3. Determine the amount of data required for audio by multiplying the total play time in seconds by the bit-rates of all audio tracks and summing the results. Subtract this number from the size of the DVD format.
4. Subtract any space required for non-DVD Video (ROM) assets.
5. Divide the resulting adjusted capacity figures by the video play time (as determined in the first step).
6. Multiply the resulting "bits-per-second" figure by an overhead allowance of 0.95 (or less if your Project warrants a larger overhead safety margin).
7. If the resulting number is greater than 8,000,000 bps, use 8,000,000 bps instead.
8. Make sure that the sum of the video bit-rate and all of the audio bit-rates that occur in audio tracks of the same video clip does not exceed 9,800,000. If it does, subtract the sum of audio bit-rates from this number and use if instead of the previously calculated figure.

The result is the optimal bit-rate for CBR encoding, or average bit-rate for VBR encoding.

## Choosing the Encoding Mode (CBR, 1-Pass, or 2-Pass VBR)

Besides determining an optimal bit-rate before you begin serious encoding, you will also need to make a decision about which encoding mode you'll use — Constant Bit-Rate, 1-Pass, or 2-Pass Variable Bit-Rate. Earlier in this chapter we noted that for shorter program material, high-rate CBR is the way to go. Other situations may not be so clear. Here are some notes on the characteristics and relative advantages and disadvantages of each mode…

### Constant Bit-Rate (CBR) Encoding

CBR encoding has the advantage of being by far the most straightforward mode of encoding and, as noted before, it gives excellent results as long as bit-rates can be kept fairly high (generally 6 to 8 Mbps; possibly less if the material is easy to encode).

The disadvantage of CBR is that the overall bit-rate, as yielded by calculation, is likely to fall beneath the range that CBR can be trusted to encode with high quality.

Therefore, CBR is best used on material of short duration, where a high bit-rate setting can be used. In Projects that compile many short clips into a longer piece, it also may be more productive to encode at high-bit-rate CBR and replicate on DVD-9 or DVD-10 than to spend the time needed to get satisfactory results with VBR on so many short pieces.

### 1-Pass Variable Bit-Rate (1-Pass VBR) Encoding

As the name implies, 1-Pass VBR uses some of the technology of 2-Pass Variable Bit-rate, but in a single pass through the tape. With 1-Pass VBR, the bit-rate is varied "on the fly," in direct correspondence to the complexity of the video program material. For instance, with "easy" material, such as talking heads, or a static landscape vista, the bit-rate might be relatively low; with "complex" material, such as a car chase, or an action sequence with a lot of wipes or other complex transitions, the bit-rate can rise dramatically.

The primary advantage of 1-Pass VBR over CBR is that with a given setting of the Bit-Rate parameter (which is not necessarily the bit-rate that results in this case) it may give more satisfactory results than with CBR; that is, the encoded files may simply look better. And as we'll learn more about, the advantage of 1-Pass VBR over 2-Pass VBR is that it's a relatively faster process. However…

The disadvantages of 1-Pass VBR, it turns out, are rather severe. The nature of the process is that the Bit-Rate parameter defined in the Setting window is only a starting point. During the encode pass, the system will go to a higher rate (with a defined ceiling), whenever it is deduced to be necessary, without regard to the effect on overall bit-rate and file size.

The result is that when you encode with 1-Pass VBR selected, you have no way of knowing what the size of the resulting file will be until the encode pass is complete — and hence there is no way to effectively optimize settings. In some cases, the effective bit-

rate of 1-Pass VBR may be 60% higher than that of CBR, or even more — which may mean than that files that would otherwise fit on the disc might prove too large when encoded with 1-Pass VBR.

There is one situation in which 1-Pass VBR may be used effectively to improve quality without losing control over file size: when the source material consists of relatively easy material — such as talking heads, or karaoke-style music videos — interspersed with crossfades and other transitions that are more difficult to encode. In this case, the "spikes" of bit-rate at the transitions will be occupy relatively little of the overall time and the contribution to increasing file size will be consequently smaller. In this case, you may get a good result by setting the Bit-Rate parameter a little lower than the optimal CBR value calculated and running as 1-Pass VBR. However, you must always be sure to check the size of the resulting files to make sure you are no overflowing the capacity of the target format.

## 2-Pass Variable Bit-Rate (2-Pass VBR) Encoding

With 2-Pass VBR, you can combine the visual benefits of 1-Pass VBR with the space-efficiency benefits of CBR.

*The 2-Pass Variable Bit-Rate encoding is not available in the standard version of DVDConductor and DVDVirtuoso. This feature may be added by installing the DVDEncodingPack upgrade.*

As the name implies, 2-Pass VBR operates as follows: First the entire length of material is played through the encoding system and analyzed, in what is known as a "profiling" pass. During this pass, no actual encoding is performed. The system, however, examines the source stream frame-by-frame and determines how difficult each frame (or group or frames) will be to encode.

After the profiling pass, the system then calculates a bit-rate curve, or "profile," based on the information obtained during the profiling pass along with the settings you've chosen in the Settings window for Average, Peak, and Minimum Bit-Rate. The resulting curve is calculated to respect these limits and deliver a file whose size is equivalent (within a margin) to the same length of material encoded in CBR at the average rate.

Finally, the material is played again through the system. During this second pass, the system performs the actual encoding — varying the bit-rate along with the picture, to deliver a result that is optimized for every frame or group of frames.

2-Pass VBR can be very useful, but it is not magic. It works best on longer-form material where it has a chance to balance hard-to-encode scenes against easier material. Likewise, it has the most "room" to work when you have a mix of easy and complex material in the pass you wish to encode. If you have a 2-hour program that is fast-action, difficult-to-encode material from one end to the other, then 2-Pass VBR will not yield the best results.

The biggest disadvantage of 2-Pass VBR is that it takes much more time than either CBR or 1-Pass VBR. At the very minimum, it will require at least twice as much time as the length of the material you wish to encode. In practice, however, it takes longer than that from start to finish. Furthermore, during the quality assurance process, you'll likely discover sections of the material that are not fully optimized. These must then be "hand-encoded" using your Spruce authoring software's segment re-encoding feature — until the results are as desired. This requires not only lots of time but highly skilled personnel.

Also, one should not make the mistake of automatically assuming the 2-Pass VBR will give a better result than CBR at the same rate. VBR introduces much more complexity into the encoding process, with increased possibilities for error. Especially with shorter material, 2-Pass VBR may actually introduce more problems than it alleviates.

That said, 2-Pass VBR is close to being a standard for encoding of feature films — a key technology that allows full-length motion pictures to be delivered in the 4.7GB DVD-5 format with very good quality. Even as larger-capacity DVD formats (such as DVD-9) move into the forefront, 2-Pass VBR continues to be an important means of increasing play time for a given disc size.

## Encoding with 2-Pass VBR

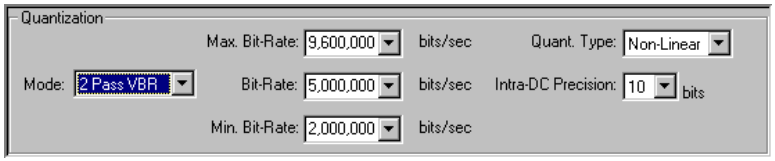
The basic operation of 2-Pass VBR is fairly simple. All you need to do is select the 2-Pass VBR mode, set the maximum and minimum bit-rates, and set the overall bit-rate.

### Hardware & Software Requirements

Encoding with 2-Pass VBR requires the use of a source video tape deck that supports serial machine control. Otherwise there is no way for the system to align the two passes.

### Setting Maximum, Minimum, & Overall Bit-Rate

When you select 2-Pass VBR mode in the Settings window, the Quantization section of the MPEG Video Encoder tab will show a total of three bit-rate fields (located near the top center of the following screenshot):




*The Quantization section of the MPEG Video Encoder tab has three bit-rate fields.*

The middle Bit-Rate field (***Bit-Rate***) indicates the overall, or average, bit-rate that will be applied. The number entered here is the same number that one would use to encode with CBR, based on the calculations detailed in the previous section.

The Maximum Bit-Rate field (***Max. Bit-Rate***) indicates the peak of the VBR encoding curve. The value set here needs to be calculated with respect to the maximum total bit-rate allowed by the DVD-Video Specification and the audio program material to be included.

The Minimum Bit-Rate field (***Min. Bit-Rate***) indicates the floor beneath which the bit-rate will not be allowed to dip. This is a "soft" quantity whose optimal setting may be determined with experience. For most material, we recommend the default setting of 2 Mbps (2,000,000 bps).

Returning to the hypothetical Project we described earlier in this section, let's define the rates to be used for the main feature. As you may recall, we defined that the main feature has 2 tracks of AC-3 5.1 surround audio, each at a bit-rate of 448 kbps, and a single AC-3 stereo track at 224 kbps. The total of these two is 1,120 kbps, or 1,120,000 bps.

The maximum bit-rate allowed by the DVD-Video Specification for combined video plus audio and subtitles is 10,080,000 (10.08 Mbps). We must make sure that the total bit-rate never exceeds this figure. We can calculate a peak rate as:

$$9{,}800{,}000 - 1{,}120{,}000 = 8{,}680{,}000 \text{ bps peak}$$

In practice, it's usually a good idea to round down the peak rate a little bit for sake of safety. There will generally be little difference in the results of encoding resulting from such adjustments. In this case, we might elect to drop the peak rate down to 8,500,000 bps.

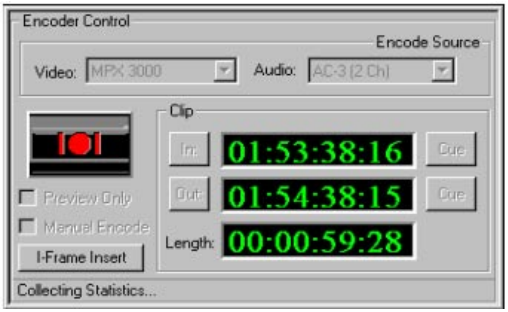
For setting the Bit-Rate (overall), we will use the figure of 6,180,000 bps that we derived from the calculation earlier in this section. It is worth noting that file size resulting from 2-Pass VBR may vary a little from the corresponding CBR setting, so it's a good idea to look at the file size after encoding to make sure you won't overflow the disc.

For the minimum setting, we will use the general default of 2,000,000 bps. This will give a good result while allowing ample "headroom" for the VBR algorithm to work its magic.

## Executing the 2-Pass VBR

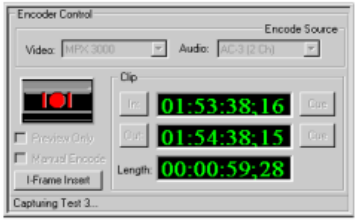
Once you have set the encoding mode and the overall, maximum, and minimum bit-rates, starting the encoding process is the same as for CBR encoding. Simply press the Start/Stop button in the Encoder Control section, then set a name and storage location for the file to be created.

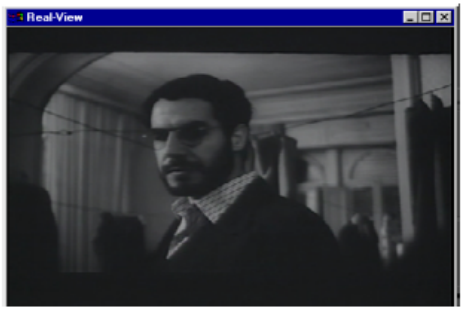
Next, the system will cue up the tape, then roll it through the full length of the segment to be encoded while displaying the message ***Collecting Statistics*** in the Encode Status field. During this time, no decoder output is visible.




*After you press the Start/Stop button in the Encoder Control section to begin 2-pass VBR encoding, first the system will roll through the entire desired segment to collect information, as shown by the* ***Collecting Statistics*** *message in the status field.*

Once the system completes this first pass, it will cue the tape back to the preroll point (typically, five seconds before the In point), then roll the tape once more.




*Once actual encoding begins, the status field will indicate* ***Capturing [File Name]****. At the same time, the Real-Time Previewer will launch and display the encoded video.*

This time, the system will begin actual encoding, the Real-Time Previewer will launch, and the decoded picture and sound will be fed monitoring system attached to the to the decoder card's respective outputs.

Once the second (capture) pass is complete, the system will halt and present a dialog to load the encoded video and audio files into the decoder, just as with CBR encoding.

## Reviewing a 2-Pass VBR Encoding

After encoding a segment in 2-Pass VBR mode, we recommend you review it carefully. Due to the nature of 2-Pass VBR encoding, it's possible for the encoded result to look quite acceptable in most of the stream, but to have problems in particular segments. Individual problem areas may be addressed by using your Spruce authoring software's segment re-encoding features, as detailed next.

## Segment Re-Encoding

Your Spruce authoring software includes a very useful feature known as "segment re-encoding." This is the capability to re-encode individual sections of video, with individually set bit-rates and parameters, without having to re-encode the entire asset from start to finish.

> *Segment-based re-encoding is not available in the standard version of DVDConductor and DVDVirtuoso. It may be added by installing the DVDEncodingPack upgrade.*

These re-encoded segments are then inserted seamlessly into the video track — making it possible to completely optimize the results of 2-Pass VBR encoding. Segment re-encoding is performed from within the Spruce authoring environment.

> *Note: To explain segment re-encoding, we'll be discussing DVD Movies and some related terms. If you need definitions for these terms, or need general information about working with DVD Movies, please refer to Chapter 6 of your User's Guide.*

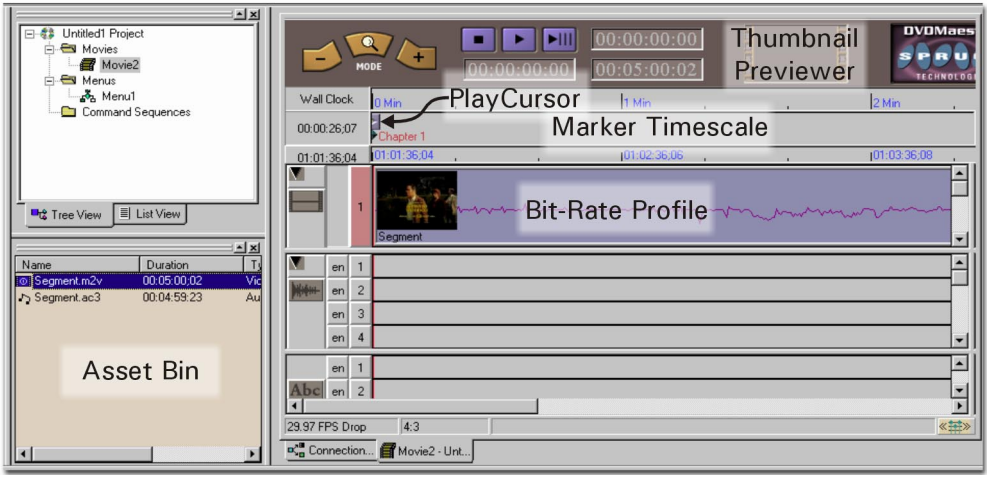
There are two reasons why you might use segment-based re-encoding of video:

- Specific sections of video need to be re-encoded with different parameters in order to optimize picture quality.

  – or –

- A portion of video content has changed and you would like to update it without re-encoding the entire piece.

First, we will need to load the encoded files into the DVD Movie, where we can isolate sections for re-encoding.




To load the encoded files into the DVD Movie:

1. Close the Encoding Control window, and load the encoded files into the Asset Bin, as described earlier in this Encoding Guide.
2. Open a DVD Movie by double-clicking on its icon in the Project Manager. If you wish, expand the DVD Movie window to fill the Workspace.
3. Place the encoded MPEG file into the video timeline by dragging it from the Asset Bin.

From within the Marker Timescale, you can drag the PlayCursor back and forth to identify the beginning and end of any sections that need to be re-encoded. (The Thumbnail Previewer will display a video image of the PlayCursor's current location.)

The video track for the desired video asset can show a continuous profile or "graph" of the bit-rate as defined and executed in 2-Pass VBR.

To display the bit-rate profile:

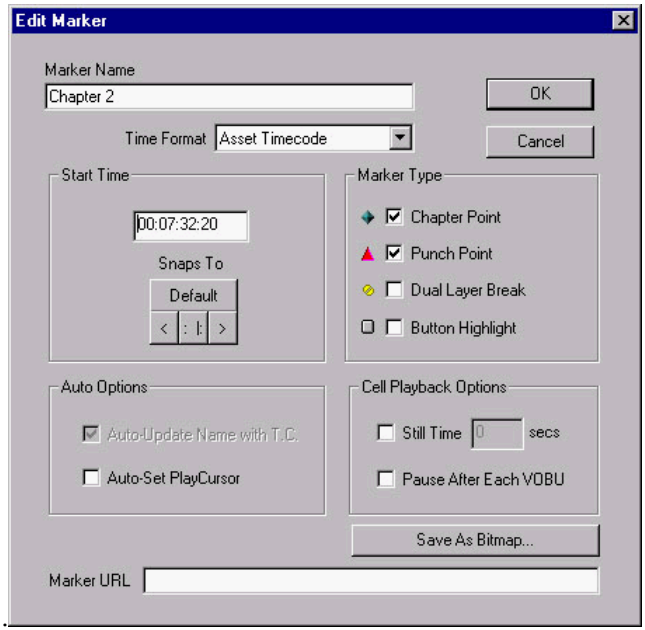
1. Open the authoring system's Program Preferences dialog by selecting ***File*** then ***Preferences*** from the Menu Bar.
2. Select the ***Movies*** tab.
3. Enable the ***Display Bit-Rate profile*** setting.

Once you have identified a section of the existing video asset that you wish to re-encode — either to optimize picture quality or to replace an asset that has been changed — the next step is to mark a "Punch-In" and a "Punch-Out." These two punch Markers represent, respectively, the "in-point" (for where the re-encoded segment will begin), and the "out-point" (for where re-encoded segment will end).

To mark a Punch-In and a Punch-Out:

1. Click in the Marker Timescale at the desired time for the Punch-In.
2. When the Edit Marker dialog opens, select the Marker Type to be ***Punch Point***. If you wish, you can also rename the Marker and adjust its location from within the Edit Marker dialog. When done, click ***OK***.

   *Note: There is no separate Marker Type choice for "Punch-In" or "Punch-Out"; all are considered punch point Markers. Whatever punch point Marker appears earliest (furthest left) in the Marker Timescale will be considered the Punch-In Marker; the punch point that appears next will be considered the Punch-Out Marker; to avoid confusion, you should never have more than two punch points in a movie at a time. A punch point marker can also be assigned any other duties (chapter point, button highlight etc.).*

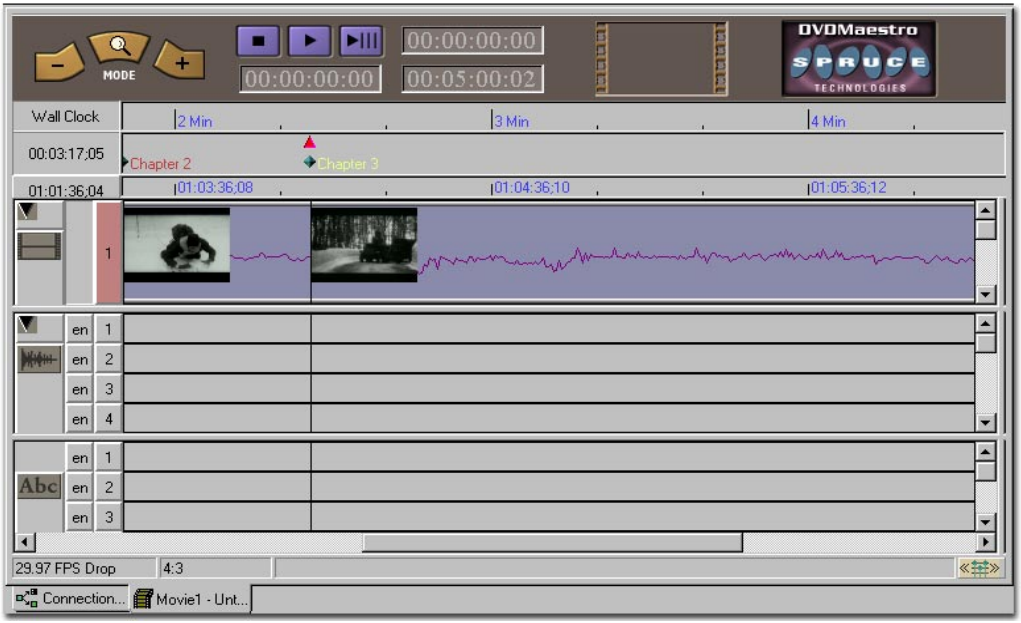



   *Place the Punch-In Marker by clicking in the Marker Timescale (above the Video Timeline). Check **Punch Point** then, if you wish, you can rename the Marker or adjust its location. When done, click **OK**. Repeat the same procedure to set the Punch-Out Marker.*

3. The Punch-in will appear in the Marker Timeline with a distinctive red "arrowhead."
4. If desired, you can "scrub" the Punch-In Marker to reposition its location; this is done by clicking once and holding its red arrowhead and then dragging it left

(earlier) or right (later) in the Marker Timescale. As you do this, the current starting frame will appear in the Thumbnail Previewer window.

5. Now you can mark the Punch-Out by clicking once more in the Marker Timescale. As before, select ***Punch Point*** in the Edit Marker dialog. As with the Punch-In Marker, you can also reposition the Punch-Out Marker by jogging it in the Marker Timescale



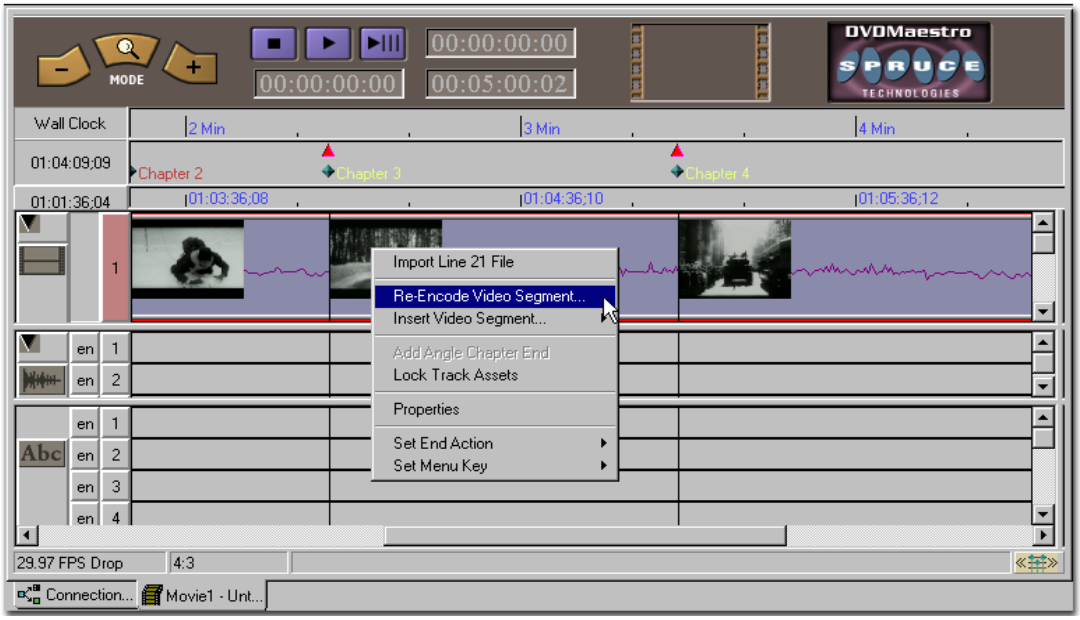

*Punch-In and Punch-Out Markers can be adjusted easily, just by dragging them as you would drag Chapter Point Markers.*

Once you've defined the Punch-In and Punch-Out, you're ready to perform segment re-encoding, to insert new video data between the two Markers.


*As you can see above, once the Punch-In and Punch-Out have been defined, you're ready to perform segment re-encoding for the portion of video between the two punch point Markers.*

To perform segment re-encoding between two punch points Markers:

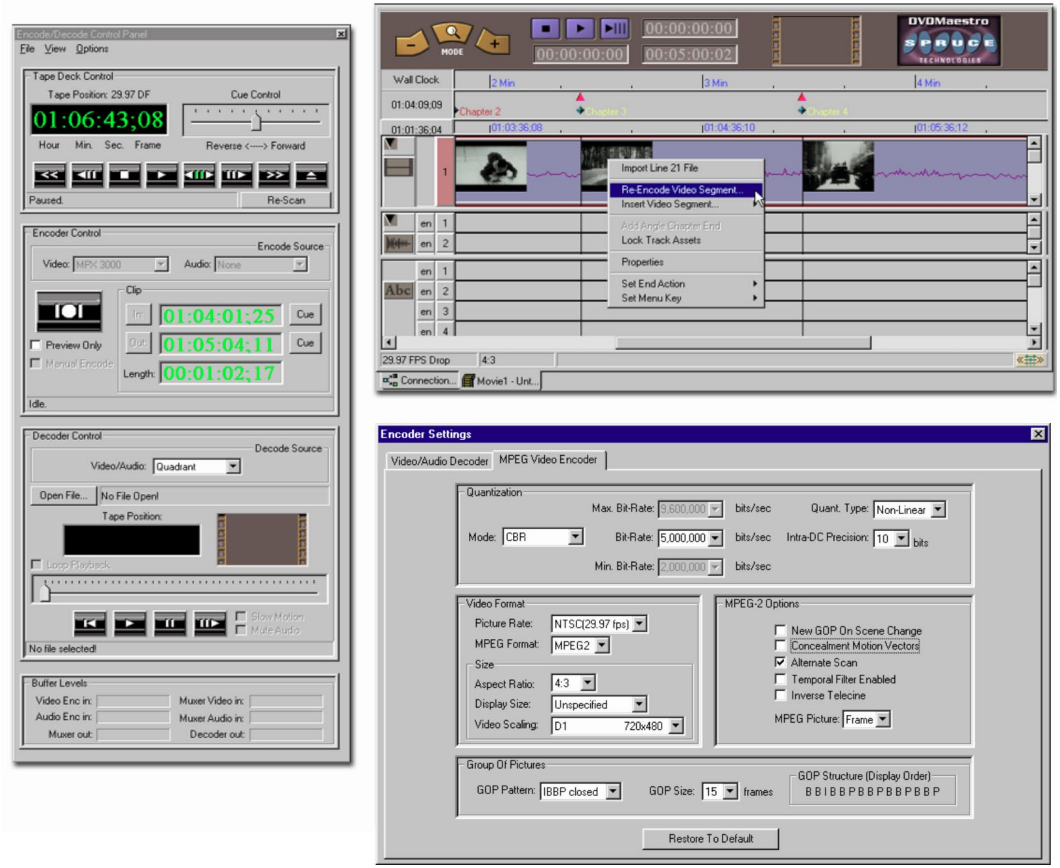
1. In the Video Timeline, right-click on the video asset you wish you re-encode.
2. When the pop-up context menu appears, select ***Re-Encode Video Segment***.




*To initiate the segment re-encoding process, right-click in the Video Timeline and select* ***Re-Encode Video Segment*** *from the pop-up context menu.*

The Encode/Decode Control Panel appears onscreen over the DVD Movie (and Spruce authoring software's other screens), the same as any other time it opens. You'll notice that the Clip In and Out times in the Encoder Control section of the Encode/Decode Control Panel correspond, respectively, to the locations of your Punch-In and Punch-Out Markers.

*Note: Encoding is set for **Video Only**, as audio is usually not re-encoded.*




*The Encode/Decode Control Panel, showing the Clip In and Out times corresponding to the Punch-In and Punch-Out times. This screenshot also shows the Encoder Settings window.*

3. The settings used to create the original encode have been restored within the MPEG Video Encoder window. An exception is if the ".enc" file is no longer with the video file – in that case the settings are not restored. Modify the parameters for re-encoding as needed.

*Note: It is not possible to adjust the encoder's in, out, or length fields. If these need to change, then you must exit the Encode/Decode Control Panel and modify the punch point locations.*

4. Once all settings have been modified, click ***Start*** to begin re-encoding. The ***Name Elementary Stream(s)*** dialog appears:


5. Click ***Save***.

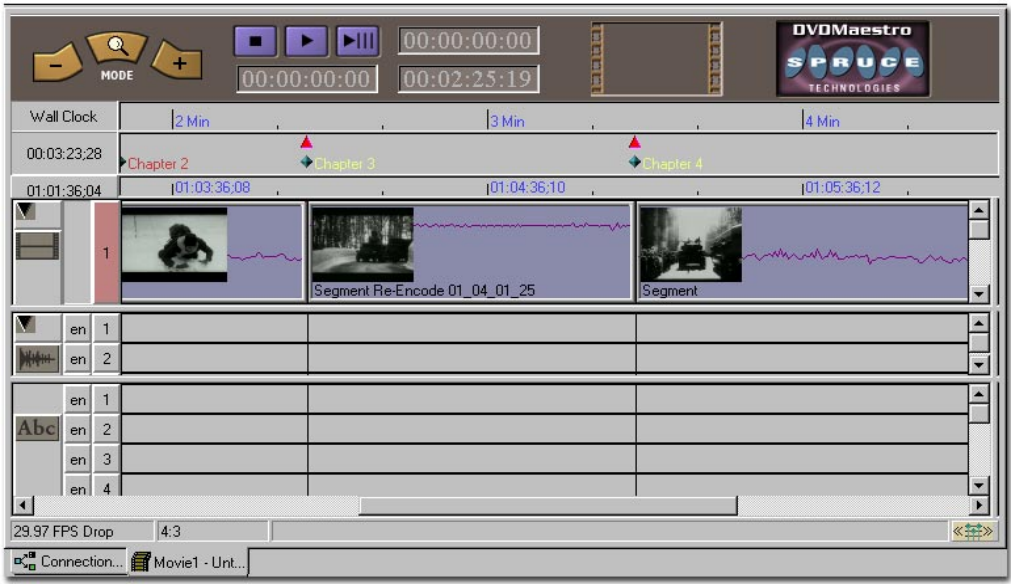
   *Note: As you'll see, DVDMaestro generates a name for the re-encoded segment file based on the name of the original file and its timecode point, numbering the files as subsequent re-encode operations are performed. If you do not wish to use the generated name, the dialog gives you the opportunity to assign a file name and directory path as desired.*

6. Next, just as with regular machine-controlled encoding, the encoder shuttles the source deck to start timecode location, drops it into play, and begins encoding from the exact point defined by the Punch-In. The encode continues until it reaches the Punch-Out time.

Upon reaching the Punch-Out time, the encoder halts encoding and prompts you to load the file into the Decoder Control section of the Encode/Decode Control Panel for review. There, you can view the re-encoded segment. If you are not satisfied, you can perform additional re-encode operations with different settings until you're satisfied with the segment's picture quality.

Once you've completed segment re-encoding (whether you do a single re-encode pass or many), you can close out the Encode/Decode Control Panel by clicking on the upper-right close box.

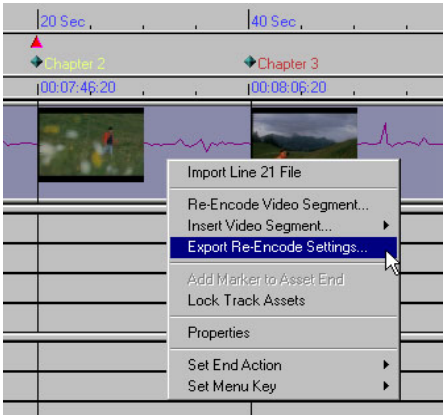
When the Encode/Decode Control Panel closes, the *last* segment that you re-encoded is automatically inserted into the video track, beginning and ending at your punch points. The new segment appears as a separate segment to indicate that it has been inserted into the stream.




*The re-encoded segment, shown inserted into the middle of video track 1.*

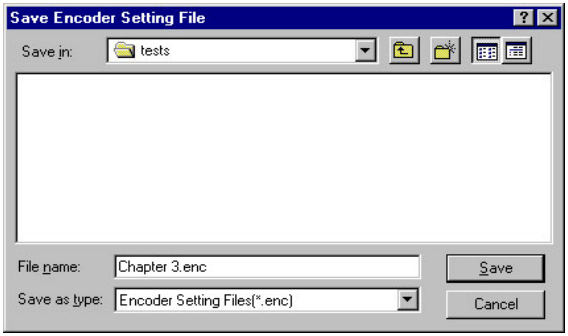
## Segment Re-Encoding on Networked Systems

For situations in which the authoring and encoding applications are run on different computers, there is a method of sharing encoding settings over network, allowing for segment re-encoding even when the encoding and authoring functions are separated.




To set up segment re-encoding for separate computers:

1. On the authoring system, select that area to be re-encoded by placing Punch Point markers as described previously.
2. Right-click on the video timeline between the two Punch Points. From the context menu, select ***Export Re-Encode Settings*** as shown above.
3. A File Save dialog will appear as shown below. Select the location at which you will store the file of encoder settings. This should be a directory that is accessible to the encoding systems.



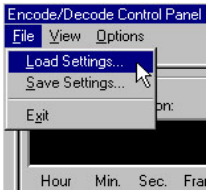

4. Assign a file name, and click ***Save***.

The Encoder Setting file can now be opened by the encoding system directly from its Encode/Decode Control Panel.

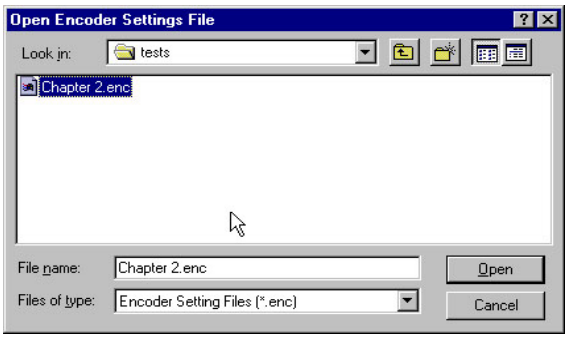
To re-encode the video segment:

1. Make sure that the correct source video tape is loaded and the source tape deck is under control of the encoding system.

2. Start the encoder software, go to the File menu on the Encode/Decode Control Panel. Select ***Load Settings***. (See below.)




3. In the Open Encoder Settings File dialog that appears, select the Encoder Settings file saved from the authoring system as shown below.




4. Select the desired file and click on ***Open***.

   The Punch-in and Punch-out points are loaded into the Encoder Control section. The settings used to create the original encode have been restored within the MPEG Video Encoder window. An exception is if the ".enc" file is no longer with the video file – in that case the settings are not restored. Modify the parameters for re-encoding as needed.

   *Note: It is possible to adjust the encoder's in, out, or length fields. Do not adjust these – they must be as originally loaded for a successful segment re-encode. If these need to change, then you must exit the Encode/Decode Control Panel, modify the punch point locations on the authoring system, and re-export them.*

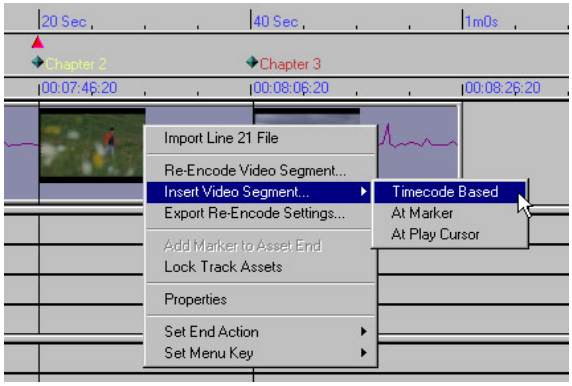
5. Modify the encoding Bit-Rate and Mode settings as desired for segment re-encode.

6. Perform the encode as normal. Encode the output file to a directory that is accessible to the authoring system or that can be moved to that system easily.

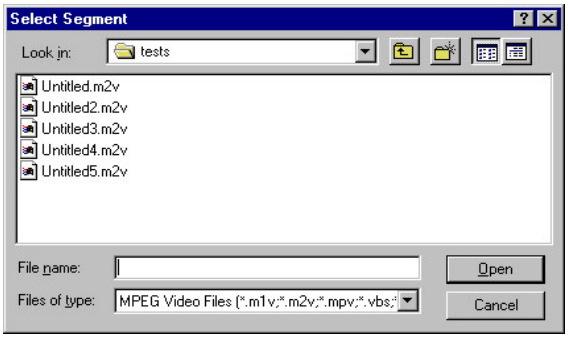
Once the re-encode is completed, it can be inserted directly into the original stream on the authoring station.

To insert re-encoded section into MPEG video stream:

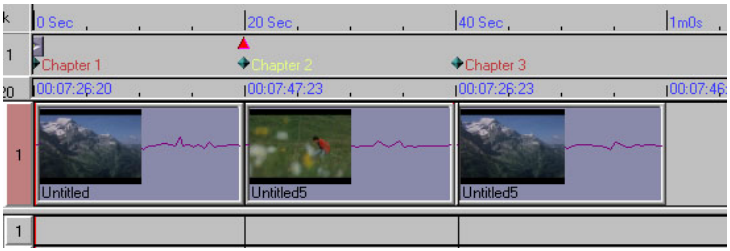
1. Mount the directory with the segment-re-encoded file onto the authoring station, or copy data onto a drive accessible to that system.
2. Right-click with the mouse on the video timeline which contains the original file.




3. Select ***Insert Video Segment***. From the submenu that appears, select the Timecode Based option. (See above.)



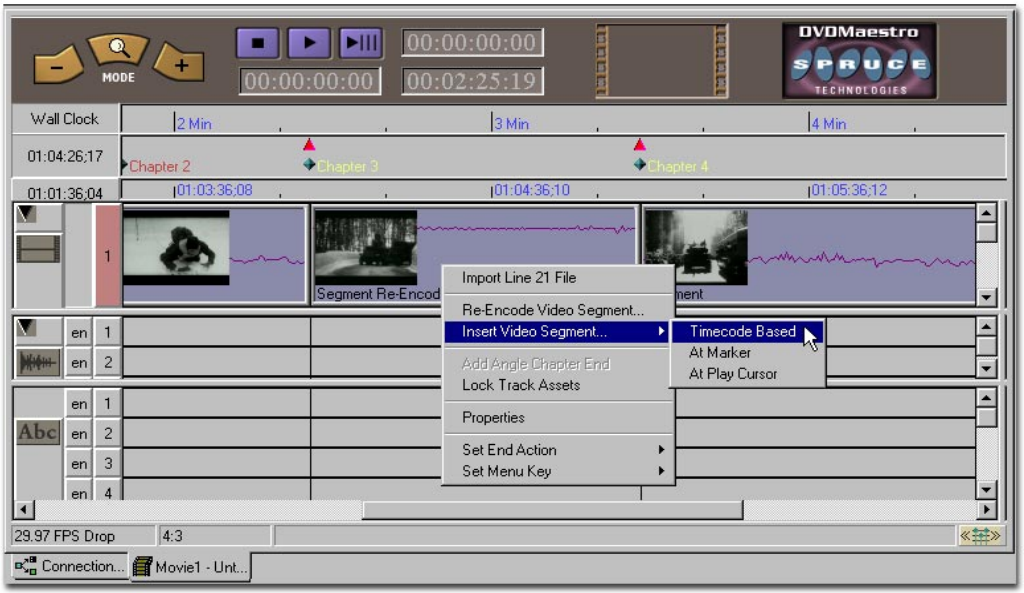

4. From the Select Segment dialog, as shown above, choose the file representing the re-encoded segment. Click on ***Open***.



The re-encoded segment will be dropped directly into place in the video timeline, and it will play back seamlessly in the RealView™ window and in the Navigation Simulator. Upon compile, the original and re-encoded segments will be combined in a single video object (".vob") file.

## Working with Multiple Versions of a Re-Encoded Segment

If you've created multiple versions of a re-encoded segment, the command ***Insert Video Segment*** — included in the same pop-up menu as ***Re-Encode Video Segment*** — can be used to choose which file you wish to insert. This way you can easily review various versions, all in context.



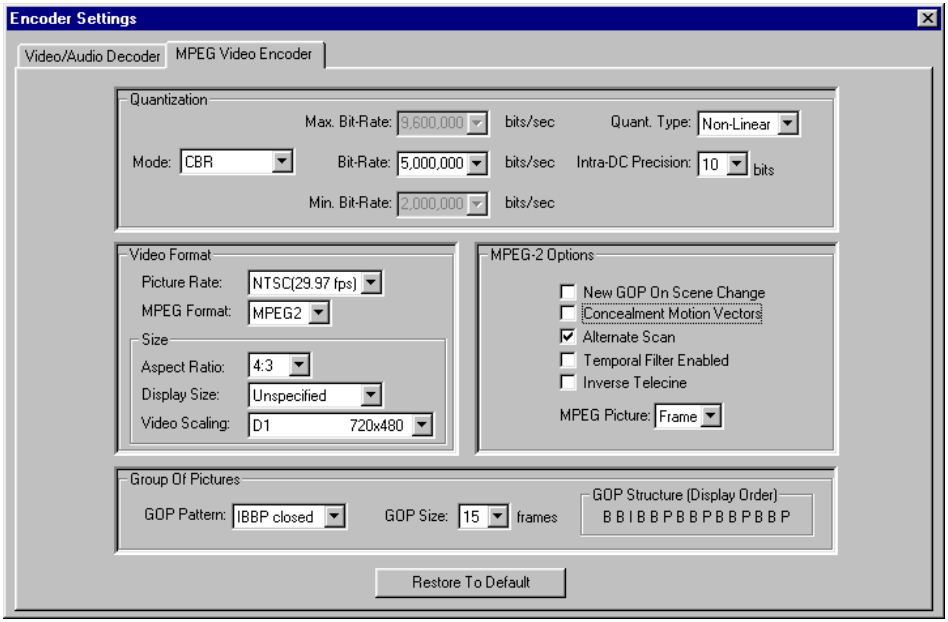

Note that when you use the ***Insert Video Segment*** command, the segment is placed according to the timecodes of the video in the segment, without regard to the placement of Punch-In and Punch-Out points. If you create a file with segment re-encode, and then move the punch points, the previously encoded file will always insert where the punch points were at the time it was encoded.

You can perform as many segment re-encodes as you wish, even within or overlaying a previously re-encoded segment. With the segment re-encode feature, a new dimension of power and flexibility has been added when encoding assets for use with Spruce authoring software.

## MPEG Encoding Parameters

The encoding mode and bit-rate are the two MPEG encoding parameters you'll be concerned with most often. These need to be tended to (even if you decide to leave them in their current setting) for every encoding job.

With the exception of Picture Rate (in the Video Format section, which needs to be set to follow the standard of the incoming video signal), the other options and parameters in the MPEG Video Encoder tab of the Encoder Setting window are typically used much less often.




*In the Encoder Settings Window, select the MPEG Video Encoder tab to set the encoding mode (CBR or VBR), the bit-rate, and other MPEG video parameters.*

This section will go through the settings and options to explain their operation, and to detail how they may be used in specific situations. In general, you'll find that most of these parameters may be left alone most of the time.

Press the ***Restore to Default*** button to reset all settings (with the exception of ***Picture Rate***, which stays as already set) on this dialog to factory defaults.

All of the MPEG encoding parameters are grouped in the MPEG Video Encoder tab of the Setting window. There are four major sections for this tab:

- The Quantization section

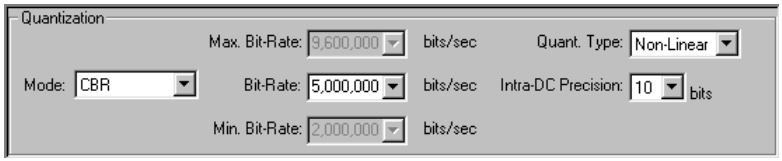
- The Video Format section
- The MPEG-2 Options section
- The Group of Pictures section

## Quantization (CBR or VBR Encoding) Section

As we covered previously in this chapter, the Quantization section is where you set the encoding mode — Constant Bit-Rate (CBR) or Variable Bit-Rate (VBR) — and the actual bit-rate settings (in terms of bits per second).

There are also three optional parameters:

- Quantization Type (Non-Linear or Linear) and Scale;
- Intra DC Precision (8, 9, or 10).




*Encoding mode and bit-rate are all-important parameters for DVD. Other MPEG quantization parameters are available for advanced applications.*

As we'll detail, only in rare circumstances would you change the default values of these parameters.

### Mode

Select either ***CBR*** (Constant Bit-Rate), ***1 Pass VBR*** (Variable Bit-Rate), or ***2 Pass VBR*** as the encoding mode. The differences are covered previously in this manual.

### Bit-Rate

The ***Bit-Rate*** settings range from 1,000,000 to 9,600,000 when MPEG-2 is selected as the MPEG Format, and from 1,000,000 to 5,000,000 when MPEG-1 is selected. The science behind choosing the actual rate to use is covered earlier in this manual.

*Note: The DVD specification allows a maximum MPEG-1 bit-rate of 1,856,000.*

### Max. Bit-Rate

This setting applies only when the Mode is set to 1 or 2 Pass VBR. This value must be greater than the Bit-Rate setting (when active). See the discussion on 2 Pass VBR earlier in this manual.

### Min. Bit-Rate

This setting applies only when the Mode is set to 2 Pass VBR. This value must be less than the Bit-Rate setting (when active). See the discussion on 2 Pass VBR earlier in this manual.

### Quantization Type (Quant Type)

There are two types of quantization available in MPEG-2 video encoding: linear and non-linear (which is the default). MPEG-1 uses linear quantization only. MPEG-2 has both types of quantization available — though non-linear is used almost exclusively, as it provides greater dynamic range.

> *Note: When MPEG-2 was defined, the non-linear quantization scale was introduced as an across-the-board improvement on the previously used linear scale. The option of linear scale in MPEG-2 was defined only to accommodate full backward-compatibility with MPEG-1. There are no conditions known under which a linear quantization type would be preferable to Non-Linear type in MPEG-2.*

For MPEG-2, we recommend you always select ***Non-Linear***. For MPEG-1, ***Linear*** is the only option available.

### Intra-DC Precision

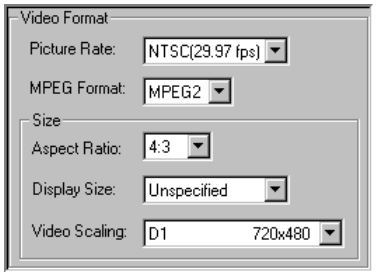
This parameter controls the precision that is applied to relatively non-changing (static) portions of the picture. The legal values for DVD-Video purposes are 8, 9, and 10 bits. In most cases, the default value of 10 is suitable. In material without subtly-shaded coloration, settings of 8 or 9 bits may make it possible to use somewhat lower bit-rate settings without introducing artifacts.

In most circumstances, we recommend using only the default setting for Intra-DC Precision.

> *Note: For very high-motion material, you might experiment with a setting of 8 bits, although it's unlikely you'll perceive any difference in encoding quality.*

## Video Format Section

The video format settings include Picture Rate, Aspect Ratio, Chroma Format, and MPEG Format. These are general settings that will most often be defined by the type of video source and the target application.




*The Video Format section of the MPEG Encoder Settings tab sets the basic functions of frame rate, aspect ratio, video scaling, and MPEG format.*

### Picture Rate

Picture rate settings are available for NTSC (29.97 fps) and PAL (25 fps). Take care that this is set appropriately for the encoding source.

*Note: When authoring, it's necessary to match the PAL/NTSC setting of the Project Properties with the actual format of video used. This setting should be set prior to importing assets.*

### MPEG Format

The two available MPEG Format settings are MPEG-2 and MPEG-1. Encoding for DVD is nearly always done using MPEG-2, as the visual quality is far superior to MPEG-1. Lower-rate MPEG-1 may be useful in instances where very long playback time is required, or when the delivery medium is to be something other that DVD, for example a DVDonCD title.

### Aspect Ratio

Aspect Ratio settings are available for 4:3 (conventional TV) or 16:9 (Widescreen). When 16:9 is selected, the source video to be encoded must already be anamorphic (16:9 squeezed into a 4:3 aspect – everything looks skinny). This sets a flag that triggers the end-user's DVD player to expand the picture back to 16:9 – how it actually displays depends on what it is being viewed on (16:9 or 4:3 display) and, with a 4:3 display, whether letterbox or pan and scan are selected.

*Note: Do not use the 16:9 setting when encoding source video that is already in a letterbox format – this setting is only for use with anamorphic video.*

### Display Size

The Display Size allows you to force the display to be ***720 Horizontal***, ***540 Horizontal***, or the default of ***Unspecified***. This setting determines what is put into the Sequence Display Extension of the MPEG header information.

- **Unspecified** – Leaves the Sequence Display Extension out of the MPEG header information. This is the default and recommended setting.
- **540 Horizontal** – Specifies 540 as the Display Size in the Sequence Display Extension of the MPEG header information. Use this setting with 16x9 Pan-Scan material.
- **720 Horizontal** – Specifies 720 as the Display Size in the Sequence Display Extension of the MPEG header information. Spruce is not aware of any current reason to specify this size – it is included to allow flexibility for the future.

Setting this mode in no way affects the way a title should be authored. The aspect ration within the timeline and the menu editor should be set appropriately for the desired aspect ratio.

### Video Scaling – MPEG-2

The Video Scaling setting determines the size of the frame created by the encodes. The settings are:

- ***D1*** (default) 720x480 (NTSC), 720x576 (PAL)
- ***1/2D1*** 352x480 (NTSC), 352x576 (PAL)
- ***D1 Cropped*** 704x480 (NTSC, 704x576 (PAL)

The ***D1*** setting is the default, producing the highest resolution allowed.

The ***1/2D1*** setting can be a useful alternative to MPEG-1 when you must reduce the file size, but still want MPEG-2 encoding quality. This setting samples every-other horizontal pixel, reducing the horizontal resolution by half. Since there are fewer samples, using a lower bit-rate (3Mbps for example) results in better results than at full D1. The trade-off is a loss of horizontal resolution.

The ***D1 Cropped*** setting can be useful when the video to be encoded has horizontal blanking edges (black lines on each side of the frame) that you would like to have cropped off.

> *Note: In both the **1/2D1** and **D1 Cropped** settings, the video is expanded during playback to full screen.*

Two additional modes are added if you have unselected the Option pull-down's ***DVD Compliant Only*** setting:

- ***2/3D1*** 480x480 (NTSC), 480x576 (PAL)
- ***Square Pixel*** 640x480 (NTSC only)

These are not supported by the DVD specification.

### Video Scaling – MPEG-1

If you set the MPEG Format to ***MPEG-1***, there is only one choice here:

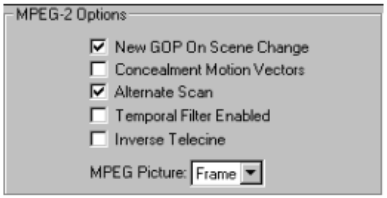
- ***SIF 352x240*** 352x240(NTSC), 352x288 (PAL)

One additional mode is added if you have disabled the Option pull-down's ***DVD Compliant Only*** setting:

- ***Square Pixel*** 320x240 (NTSC only)

## MPEG-2 Options Section

The MPEG Specification provides a number of settings that, in most situations, may have only a marginal impact on picture quality. We recommend you use the default settings for most of these parameters.




*The MPEG Options section includes several miscellaneous parameters.*

### New GOP On Scene Change

With this feature selected, the system will automatically insert an I-frame and start a new GOP (Group of Pictures) whenever an abrupt change is detected in video.

In most usage, this parameter will result in better encoding quality, and will provide better control over chapter start points. When encoding for purposes that require careful control and matching of GOP structure (such as multi-angle video), however, use of this feature will be counterproductive. In these instances, you should switch this parameter ***Off***.

### Concealment Motion Vectors

Concealment motion vectors are redundant information that can be optionally included in the MPEG stream to aid error recovery in non-DVD applications. Their use in DVD is not recommended, as they do not provide any real benefit while consuming a small amount of bandwidth otherwise available for picture data.

### Alternate Scan

For the pattern of picture block-scanning, you can select ***Alternate*** (default) or ***Zig-Zag*** (when ***Alternate*** is not checked). Alternate Scan is a more irregular pattern that is optimized for interlaced video. The use of ***Alternate*** scan is recommended except in the less-likely case of encoding progressive-scan video. ***Zig-Zag*** scan is considered the appropriate choice for progressive-scan pictures.

> *Note: Increasingly, digital video cameras are offering a progressive scan option, which is generally of most benefit for still rather than moving images. However, since many of us are likely to be seeing more progressively scanned source material, if the source (master) video recording was digital, it may be a good idea to ascertain whether the it was captured as interlaced or progressively scanned.*

### Inverse Telecine

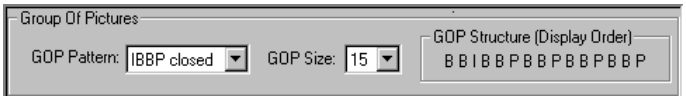
As detailed later in this manual, the ***Inverse Telecine*** checkbox should be selected whenever you encode material that was shot on 24 fps film and transferred to NTSC (29.97 fps) video. The Inverse Telecine function removes redundant information that's inserted during the process of converting from the film frame rate of 24 fps to interleaved video at 29.97. This redundant information reduces encoding efficiency; consequently its removal results in better overall performance.

### MPEG Picture

The MPEG Picture setting is forced to the Frame setting only.

## Group of Pictures Section

MPEG-2 video is encoded as different frame types. This is done in order to exploit both temporal (time) and spatial (2-dimensional) redundancy, which results in greater encoding efficiency. In this section, you can define the pattern and size of the GOPs.




*The Group of Pictures section governs the sequence of frame types used for encoding.*

### GOP Pattern

The GOP Pattern parameter lets you select the pattern, or sequence, in which the three frame types (I, B, and P) will be repeated. Available GOP patterns include IP, as well as patterns that include all three frame types. Both Open and Closed types are available as well. In general, encoding for DVD-Video should be performed using a closed GOP type, as this allows the best random entry into the stream for jumps, fast forward, and so forth.

The following MPEG GOP structures are supported: IBBP closed, IBBP open, IBP closed, IBP open, IBB, IB, and IP. For most DVD purposes, GOP structures of IBBP closed or IBP closed at sizes of 12 to 16 frames are recommended. Smaller GOP structures such as IP, IB, or IBB are very inefficient at bit rates compatible with DVD, and are recommended only in exceptional circumstances and then only for short sequences. I-frame only encoding is not supported, as this mode is not suitable for use at DVD bit rates.

### GOP Size

The GOP size can be varied according to the GOP patterns selected. Usually, larger GOP sizes result in better encoding performance.

For most material, longer GOP Patterns and GOP size will provide the most efficient coding. Particular sequences of material that change continuously — such as a fade-from-black — may benefit from encoding with smaller GOP Patterns and Sizes.

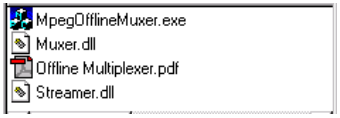
## Encoding and Multiplexing for Video CD

By encoding MPEG-1 video with MPEG-1 Layer 2 audio at a sample rate of 44.1 kHz, all requirements are met for encoding for Video CD (VCD).

> *Note: Typically the MPEG-1 video bit-rate is around 1,500,000. See your Video CD authoring tool's documentation for details.*

Unlike DVD, VCD authoring is customarily performed using MPEG-1 system streams that have been previously multiplexed. Most Video CD authoring tools do not support authoring with elementary streams.

In order to support use of Spruce encoding systems in Video CD authoring, a separate utility program is provided that can quickly multiplex MPEG-1 elementary streams for video and audio.

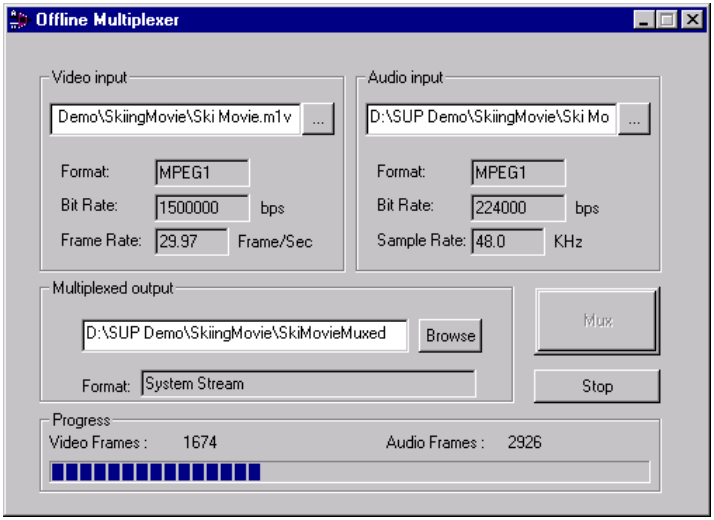



*The files that make up Spruce's MPEG Offline Multiplexer.*

> *Note: The following is an overview of how to use the MPEG Offline Multiplexer. See the Offline Multiplexer document (in PDF format, as shown above) for detailed instructions.*

To multiplex video and audio for Video CD:

1. Locate the Offline Multiplexer application (which should look like the screen above). This program is found in a separate directory under the Utilities folder in the Spruce folder created when the software is installed.



2. To start the program, double-click on ***MpegOfflineMuxer.exe***.

   The Offline Muxing application displays an interface dialog with spaces to define the video and audio source files as well as the output file as shown above.

3. Type in the path of the video source file or click to the right of the Video File field to browse.

4. Repeat for the audio source file.

   An output file is automatically designated that has the root name of the video file with the extension ".mpg". If desired, you may designate another name and path for the output file.

5. Click on the ***Mux*** button to initiate MPEG multiplexing.

The Progress meter at bottom of the dialog indicates the progress of multiplexing. Upon completion, the resulting output file may be input into standard Video CD authoring tools.

## NTSC Film Mode (Inverse Telecine)

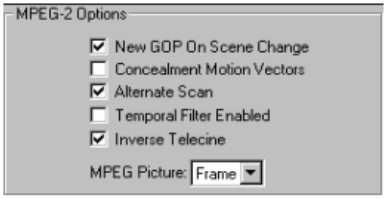
When material is transferred from film (with a frame rate of 24 frames per second), to NTSC video (with a frame rate of 29.97 frames per second), the differing frame rates are resolved by converting each frame for film into two (redundant) video fields, then repeating some of the fields in a defined pattern known as the "cadence." The whole process is generally known by the term "3:2 pulldown."

*The Inverse Telecine feature is not available in the standard version of DVDConductor or DVDVirtuoso. It may be added by installing the DVDEncodingPack upgrade.*

In MPEG encoding, these redundant video fields present two problems:

- The repeated fields represent redundant information to encode, reducing encoding efficiency by 20%.
- The video frames that include fields from two different film frames will show "frame-jitter" when using the Single-Step button to view frames one at a time.

During encoding, both of these problems can be addressed by using the Inverse Telecine option in the MPEG-2 Options section of the MPEG Video Encoder tab of the Settings window.




*The Inverse Telecine option can be found in the MPEG-2 Options section of the MPEG Video Encoder tab of the Settings window.*

When the Inverse Telecine option is selected, the encoding process will automatically attempt to detect the redundant fields inserted during the film-to-video transfer process. During encoding, your Spruce authoring software will then skip over these frames; after all, there's no need to re-encode material that has already been encoded.

In place of the repeated field, the encoding process inserts a flag that indicates that one of the fields should be repeated. Indeed, during playback of the MPEG stream or finished DVD disc, the decoder system reads these flags and automatically repeats the needed field(s) — in effect, performing the film-to-video transfer process on the fly. The result is substantially more efficient encoding (a better picture for the given bit-rate), and freedom from frame jitter.

To execute encoding with Inverse Telecine, simply select in the Inverse Telecine checkbox in MPEG-2 Options before you begin the encoding process.

## Limitations of Inverse Telecine

The process of accurately detecting the repeated fields is complex and sensitive, and there are many situations in which the correct "cadence" may not be detected properly, including:

- When material is shot on film, but edited on video, the cadence from the film-to-video transfer is modified from the original. This will usually cause the Inverse Telecine to lose the cadence at least temporarily.
- If the material is extensively edited in video (such as many TV commercial spots, which often are shot on film and subjected to fast-cut editing), Inverse Telecine may have no chance of ever correctly detecting the cadence of repeated frames.
- When using Inverse Telecine in 2-Pass VBR encoding (these two often go together because 2-Pass VBR tends to provide the most benefit in use on long-form feature films), the Inverse Telecine process may not detect frames in the same way between the first and second pass. This can create major problems, as it may cause alignment of a low bit-rate setting with a hard-to-encode section of video. This problem principally occurs when using an analog video source, as this format is subject to noise that varies from play to play. When using digital video sources, this type of error is less likely to occur.
- When video includes slow-moving material, the Inverse Telecine process may have difficulty in distinguishing the correct fields to repeat, since it depends on a threshold of difference between fields to make the correct decision.

## Controlling the Length When Using 2-Pass VBR

The use of Inverse Telecine for transfer from film-originated video at 29.97 fps implies conformance between the MPEG GOP structure and 3:2 pull-down cadence. This means that frequently the defined length of video cannot be correctly processed at a defined GOP structure. This situation may be handled in one of two ways.

One method is to extend the length by one or two frames, allowing for accurate inverse telecine but at the expense of a precise length. The other method is to allow an inverse telecine error in the final encoded GOP where a different GOP structure can be selected, resulting in a precise length. Currently this is how it is being handled in the encoder.

## Reviewing Inverse Telecine

Once you've encoded with Inverse Telecine, you can check the results by using the Single-Step button in the Decoder Control section. When the telecine cadence is properly detected, all still frames will be perfect, without field jitter. If you encounter an error in field detection, it will show as one of more frames whose still image is not stable. Depending on the picture, the field jitter may be very pronounced.


*In the left-hand frame, the telecine cadence has been properly detected; in the right-hand frame, the blurred image shows field jitter, which strongly suggests an error in detection. If the errors are minor and infrequent, or difficult to notice in normal full-speed (1x) playback, they may nonetheless be acceptable.*

Using segment re-encoding, you may be able to correct some or all of the Inverse Telecine errors that occur in a program. However, depending on the material and situation, you may find that the prevalence of cadence errors is such that encoding *without* Inverse Telecine may actually give a better result. Also, identification and correction of Inverse Telecine errors in a long program can be quite time consuming, and you may have to judge whether the situation warrants the investment of time involved.

## Forced I-Frames

In MPEG encoding, the ongoing sequence of video frames is divided into units known as Groups of Pictures, or "GOPs." The MPEG encoding algorithm searches within the GOP to do reduce data rate by eliminating redundancies from one frame to the next. This is part of the reason that MPEG encoding can yield very high compression ratios while keeping a very good-looking picture.

> *I-Frame forcing is not available in the standard version of DVDConductor or DVDVirtuoso. It may be added by installing the DVDEncoderPack upgrade.*

Each GOP is made up of three types of frames:

- The I-Frame (Intra Frame)
- The P-Frame (Predictive Frame)
- The B-Frame (Bidirectional Frame)

The I-Frame is formed by coding entirely within the current frame (assuming the GOP structure is "closed", which we'll describe later), without reference to frames that precede or follow it. P-Frames are encoded from a "predicted" picture based on preceding frames, and B-Frames are encoded based on an interpolation from other frames that come before and after. The I-Frame, therefore is the only type of frame that can stand by itself, without requiring information from other frames in the GOP. Every GOP contains an I-Frame.

Because the I-Frames have this "stand-alone" capability, chapter start points in a DVD Movie can be entered only where an I-Frame is found. Otherwise, the picture could not be reproduced when the chapter start point is accessed at random. Likewise, MPEG editing functions such as trim and concatenation can be done only at the point that an I-Frame occurs at the beginning of a GOP.

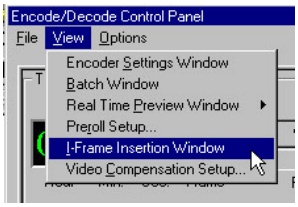
In MPEG encoding for DVD, GOP boundaries occur about every half-second (it varies, but overall it's around this figure). That means that when you create Chapter Point Markers (which define chapter start points), they may have to be adjusted forward or backward to fall on an I-Frame. In many instances, this is not a problem. However, if you wish to place a Chapter Point Marker at a specific frame, you may need to "force" the occurrence of an I-frame at that location. And to do this, the encoding section of your Spruce DVD authoring system gives you the capability of defining a list of timecode locations where I-Frames will be forced to occur prior to starting encoding.

> *Note: I-Frame Insertion is not available when using the Manual Encode mode, as there is no way to reference a specific location.*

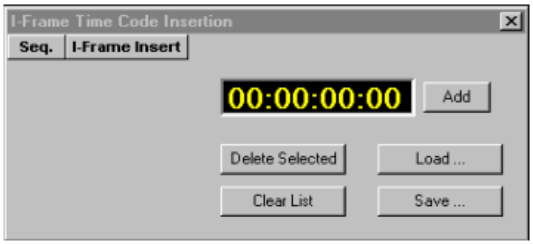
When using encoding with serial machine control, you may access the I-Frame Force list from the View menu. During encoding, every timecode location in this list will be converted to a forced I-Frame, and may be used as a Chapter Point Marker in authoring.

To set up the I-Frame Insertion list:

1. From the View pull-down menu, select ***I-Frame Insertion Window*** (keyboard shortcut: ***Alt - V - I***).

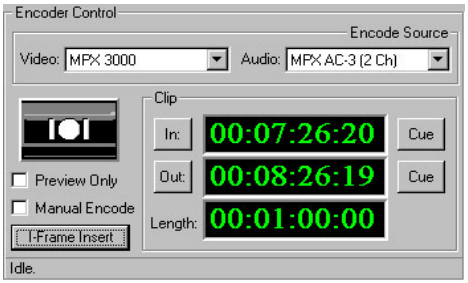



2. The I-Frame Time Code Insertion window, as shown below, will open.




In this window, you can define timecode locations that will be used to force I-frames in the encoded video.

I-frame force points can be added by cueing the source deck and clicking on the I-Frame Insert button in the Encode/Decode Control Panel. By typing time code values into the I-Frame Time Code Insertion dialog or by importing a formatted text list of time code values, this can be accomplished.



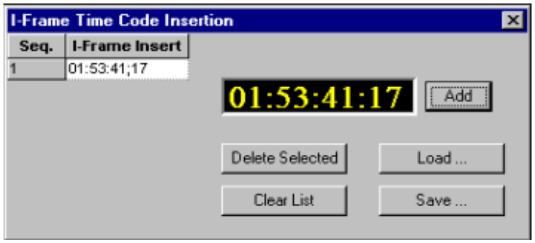
To enter an I-Frame Insertion point:

1. Cue the source deck to a point at which you wish to insert an I-Frame.
2. Click on the I-Frame Insert button in the Encoder Control section on the Encode/Decode Control Panel as shown above.

   The time code of the current position of the source tape deck will appear in the lefthand section of the I-Frame Time Code Insertion dialog. If the dialog is not already open, it will appear onscreen when the I-Frame insert button is pressed.

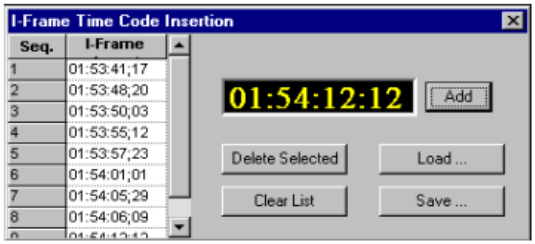
   —or—

1. Open the I-Frame Time Code Insertion dialog.
2. Click on the main timecode field.
3. Type in a time code that occurs in your source program at the point which you want to force an I-Frame.
4. Click on the ***Add*** button to the right of the time code field.




5. The entered timecode will appear in a list field to the left of the timecode field.

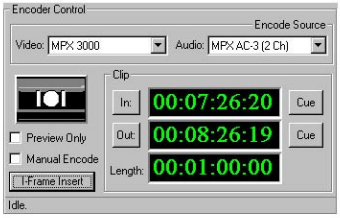
To define the complete list of I-Frame force points, repeat the process from step 1.

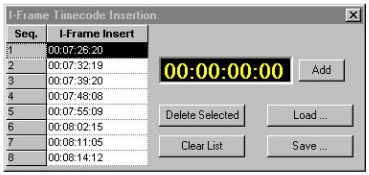


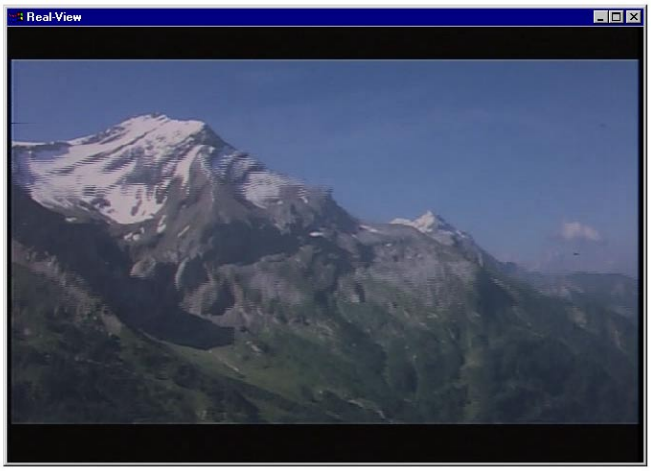

*As you define multiple I-Frame force points, they'll appear within a list in the I-Frame Time Code Insertion window.*

## Encoding with Forced I-Frames

Once a set of time code values have been entered into the I-Frame Time Code Insertion dialog (see above), these values will be used for insertion during the encode. All that needs to be done, then, is to execute a normal encode with machine control, with valid time code values entered in the I-Frame Time Code Insertion dialog.



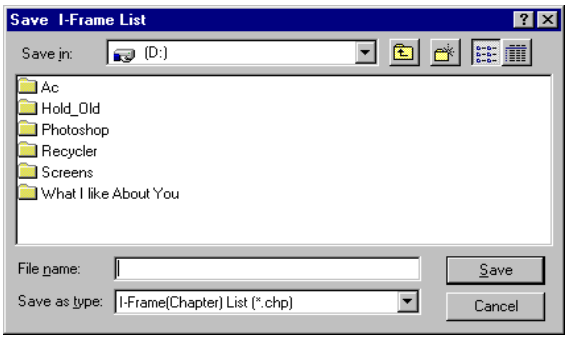




*Note: The I-Frame Insertion process is inherently limited to an accuracy of 2 frames, owing to the nature of MPEG P- and B- frames. In reviewing MPEG with forced I-frames, you will find that some frames are forced 1 or 2 frames later than the values specified.*

## Saving & Recalling I-Frame Insertion/Chapter Point Lists

The I-Frame Insertion lists you create in the I-Frame Time Code Insertion window can be saved and reopened at a later time. These I-Frame Insertion Lists can also be used later in the authoring process to place Chapter Point Markers at the same locations. This can save a considerable amount of time when defining chapter start points in a large Project. The use of Insert Lists as Chapter Lists is covered in Chapter 6 of the User's Guide.




*Saving the I-Frame Insertion list, which can also be used later in the authoring process to place Chapter Point Markers.*

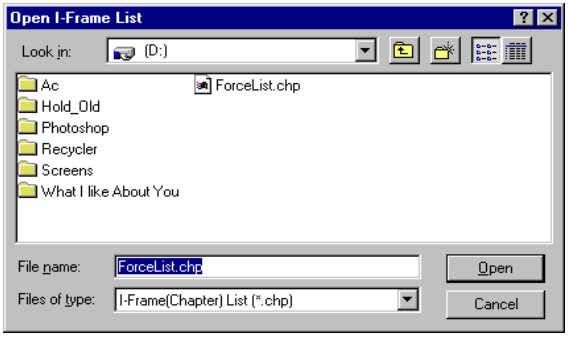
To save the current I-Frame Insertion List to your system's hard disk:

1. Click on the ***Save*** button in the I-Frame Timecode Insertion window.
2. In the File Save dialog that appears, select the location and enter the name under which you want to save the list file.
3. Click ***OK*** to save the file.

The I-Frame Insertion List is saved as a text-format file with the extension ".chp". Likewise, you can open any I-Frame Insertion List previously saved to disk.

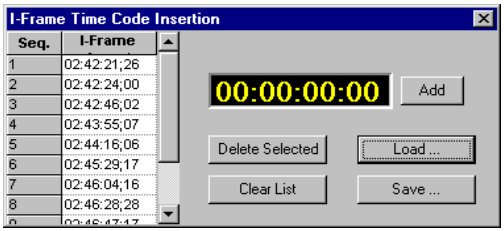
To open a previously saved I-Frame Insertion List:

1. Click on the ***Open*** button in the I-Frame Timecode Insertion window.
2. In the Open Field dialog that appears, locate and select the I-Frame Insertion List file you wish to open.
3. Click ***OK***.



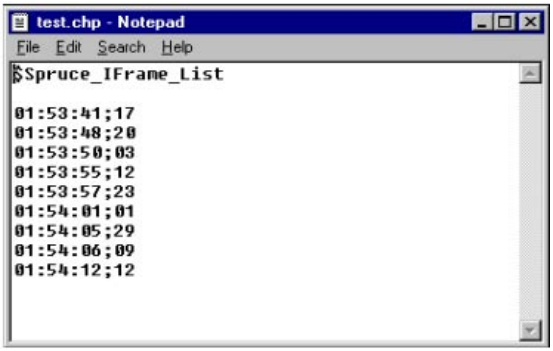

*Opening an I-Frame Insertion list.*

The selected list will appear in the I-Frame Timecode Insertion window, as shown below:




## Creating & Modifying the I-Frame Insertion List in Text Format

As noted above, the I-Frame Insertion Lists are actually text documents. This means that they can be edited (or created) using any standard word processing program, including the simple Notepad application delivered as part of the Windows NT operating system.




*An I-Frame Insertion list, shown from within Windows NT's Notepad application.*

To view the I-Frame Insertion List in a text editing program:

1. Start up the text editing program you prefer to use (Notepad will work fine).
2. Select ***Open*** from the program's File menu.
3. In the File Open dialog, set the "filter" at bottom of the dialog to ***All Files***.
4. Locate the ".chp" file for the I-Frame Insertion List you wish to open.
5. Click ***OK***.

The full list appears in your text editor's window.

As you can see, the I-Frame Insertion List is a simple list of timecodes that begins with the following characters and words:

"$Spruce_Iframe_List"

This is the file's "header string," and is necessary in order for your Spruce authoring software to recognize the list. So long as this string is included, it is quite easy to create I-Frame Insertion Lists from scratch, or to modify any existing list.

To modify an existing I-Frame Insertion List in a text editing program:

1. Open the list into your word processor, as described above.
2. Make whatever additions, deletions, or modifications to the timecode values you desire.
3. Re-save the list in "text" format under the same or different name. If you use a different name, be sure to use the extension ".chp".

To create a new I-Frame Insertion List from scratch:

1. Create a new document in your text processing application
2. At the head of the document, enter the string "$Spruce_Iframe_List" (be sure to use these exact characters and capitalization).
3. Enter timecode values (hours:minutes:seconds:frames), in the same format as they appear when you view an existing I-Frame Insertion List. Each entry must appear on a separate line.
4. Save the document in "text" format; be sure to enter the extension ".chp".

Any file created in this way can be opened as an I-Frame Insertion List or as a Chapter List in your Spruce authoring system.

## EDLs as I-Frame Insertion Lists

Conventional video editing systems are able to store lists of timecode locations as “Edit Decision Lists” (EDLs). These are text documents that can describe a wide variety of editing operations. These lists can be easily converted into a form that can be imported into the Spruce authoring system.

To convert an EDL file into an I-Frame Insertion List:

1. Open the file containing the timecode points you want to use into a text editing program.
2. Strip out all information except the actual timecode values you want to use as I-Frame/Chapter points. For instance, you may wish to use a series of “timecode in” points (the point at which a video edit occurs) to establish your Project’s forced I-Frames. Make sure each of these values appear on a separate line of text.
3. Insert the string “$Spruce_Iframe_List” at the head of the document.
4. Save the modified file in text format; be sure to enter the extension “.chp”.

This modified EDL can then be imported into the Spruce authoring system as a Chapter List or an I-Frame Insertion List.

## Special Considerations for Encoding Multi-Angle Video

When encoding material for use in multi-angle video segments (multiple video tracks) of a DVD Movie, there are certain considerations that should be observed.

- All video assets must be encoded using a closed GOP Pattern.
- All video assets must have the same GOP structure throughout.
- The combined bit-rate *of the highest bit-rate video asset,* all audio assets, and the subtitles cannot exceed 8 Mbps (8,000,000 bps).

### Closed GOP Pattern

To ensure compliance with the first point, select either ***IBBP Closed*** or ***IBP Closed*** as the GOP Pattern setting.

> *Note: Actually, these are the recommended settings for all applications, but for multi-angle work it is particularly critical.*

### Congruent GOP Structure

To ensure compliance with the second point (same GOP structure), observe the following considerations:

- Encode all segments with the same setting of the GOP Structure and GOP Size parameters.
- Switch the ***New GOP on Scene Change*** parameter ***Off***, as it will modify the GOP structures in an uncontrollable fashion.
- Switch the ***Inverse Telecine*** mode ***Off***
- If you are encoding shorter sections to be placed as multi-angle within limited areas of a longer main video, be careful to select a GOP size that can be rendered evenly with the length of the multi-angle section.

This last consideration can be difficult to understand and implement.

#### Selecting the Best GOP Size

When a multi-angle section occurs in the middle of a longer, single-angle program, selecting the most appropriate GOP size can be a challenge. Suppose we have a 30-minute video program, in the middle of which we want to have a section of exactly 5 minutes in length that has several optional camera angles available. After encoding the main video, we then set up to encode exactly 5 minutes, using the default GOP size of 15 frames.

Provided that 29.97 fps timecode is used, this will work out fine, since 15 frames will equal exactly 1/2-second (actually 0.1% more, but not worth going into here). As long as the multi-angle section is an equal number of seconds in length, it will be fine.

On the other hand, if the multi-angle section is defined to be 5 minutes 2 seconds and 4 frames, then we either have to modify the length to an even number of seconds, or find a GOP size that will work out to be an even division of the total length.

In non-drop frame timecode, 05:02:04 works out to be 9064 frames (30 frames to the second, 1800 frames to the minute).

To find a value of GOP size that will work, we have to try dividing different numbers from the available settings into the number of frames. Since encoding quality usually works out better the larger the GOP size, we start from the largest size available (16 frames) and work our way down.

| Program Length (frames) | GOP Size | Number of GOPs |
|---|---|---|
| 9064 | 16 | 566.5 |
| 9064 | 15 | 604.2666667 |
| 9064 | 14 | 647.4285714 |
| 9064 | 13 | 697.2307692 |
| 9064 | 12 | 755.3333333 |
| 9064 | 11 | NA |
| 9064 | 10 | 906.4 |
| 9064 | 9 | 1007.111111 |
| 9064 | 8 | 1133 |

As you can see from this, the largest available value of GOP Size that will yield an even number of GOPs from this program is 8 (11 would have worked, but its not an available setting). This means that *both* the main program and the multi-angle program segments must be encoded with this value. (Alternatively, you could encode the main program in sections and concatenate them together, as described later in this manual.) Since 8 is rather a low figure for GOP size, we would recommend that you change the length of the multi-angle segment by a few frames instead, but if this is not possible then 8 would be the only option.

## Bit-Rate for Multi-Angle

To ensure compliance with the fact that the combined bit-rate *of the highest bit-rate video asset*, all audio assets, and the subtitles cannot exceed 8 Mbps (8,000,000 bps), you can perform the following calculations:

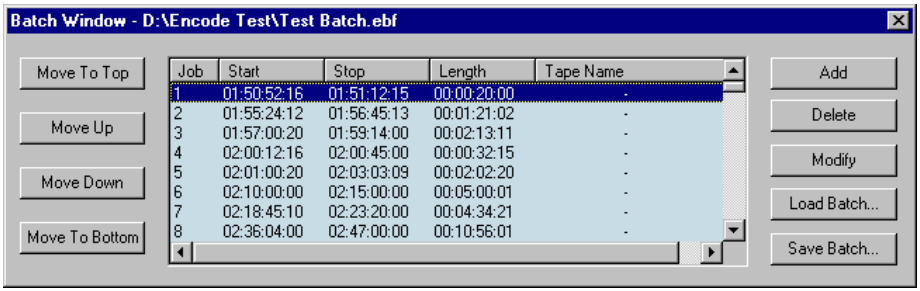
1. Add together the bit-rates of all audio tracks that are to accompany the multi-angle section.
2. Subtract this total audio bit-rate from 8,000,000.

3. Make sure your encoding bit-rate does not exceed this figure. (Actually, it's a good idea to back off an addition 0.1 Mbps or so for safety.)

If you observe these points in encoding, you will find authoring of multi-angle video (described in Chapter 11 of your User's Guide), to be quite easy and straightforward.

## Batch Encoding

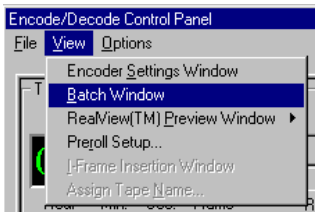
DVDMaestro, DVDConductor, and DVDVirtuoso support batch encoding, which allows you to encode multiple files automatically, without having to set up an individual encoding procedure for each file. The Batch window is where you define "encoding jobs" — a list of video and/or audio files that you wish to encode automatically.




*The Batch Window manages a list of successive encoding jobs to be performed automatically.*

To open the Batch window:

1. Select ***Batch Window*** under the View pull-down menu (keyboard shortcut: ***Alt - V - B***).




Initially, the Batch window will appear onscreen empty.

To add encoding jobs to the Batch List:

1. In the Encode/Decode Control Panel and the Settings window, set the encoding parameters — including Start and End time, Bit-Rate, Encoding Mode, etc. — as desired.
2. Click on the ***Add*** button to the right of the main list field in the Batch window. The new job is added to the list.
3. Repeat until all the jobs required have been added to the list.

All encoding settings are stored with each entry in the Batch list, even though only the start and end times are shown.

To view the stored parameters for an encoding job in the Batch List:

1. Double-click on the job to be recalled. The settings of the selected entry loads into the Encode/Decode Control Panel and Settings window.
2. View the encoding parameters as desired from the window and control panel.

If desired, you may execute a single encode from the recalled settings. Used in this way, the Batch window can serve as a convenient "memory bank" for frequently used settings.

Having recalled an encoding job from the list, its parameters can be modified as desired and re-entered into the list with the settings changed.

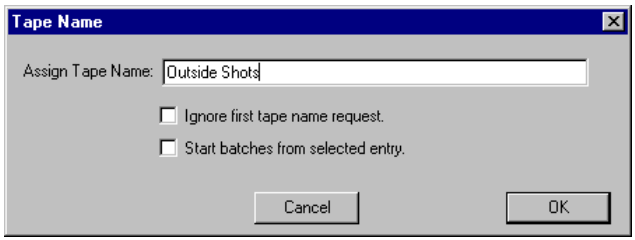
To modify an entry in the list:

1. Recall the entry you wish to modify by double-clicking on it in the Batch List.
2. Make whatever changes you desire in the Encoder Settings window and Encode Control Panel.
3. Click on the ***Modify*** button in the Batch Window to register the changes into the Batch List.
4. If desired, you can also change the order of entries, or delete entries in the list using the ***Delete*** button and the ***Move*** button in the left-hand portion of the window.
5. Once you are satisfied with the list of entries, you should save the batch settings using the ***Save Batch*** button.

   *Note: The batch file does not automatically update the saved file. The batch file must be resaved if you make any modifications. A prompt appears if you try to close the encoder application without saving the batch settings.*

### Assigning a Tape Name (Alt - V - N)

Use this to name tapes as displayed in the Tape Name field. Selecting ***Assign Tape Name*** opens the following dialog:




Type in a name and press ***OK*** to have it added to the currently selected batch entry (in the Batch window).

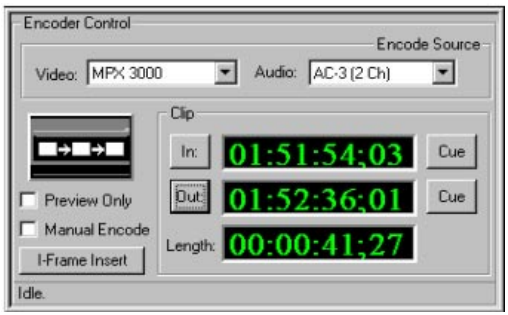
Select ***Ignore first tape name request*** to have the batch encoding process start with the tape currently loaded without prompting for a new one.

Select ***Start batches from selected entry*** to have the batch encoding process start with the currently selected entry (as opposed to going back to the first entry and starting there). When selected, the highlight line turns red.

### To launch the batch encode process:

1. Go to the Options menu in the Encode/Decode Control Panel and select ***Batch Mode*** (keyboard shortcut: ***Alt - O –B***). The Start Encode button changes to a distinctive icon to show that Batch Mode is in effect.

   *Note: Batch Mode is only available when Manual Mode is not selected.*




   *The Encode Start button in the Encoder Control section changes its appearance when Batch Mode is active.*

2. Click on the ***Start Encode*** button. The system prompts you to select a name and path for the first file.
3. Set the root filename and path using the New File dialog.

The system creates video (.m2v or .m1v) and audio (.ac3, .m1v or .aif) using the root filename with numbered extensions to indicate the list entry. The items in the encode list will be executed sequentially until done. At the end of the process, the system offers a prompt to load the last encoded file into the decoder for preview.

> *Note: When multiple tape names are included in a single batch, the encoding process halts when it reaches a new tape. A dialog prompting you to insert the appropriate tape displays.*

## Batch Window Features

The Batch window displays a table with five columns:

- Job Number
- Start
- Stop
- Length
- Tape Name

Each row of the table represents a single encode operation, resulting in an audio file, a video file, or a matched pair of files for audio and video.

You'll find several buttons grouped on the left- and right-hand sides of the Batch window; these will help you manage the list. The right-hand group of buttons covers the core functions of adding, deleting, and modifying entries in the table, while the group along the left-hand side provides mainly for changing the order of entries in the list.

The buttons along the right-hand side include:

- Add
- Delete
- Modify
- Load Batch
- Save Batch

The buttons along the left-hand side include:

- Move To Top
- Move Up
- Move Down
- Move to Bottom

Let's review the operation of these buttons. . .

### Add

You'll use this button to create entries in the batch list and set parameters for the clip you wish to encode as a list entry — including video and audio source selections, bit-rate, its In/Out points, and so on. When the entry settings are complete, click on the ***Add*** button to place the new entry into the list. Then create the next entry's settings, add it to the list, and continue as you did with the first entry.

### Delete

Should you wish to remove an item from the list, select the item to be deleted, then click the ***Delete*** button.

### Modify

To modify an entry in the list, first double-click to select that item and restore its settings. The parameters assigned at time of creation will reappear in the Encode/Decode Control Panel and the Settings window. Make any changes you wish, then click ***Modify***. Changes made will be transferred to the entry.

### Load Batch & Save Batch

Batch encode lists may be saved to disk and reloaded using the ***Load Batch*** and ***Save Batch*** buttons.

### Move To Top, Move Up, Move Down, & Move to Bottom

The buttons along the left-hand side of the Batch window can be used to rearrange the order of the entries in the table, exactly as labeled.

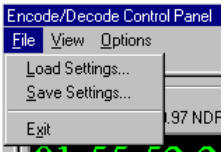
## Other Encoding Functions (Encode/Decode Control Panel Pull-Down Menus)

There are three pull-down menus associated with the Encode/Decode Control Panel:

- The File menu
- The View menu
- The Options menu

The commands associated with these menus are as follows. . .

### File Menu (Alt - F)




#### Load Settings (Alt - F - L)

Select ***Load Settings*** to load previously saved settings into the Encode/Decode Control Panel. These settings are in files with a ".enc" extension. Each time you perform an encode, a ".enc" file is created along with the MPEG files.

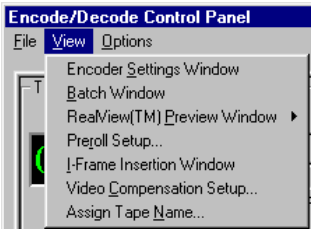
#### Save Settings (Alt - F - S)

Select ***Save Settings*** to save the current settings of the Encode/Decode Control Panel.

#### Exit (Alt - F - X)

Select ***Exit*** to close the Encode/Decode Control Panel and return to authoring your Project.

### View Menu (Alt - V)




#### Encoder Settings Window (Alt - V - S)

Select ***Settings*** to assign parameters for both audio and video encoding. The Encoder Settings window is described in detail in previous sections.

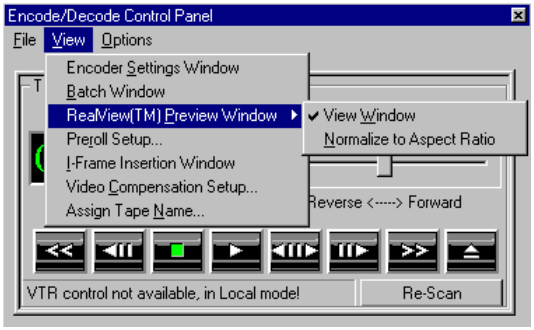
*Note: Before you can begin encoding, it is important to see that the Encoder Settings parameters, especially the encoding mode and bit-rate, are set properly. The Encoder Settings window is detailed earlier in this chapter.*

**Batch Window (Alt - V - B)**

This command opens the Batch window, where you can enter a list of audio/video clips for automated encoding. Batch encoding operations and the Batch window are detailed earlier in this chapter.

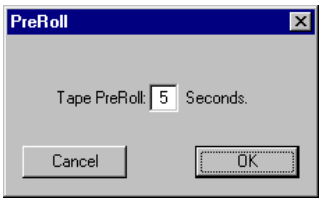
**RealView™ Preview Window (Alt - V - P)**

This opens a submenu where you can enable ***View Window*** to display the preview window on the system's monitor (if ***Overlay*** is selected as the decoder's video output), and you can reset its aspect ratio (***Normalize to Aspect Ratio***) if it has become distorted.




**Preroll Setup (Alt - V - R)**

This command opens a dialog where you can assign the value of PreRoll, used with tape machines controlled by your Spruce authoring software's machine control feature.




PreRoll is used to give a machine a certain period of time, usually a few seconds, to get "up to speed" before encoding starts (the In time). The default value of Preroll is 5 seconds. The minimum preroll amount for successful operation is 1 second – unless you are using something like a DDR (Digital Disk Recorder) when "0" is necessary for proper functionality.

**I-Frame Insertion Window (Alt - V - I)**

The I-Frame Insertion Window may be used to force entry points at desired locations in the encoded stream. The operation of this window is described in detail earlier in this Encoding Guide.

### Video Compensation Setup (Alt - V - C)

In quality-conscious MPEG encoding, it is often helpful to process the video signal prior to encoding in order to reduce spurious video noise, excessive film grain, or other high-frequency content that affects encoding. Today, several excellent real-time processors are available that can enhance the quality of results in encoding by this type of signal conditioning.

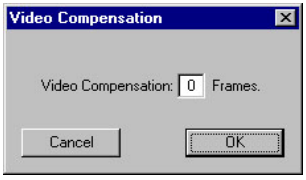
As with other digital video signal processing devices, these processors introduce a delay into the video signal path, measured in frames. For real-time encoding, this delay represents a problem, since the audio and time code signals are not delayed to match.

In order to facilitate the use of digital video preprocessing in high-end encoding, a feature has been added that will compensate for delay in the video path. When this is used, a corresponding time retard is applied, resulting in perfect sync of audio and video as well as frame-accurate encoding.

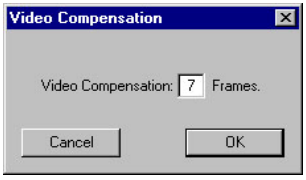
> *Note: The Video Compensation feature cannot be used when* ***MPX SDI/PCM*** *is selected as the audio encoding mode.*

#### To Use Video Delay Compensation

1. From the View menu in the Encode/Decode Control Panel, select Video Compensation Setup (key equivalent Alt + V + C). The Video Compensation dialog appears.




2. Enter the value of the delay (in frames) introduced by the processing device you are using as shown below.

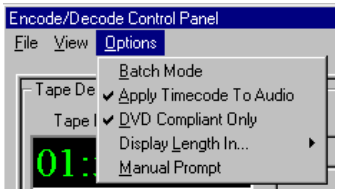



To determine the correct value for the processing device you are using, consult the manufacturer's documentation.

### Assign Tape Name (Alt - V - N)

Use this to name tapes when using the batch encoding method (as covered earlier in this manual).

## Options Menu (Alt - O)




The selections in the Options menu are "modal" in nature; that is, when selected, that option is in effect until the menu item is deselected.

### Batch Mode (Alt - O - B)

When ***Batch Mode*** is selected, all settings for encoding are taken from the list in the Batch window. Once encoding is initiated in Batch Mode, your Spruce authoring software executes individual encoding of clips until the Batch window list completes. Note that this option is not available if there is not a batch list open in the Batch window or if Manual Encode is selected.

### Apply Timecode to Audio (Alt - O - A)

When this command is selected (which is the default setting), audio encoding is "punched" in and out at the same time as the video encoding — in other words, the time entries for video also trigger audio encoding. As long as the audio source is also locked to video (that is, audio is derived from tracks on video or from an audio source locked to video), video and audio will be perfectly synchronized.

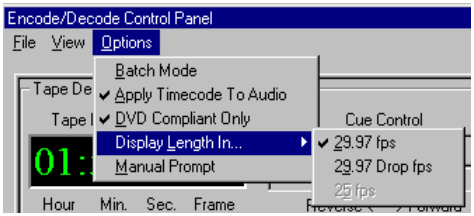
> *Note: If this option is disabled, you will be required to specify audio timecode In (start) and Out (end) times during encoding. For more information, please see the "Timecode Sub-Tab" section later in this manual.*

### DVD Compliant Only (Alt - O - D)

When this option is selected (which is the default case), all encoding parameters are constrained to the ranges that ensure compliance with the DVD specification. When encoding video and audio for other purposes, need may arise to set some parameters outside the DVD compliant range. For that situation, you may deselect ***DVD Compliant Only***.

### Display Length In (Alt - O - L)

This opens a submenu where you select how the Length setting displays. PAL systems use 25 fps; NTSC systems can use 29.97 fps or 29.97 Drop fps (for dropframe timecode).



**Manual Prompt (Alt - O - M)**

The ***Manual Prompt*** option provides prompting for encoding in Manual mode, so that encoding can begin immediately at the point determined by the operator.

When this option is selected, the system brings up additional alerts on triggering of Manual encoding, ensuring that the operator has started the video/audio source before encoding actually begins. Encoding begins immediately after the ***OK*** button is pressed. This allows the user to more precisely control the start of Manual mode.

The exact prompts that appear depend on whether a machine controlled source is connected. In the case of an encode from a machine-controlled source, the following appears:


*This is the prompt that appears when encoding from a machine controlled source.*


*This is the prompt that appears with a manually controlled source.*

## AC-3, MPEG, and PCM Audio Encoding

Earlier in this manual, we learned how to encode video and an associated stereo audio track from the same source deck. In many professional situations, this is all that is required. The situation often gets more complicated than that though, most commonly when you use a separate audio tape deck. You may need to encode stereo or 5.1 audio from separate media, for example, either because there is more than one stereo soundtrack involved, or because the main soundtrack is in 5.1 discrete sound, and the video format doesn't have enough audio tracks to support this.

There are a number of potential configurations for audio encoding. What determines which you can use depends on your situation. When using a separate audio source deck, whether or not the source tape has timecode determines the encoding options you have.

If there is no timecode on the tape, then your only option is to perform a "wild" encode, described later in this section.

If the tape does have timecode, then you can choose from one of three methods for encoding:

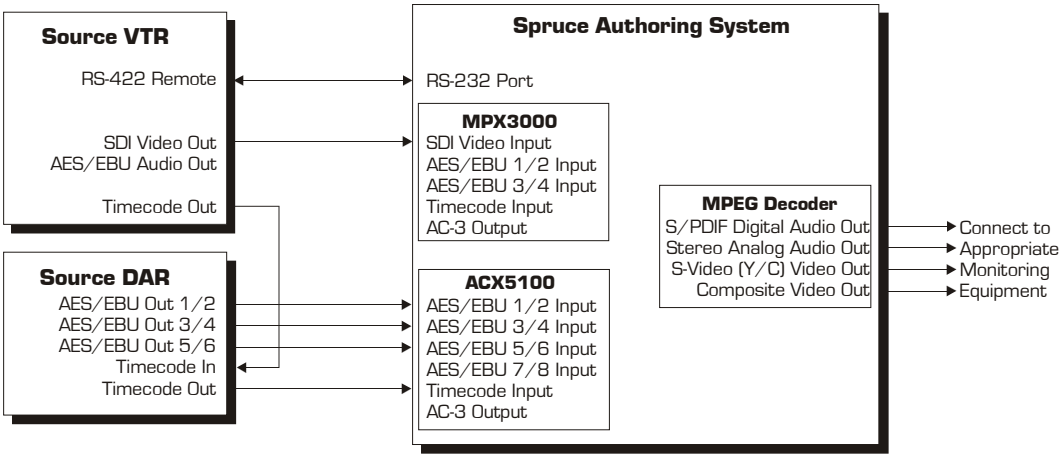
- Simultaneously with the video encode by having the audio deck "chase" the video deck. In this situation you are able to encode both the video and audio at the same time, even if the audio timecode is different than the video. You can encode AC-3, MPEG-1 Layer 2, and PCM formats. For AC-3 encoding, you must connect the timecode output from the audio deck to the timecode input of the MPX3000 or ACX5100 (whichever you are using for the audio), and enter appropriate start and end times for it in the Timecode tab of the AC-3 Audio Encoding window. If the audio timecode is different than the video timecode, be sure the ***Apply Timecode to Audio*** setting of the Options pull down menu is not selected. See the *Spruce General Hardware Installation Guide* for connection details. See the *Encoding Video and Audio from Separate Decks* section for operational details.

- As an audio-only encode by connecting the audio deck's serial remote control port to the encoding system (in place of the video tape deck). You can encode AC-3 and MPEG-1 Layer 2 formats only. Spruce, and the Sony PCM8000. For precise encodes, it is recommended that you supports several popular audio decks in this manner, including the Tascam DA-88 and DA-98connect the timecode output from the audio deck to the timecode input of the MPX3000 or ACX5100 (whichever you are using). Select ***None*** for the Video source of the Encoder Control section. See the *Encoding Synchronized Audio without Video* section for more information.

- As a manual audio-only encode by connecting the timecode output from the audio deck to the timecode input of the MPX3000 or ACX5100 (whichever you are using). You can encode the AC-3 format only. See the *Performing a Manual Timecode Triggered Audio Encode* section for details.

## Encoding Video and Audio from Separate Decks

This section describes encoding video and audio simultaneously, but from separate tape decks. Spruce encoding systems support serial remote control of a single deck, so controlling two decks requires you to use the audio deck in a "chase" mode. In this setup, the timecode out of the video tape deck connects to the timecode input of the audio tape deck. By placing the audio tape deck into its "chase" mode, it will automatically follow the VTR.




*Sample connections for a digital audio tape deck (DAR) in "chase" mode. In this case, the audio connections are to the ACX5100 – you may connect to the MPX3000 instead when encoding two channel audio.*

*Note: The timecode inputs of the MPX3000 and ACX5100 are active only when encoding AC-3 format audio. This connection is ignored for MPEG-1 layer 2 and PCM audio formats.*

Using the "Chase" mode when encoding MPEG-1 Layer 2 or PCM audio:

1. Connect the tape decks to the encoding system as shown above. It is not necessary to connect the audio deck's timecode output to the MPX3000/ACX5100 though.
2. Set the audio deck into its "chase" mode. If the timecode on the audio source tape does not match the timecode of the video, then you must enter an offset into the audio deck. See the audio deck's documentation for details.
3. Enter the appropriate In and Out times in the Encode/Decode Control Panel's Encoder Control section.
4. Initiate the encode. The audio deck starts chasing the remotely controlled video deck.

*Note: You may have to increase the preroll setting to ten seconds in order to allow sufficient time for the audio deck to synchronize.*

Using the "Chase" mode when encoding AC-3 audio:

1. Connect the tape decks to the encoding system as shown above. For precise encodes, connect the audio deck's timecode output to the MPX3000/ACX5100.
2. Set the audio deck into its "chase" mode. If the timecode on the audio source tape does not match the timecode of the video, then you must enter an offset into the audio deck. See the audio deck's documentation for details.
3. For precise AC-3 encodes, enable the ***Timecode Control*** button on the AC-3 Audio Encoder window of the Encoder Settings dialog.

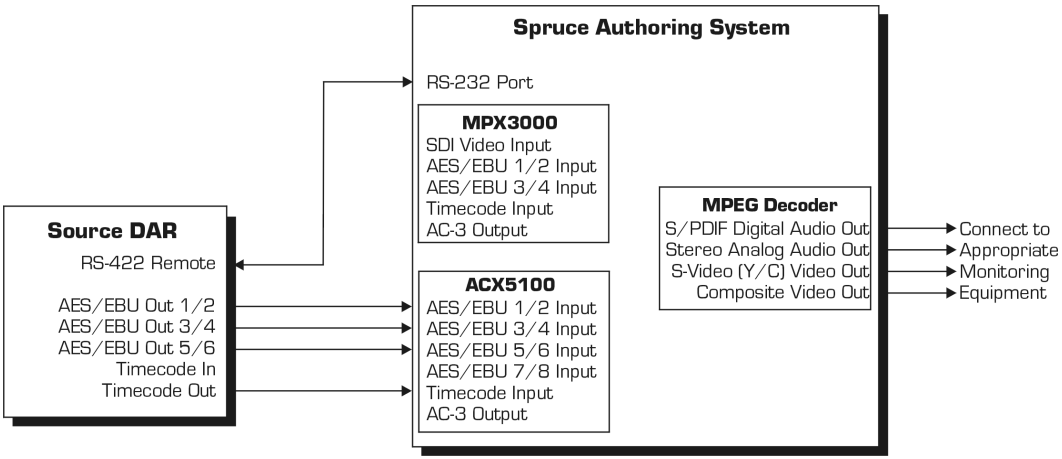
   If the audio timecode matches the video timecode, then make sure the Option menu's ***Apply Timecode to Audio*** setting is enabled.

   – or –

   If the audio timecode does not match the video timecode, then make sure the Option menu's ***Apply Timecode to Audio*** setting is disabled, and enter the appropriate ***Start*** and ***Stop*** times in the Timecode section of the AC-3 Audio Encoder window of the Encoder Settings dialog.
4. Enter the appropriate In and Out times (based on the video deck's timecode) in the Encode/Decode Control Panel's Encoder Control section.
5. Initiate the encode. The audio deck starts chasing the remotely controlled video deck.

## Encoding Synchronized Audio without Video

When you are preparing a Project with multiple soundtracks that all sync to picture, usually the individual soundtracks will be delivered on separate audio tapes, most commonly professional Digital Audio Tape (DAT) with timecode. In order to encode these to synchronize with picture, it is necessary to use a professional DAT machine that provides serial machine control using RS-422 protocol.




*Sample connections for a digital audio tape deck (DAR) only encode. In this case, the audio connections are to the ACX5100 – you may connect to the MPX3000 instead when encoding two channel audio.*

### Audio Timecode

For success when encoding synchronous alternate audio tracks, it is important that the timecode on the audio tapes have a fixed relationship to the timecode on video. Ideally, the timecode on each audio tape will be identical with the timecode on the main video. This makes it straightforward to encode from each audio tape in turn, without changing the encode In/Out points from the video encode.

Alternatively, you may find in some situations that the timecode on the audio tape is offset from that on the main video. This is workable, so long as you know the correct In and Out times, or the offset (from which you can calculate In and Out).

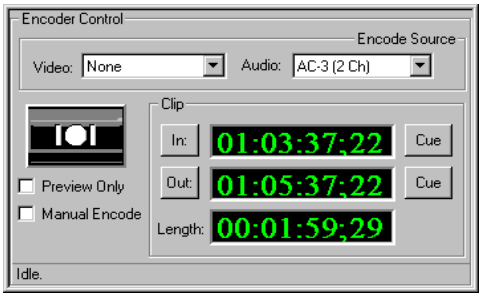
The worst situation — one which is best avoided by careful planning — is when timecode on audio has no specific relation to that on video, or is in a different format. There are no simple solutions for this kind of situation, and in many cases, the audio may have to be re-recorded with new timecode that matches the format of the video timecode.

### Audio Sample Clock

If your source audio tapes are in digital format, you'll need to ensure that the audio sample clock is locked to video. If it is, then encoding will proceed smoothly. If it is not, then you will be subject to "drift" of audio video sync over time.

### Audio Conformance

If you are working with multiple language tracks for a video program, make sure that all tracks conform with picture. If they do not (a situation common in feature film work), then there is no choice but to go into audio post and reconform the tracks to fit. This is a complex process, and well beyond the scope of this manual.




To encode synchronous audio only with machine control:

1. Setup the Encode/Decode Control Panel as shown above. Verify that audio connections and settings are set up correctly. Note that you may select either an AC-3 or MPEG audio format (PCM cannot be encoded as audio-only).
2. Enter time code values for the In and Out times.
3. Click on the ***Encode Start/Stop*** button.
4. In the Save File dialog, select the name and location for the file to be captured. Click ***OK***. The audio deck will cue to the start point and capture audio as needed.

## Performing a Manual Timecode-Triggered Audio Only Encode

This section describes performing an AC-3 audio-only encode using an audio deck with no serial control connection, and a source tape with timecode.

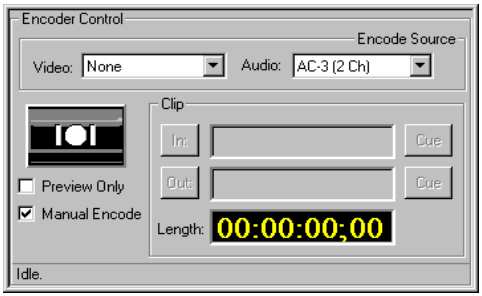
To perform a manual timecode-triggered audio only encode:

1. Connect the timecode out of the audio deck to the timecode input of the MPX3000 or ACX5100 (whichever you have connected the audio to).
2. Select ***None*** for the Video source of the Encoder Control section. Select either ***MPX AC-3 (2Ch)*** or ***ACX AC-3 (5.1 Ch)*** as applicable.
3. Make sure the Tape Deck Control section of the Encode/Decode Control Panel says "No Tape Deck Source." (Setting the tape deck to local is not sufficient – it must either be off or disconnected.)
4. Select the AC-3 Audio Encoder tab of the Encoder Settings window. Select the Timecode page.
5. Enter the desired ***Start*** and ***End*** times.
6. Select the ***Timecode Control*** button in the lower left corner of the AC-3 Audio Encoder window.
7. Press the ***Encode Start/Stop*** button.
8. As with normal encodes, the file name dialog opens. Name the file and select ***OK***.
9. A dialog now appears telling you to cue the audio source tape (referred to as an "ATR") to a point no more than 30 seconds or less than 5 seconds from the ***Start*** point.


10. Start the tape deck and select ***OK*** on the dialog. The encode will start once the tape passes the ***Start*** timecode point and stop once the ***End*** timecode is reached.

## Encoding 'Wild' Audio

In some situations, you may encode a music bed or other accompanying audio that has no firm relationship to video. This may come directly from any 16-bit 48KHz sampled audio source or from an analog source that has been properly digitally converted.




In this case, use Manual encoding with audio only.

*Note: You cannot perform PCM audio-only encodes.*

To encode audio only without machine control:

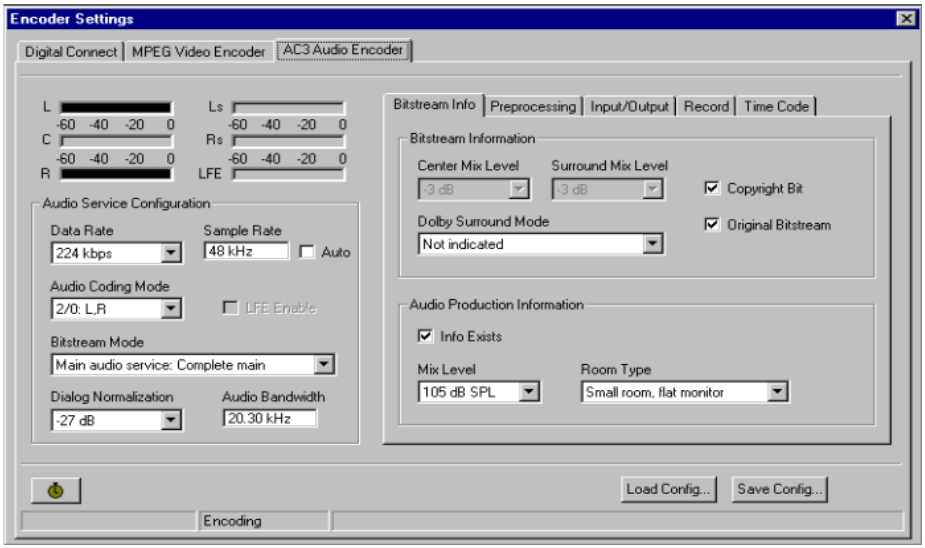
1. Cue the audio source to the desired start point.
2. Setup the Encode/Decode Control Panel as shown above. Select either ***MPX AC-3 (2Ch)*** or ***MPX MPEG(2Ch)*** as the audio source. Of course, make sure that audio connections and settings are also set up correctly.
3. Click on the ***Encode Start/Stop*** button.
4. In the Save File dialog, select the name and location for the file to be captured. Click ***OK***.
5. When you see the Encode Start/Stop button turn red, start the audio source.

   *Note: Depending on how tightly you want to cut the source material, you may need to try a couple of times to get the start point where you want it to be or use the **Manual Prompt** mode of the Options pull down menu for greater control. See the Options Menu section later in this manual for more information on the **Manual Prompt** mode.*

## AC-3 Encoding Parameters

Depending upon what you've selected as the audio encode source (in the Encoder Control section of the Encode/Decode Control Panel), the Encoder Settings window will have either an AC-3 Audio Encoder tab or an MPEG Audio Encoder tab. No tab will appear if the audio encode source is set to ***MPX SDI/PCM (2Ch)*** or ***NONE.*** If you've selected ***MPX AC-3 (2Ch)*** or ***ACX AC-3 (5.1Ch)*** as your audio encode source, then you'll see the AC-3 Audio Encoder tab.

The AC-3 Audio Encoder tab of the Encoder Settings window assigns all of the parameters associated with audio encoding in the Dolby Digital AC-3 format.



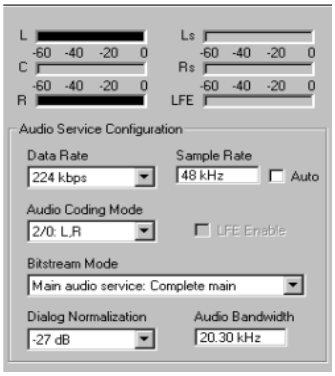

*The AC-3 Audio Encoder tab.*

The settings for AC-3 encoding are divided into the general, or basic, parameters, which are always shown. More detailed setting of parameters is available by select individual sub-tabs in the right-hand portion of the display.

> *Note: Following are brief explanations of the various AC-3 encoding parameters. The separate document "Dolby Digital Professional Encoding Manual for ACXpress" (included with your Spruce Technologies encoding hardware) contains detailed definitions. An additional reference is the "ATSC A/52" document, available for download from the ATSC Web site (www.atsc.org, the Advanced Television Systems Committee).*

As shown in the above screenshot, the AC-3 Audio Encoder tab has two major sections: the left-hand portion, with meters and other elements, and the right-hand portion — with five separate sub-tabs for setting up various aspects of the audio encoding.

Let's tour the AC-3 Audio Encoding tab, starting with the left-hand elements — all of which remain on-screen and available, regardless of which right-hand sub-tab is selected.




*The left-hand portion of the AC-3 Audio Encoding tab.*

### Level Meters

Six horizontal level meters are provided to monitor audio input activity: Left (L), Center (C), Right (R), Left Surround (Ls), Right Surround (Rs) and the subwoofer channel, Low-Frequency Enhancement (LFE).

If the hardware or software configuration is set to stereo encoding (2/0), only the L and R meters are active. When 5.1 (5/1) surround encoding is performed, all six meters will be active, assuming all channels of the input source are active.

The scale of the meters ranges from –60 dB to 0 dB.

### Audio Service Configuration

The Audio Service Configuration section of the AC-3 Audio Encoding tab contains six different parameters, constituting the most import general parameters for AC-3 encoding.

The settings available in the section are as follows.

#### Data Rate

The AC-3 data rate is the basic parameter that determines output quality. AC-3 supports a wide range of data rates for different applications. For use with DVD, Dolby Laboratories specifically recommends rates of 192 kbps for stereo, and 448 kbps for 5.1 surround.

#### Sample Rate

This parameter must match the sample rate of the incoming source audio. For DVD use, a sample rate of 48 kHz is the only legal value for compressed audio. By selecting the checkbox labeled ***Auto***, your Spruce authoring software will automatically set the sample rate to match the incoming source audio.

**Audio Coding Mode**
The Audio Coding Mode defines the configuration of audio channels as mapped to the physical speakers. The value is expressed as two single-digit numbers separated by a slash. The left number defines the number of front speakers, while the right number defines the number of rear speakers. The common settings for DVD are 2/0 (stereo) and 3/2 (5-channel surround, excluding the subwoofer or LFE channel).

**LFE Enable**
This indicates that a separate low-frequency enhancement (subwoofer) channel is available. Set this checkbox whenever you're encoding 5.1 material.

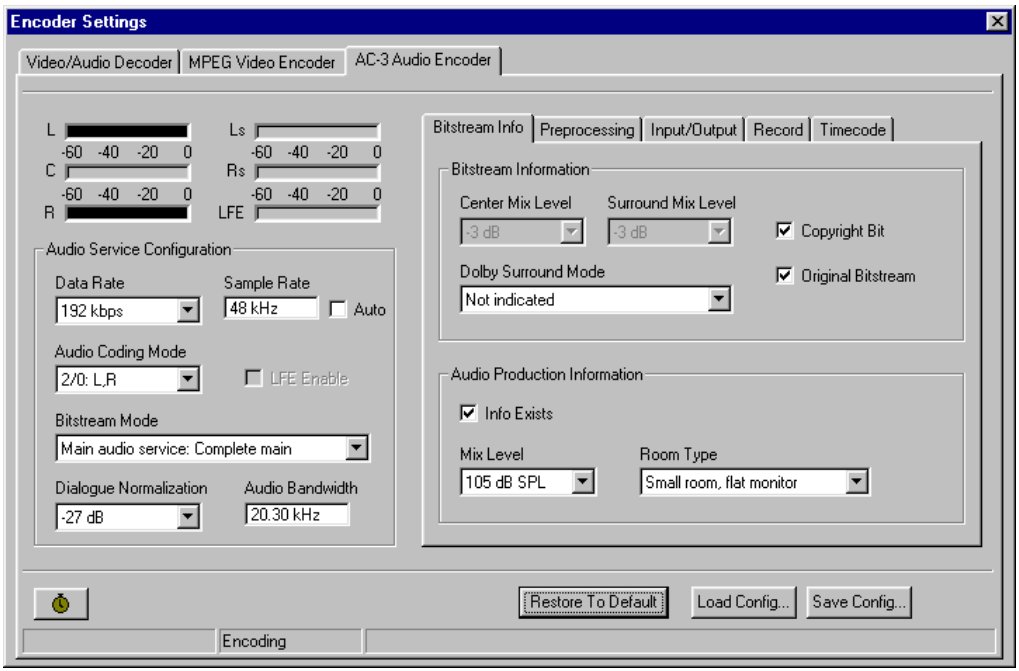
**Bitstream Mode**
The AC-3 bitstream includes data bits that flag how the stream is used. Besides the default setting of ***Complete Main***, Dolby provides settings for use by hearing impaired, commentary tracks, and so forth. These are used in non-DVD applications only. Selection of Karaoke Mode is used for Karaoke Mix Mode audio.

**Dialogue Normalization (Dialog Normalization)**
This parameter specifies the average level of dialogue relative to overall mix, and is used in encoding to help maintain the intelligibility of speech. The default value of –27 dB represents a median setting for feature film mixing, which normally carries dialogue at a level of –24 to –31 dB below peak level. For non-feature film materials, such as a talking heads-style television production, dialogue levels may be higher.

**Audio Bandwidth**
This display-only field shows the upper-frequency bandwidth of the audio, which is determined by the bit-rate, the audio coding mode, and the sample rate. (An upper-frequency audio bandwidth rating of 20 kHz or higher is excellent, as it will be higher than most people can hear.)

### Timecode Control, Save Configuration & Load Configuration Buttons

Before we get to the right-hand sub-tabs of the AC-3 Audio Encoding tab, there are four other buttons along the tab's bottom edge you should understand. . .




*The Encoder Settings dialog, showing AC3 Audio Encoder tab. The Timecode Control button is the "clock" button in the lower-left corner; Restore to Default and the Load Configuration and Save Configuration buttons are in the lower-right corner.*

### Timecode Control Button 

This button may be selected when a timecode signal is available from the video/audio source, and is connect to the timecode input.

When you select this button, which has an image of a watch, the audio encoder will "listen" to the audio source's timecode signal — rather than whatever incoming timecode reference may appear at the CPU's serial (RS-422) control port. In this way, the process of audio encoding is de-coupled from machine control, and is triggered purely by the Start Time and Stop Time entered in the Timecode tab in the right-hand section of the AC-3 Audio Encoding tab. See the discussion of the Timecode tab later in this section.

When a suitable timecode feed is available, the use of this function is highly recommended, as it guarantees accurate audio punch-ins.

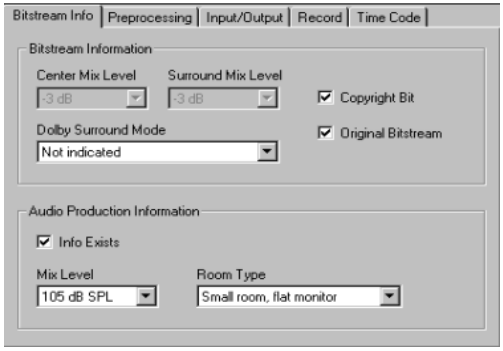
**Restore to Default:**
Press the ***Restore to Default*** button to reset the AC3 Audio Encoding parameters back to factory presets.

**Save Configuration (Save Config) Button:**
By selecting this button, you can save all of the current settings of the AC-3 Audio Encoding tab. When you click ***Save Config***, a save dialog opens, allowing you to save the current configuration.

**Load Configuration (Load Config) Button:**
This feature will let you restore previously saved settings for the AC-3 Audio Encoding tab. When you click ***Load Config***, an open file dialog will present itself, where, if necessary, you can also browse for the desired configuration file.

### Bitstream Info Sub-Tab

Found on the right-hand side of the AC-3 Audio Encoder Settings tab, Bitstream Information (***Bitstream Info***) is the first of five sub-tabs.




*The Bitstream Information sub-tab control the mixdown of multichannel information during 2-channel playback; it also stores optional Audio Production Information.*

The Bitstream Information settings are used to control the mixdown of how multichannel material is heard when played back on just a 2-channel (rather than a 5.1 surround-capable) playback system. It's also used to store certain optional Audio Production Information.

**Center Mix Level:**
This parameter is available only when:

- The ACXpress 5100 6-channel encoder is used
- And a mode is set that uses three front channels (L, C, R)

The Center Mix Level defines the level of the center-channel information — relative to the left- and right-channel information — when audio is reproduced on a two-channel (stereo only) playback system. The available values are –3 dB, –4.5 dB, and –6 dB.

**Surround Mix Level:**
This parameter is available only when:

- The ACX5100 6-channel encoder is used
- And a mode is set that uses one or more surround channels (Ls, Rs)

The Surround Mix Level defines the level of the surround-channel information — relative to the left- and right-channel information — when audio is reproduced on a two-channel (stereo only) playback system. The available values are –3 dB, –4.5 dB, and –6 dB.

**Copyright Bit:**
This bit, set by default, indicates that the source audio material is copyrighted.

**Original Bitstream:**
This bit, set by default, indicates that the current bitstream is an original bitstream.

**Dolby Surround Mode:**
This parameter is available only when encoding in 2-channel (2/0) mode. It should be set if the source material is encoded for Dolby Surround (Dolby Pro-Logic).

**Audio Production Information:**
As an option, the Dolby Digital (AC-3) Specification allows you to include basic information about the audio production with the encoded audio file(s). This information is *not* used in the audio decoding process; however, it may be useful to audio engineers or other personnel during the final audio mix or disc premastering stage.

The optional Audio Production Information includes:

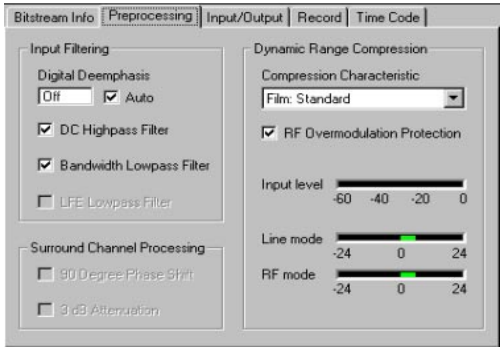
- **Info Exists:** This flag indicates that audio production information (mix level and room type) is included in the bitstream. When it is selected, the encoder will incorporate the settings of the remaining two fields into the audio output.
- **Mix Level:** Mix Level defines the monitoring level that was used in the final mixdown of the content. This can be used by a reproduction system, for example, to adjust frequency response curves for different reproduction levels.

*Note: Proper encoding for Dolby Surround requires specific mix levels. For full details, please consult the Dolby manual included with your encoder.*

- **Room Type:** This indicates the type of room used during the recording and/or mixing of the source audio. It can be used during reproduction to adjust ambience for different playback environments.

### Preprocessing Sub-Tab

Found on the right-hand side of the AC-3 Audio Encoder Settings tab, Preprocessing is the second of five sub-tabs.




*Audio preprocessing is able to remove "out-of-band" components and to optimize the signal for reproduction in typical home environments.*

The settings in this tab are used to process audio before it is encoded, for optimal encoding performance. Let's begin with the upper-left section of this sub-tab. . .

**Input Filtering:**
One of the goals for optimum audio encoding is to ensure that you encode only the audio you need. By removing unwanted high- and low-frequency material — the so called "out-of-band" components — you can audibly improve the final encoded audio files.

For instance, extremely low-frequency information — especially "0Hz" information, also called "DC" — can mess up the encoding process. To prevent this, the Preprocessing tab offers a DC High-Pass filter (detailed just below). Similarly, let's say you've restricted (in the Audio Bandwidth setting in the left-hand portion of the AC-3 Audio Encoding tab) the audio bandwidth to 20kHz — which is, practically speaking, already higher than many people can hear. If your source audio has audio information above 20kHz, however, this could interfere with the encoding process — and you'd be wise to filter that audio using the Bandwidth Low-Pass Filter (detailed just below).

Another issue to consider is "pre-emphasis." In the early days of digital recording, many digital recordings were made with pre-emphasis, a slight high-frequency boost intended to compensate for performance problems with audio Analog/Digital converters. Nowadays, audio A/D converters have improved greatly, and almost no one intentionally records with pre-emphasis. However, it is possible you may run into a

recording with pre-emphasis (intentional or otherwise), in which case it's a good idea to apply "de-emphasis," to even out the frequency response.

The Input Filtering settings include:

- **Digital De-emphasis:** In the default setting of ***Auto***, your Spruce authoring software monitors incoming digital audio signals, and if it detects pre-emphasis, it applies its own de-emphasis filter automatically. By unchecking ***Auto***, you can also force the de-emphasis filter ***On*** or ***Off***. If you're unsure of what setting to use, keep ***Auto*** checked.
- **DC High-Pass Filter:** This applies a high-pass filter (also known as a "low-cut" filter) to remove any DC components present in the incoming audio. We strongly recommend you leave this checked (its default setting).
- **Bandwidth Low-Pass Filter:** When this filter is selected, a low-pass filter (also known as a "high-cut" filter) is applied to incoming signal, to remove any frequency components that are above the encoding bandwidth (as displayed in the Audio Bandwidth setting in the left-hand portion of the AC-3 Audio Encoding tab).
- **LFE Low-Pass Filter:** When selected, this applies a low-pass (or "high-cut") filter to the input of the low-frequency enhancement (subwoofer) channel. This will eliminate frequency components that are above the LFE channel's bandwidth.

  *Note: This parameter is available only when using Spruce's ACX5100 with the LFE channel enabled.*

**Surround Channel Processing:**
In this section, you can provide further processing to the surround channels (if present). The options include:

- **90-Degree Phase Shift:** This parameter is available only when encoding in surround mode with the ACX5100. It applies a 90-degree phase shift to the surround channels. When 5.1-channel audio is played back on a 2-channel output feeding a Dolby analog surround decoder, this phase shift will cause the surround channels to be output at the rear, similar to the original mix.
- **3 dB Attenuation:** This 3 dB attenuation of the surround channels matches the practices of film mixing, in which surround channels are mixed 3 dB "hot" to compensate for the gain structure of cinema installations. Home reproduction systems are normally calibrated for unity gain on the surround channels, so the additional gain is removed in encoding.

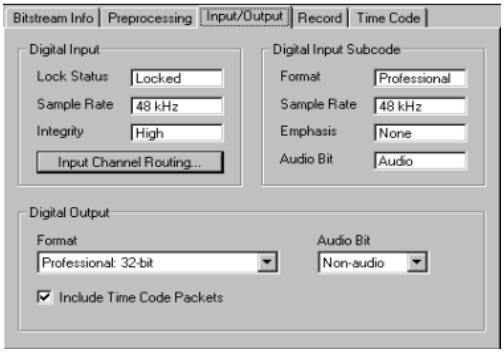
**Dynamic Range Compression:**
In this section, you can define how the audio's dynamic range — that is, the range between the loudest and quietest passages of audio — is reduced, or compressed. Dynamic range compression is applied to "even out" high- or low-level extremes, to produce more consistent listening levels.

The features of this section include:

- **Compression Characteristic:** Dolby Digital decoders provide a dynamic range compression function optimized for listening in typical home environments. This compression uses different compression "curves" (with different playback characteristics) for different types of material. The Compression Characteristic should be set for the type of material being encoded. The available settings are: ***Film Standard***, ***Film Light***, ***Music Standard***, ***Music Light***, and ***Speech***.
- **RF Overmodulation Control:** This checkbox sets the encoder to prevent RF overmodulation in set-top decoder boxes. It is primarily for broadcast applications. For normal DVD usage we recommend you leave this control unchecked.
- **Input Level, Line Mode, and RF Mode Meters:** These meters provide visual references that can be useful during the AC-3 encoding process. For more information, please refer to the "Dolby Digital Professional Encoding Manual for ACXpress" (included with your Spruce encoding hardware).

### Input/Output Sub-Tab

The fields in this sub-tab mostly indicate the status of your incoming digital audio signal; they also let you set the output format of your AC-3 encoded audio.




*The Input/Output sub-tab displays information about the status of incoming digital audio signal, and provides for setting the output format for encoded AC-3 audio.*

This sub-tab has three sections. . .

**Digital Input:**
In this section you can see important information about the incoming audio signal, and you can also reconfigure the input channels:

- **Lock Status:** Indicates that a valid digital audio bitstream is being received.
- **Sample Rate:** Indicates the sample rate of the current audio input bitstream, as indicated by bits embedded in the standard input format.
- **Integrity:** A ***High*** indicator shows that the encoder is having no problems "reading" the incoming audio signal. If there are problems with the signal, the integrity setting will indicate ***Marginal***.
- **Input Channel Routing:** The Input Channel Routing button opens a sub-dialog, where you can match input source channels to the appropriate reproduction channels (L, C, R, etc.) for playback. This allows your authoring system to work with any format of multichannel audio source, without physically re-patching the system.

**Digital Input Subcode:**
Digital audio standards allow for subcode information; these are "flags" hidden in the incoming audio signal that indicate sample rate and other information.

Spruce authoring software is able to recognize the following types of subcode information:

- **Format:** This will indicate with ***Professional*** or ***Consumer***.
- **Sample Rate:** Spruce authoring software recognizes either 44.1 kHz or 48 kHz audio.

  *Note: Remember, the DVD-Video Spec only supports a 48 kHz audio sample rate for compressed audio.*

- **Emphasis:** This indicates if the incoming audio source includes pre-emphasis (see "Pre-Processing Sub-Tab," above).
- **Audio Bit:** An indication of ***Audio*** confirms that that the incoming signal is indeed audio data, rather than ***Other***.

**Digital Output:**
Here, you set the digital output format to support the use of the digital audio stream for encoded (technically non-audio) data

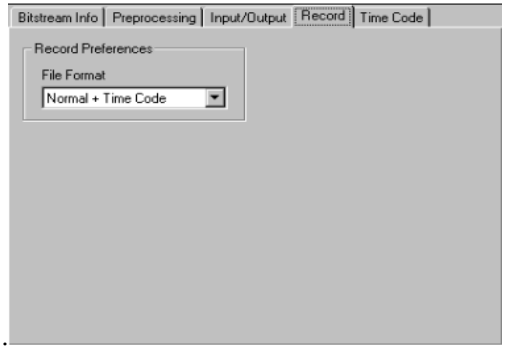
Normally, you should leave these settings in their default position, which are as follows:

- **Format:** This is set by default to ***32-Bit Professional Mode***. (The Dolby AC-3 spec includes this feature primarily for laser disc premastering, which does not apply to Spruce authoring software. However, we suggest you leave this setting in its default position.)

- **Audio Bit:** The default mode is ***Non-Audio***. (This prevents linear D/A converters from reproducing the encoded AC-3 stream if connected inadvertently.)
- **Include Timecode Packets:** By default this option is checked. (This embeds timecode packets in encoded audio files, which in turn helps to ensure accurate audio-to-video synchronization.)

### Rec/Play Sub-Tab

This sub-tab lets you access your Spruce authoring software's record preference.




*The Record/Play sub-tab: Ordinarily, this should be set to normal + time, as indicated.*

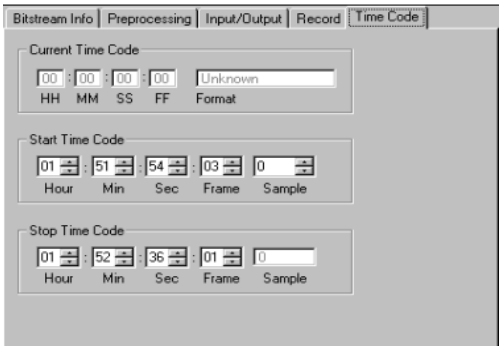
Normally, you should leave this setting in its default position, which is as follows:

**Record Preferences:**

- **File Format:** This should always be set to ***Normal + Time Code*** so that the appropriate timecode references will be captured. In turn, this will facilitate accurate audio-to-video synchronization during authoring.

**Timecode Sub-Tab**

This sub-tab displays the audio source's current timecode, and optionally allows you to specify timecode start and stop times.




*Current timecode, as well as the start and stop timecodes for encoding are displayed in the Timecode sub-tab. If you've enabled* ***Apply Timecode To Audio*** *(in the Options menu of the Encode/Decode Control Panel), then the start and stop timecodes from the video Encode/Decode Control Panel are entered here.*

This sub-tab's features include:

**Current Timecode:**

This displays the current location value of the incoming linear timecode. This field is only available if the ***Timecode Control*** button has been selected and you have played the source tape for a few seconds.

**Start Timecode & Stop Timecode:**

The Start Timecode field lets you set a start time for audio encoding. That is, when the incoming audio source's timecode location (as indicated in the Current Timecode display) reaches the desired start time, encoding will begin.

Similarly, the Stop Timecode field lets you set a stop time; when the incoming audio source's timecode location reaches the desired stop time, encoding will stop.

If you've selected ***Apply Timecode To Audio*** in the Options menu of the Encode/Decode Control Panel, then the In and Out values entered in the Encoder Control Section of the Encode/Decode Control Panel are automatically transferred to the Start Timecode and Stop Timecode fields in the Timecode sub-tab. These In and Out values apply to the video encoding process, and the Apply Timecode to Audio option simply tells your Spruce authoring software to use the same values for audio.

If, however, if you have de-selected ***Apply Timecode To Audio*** in the Options menu of the Encode/Decode Control Panel, then you can use these fields to enter separate start and stop times for audio — independent of whatever you've set for video.

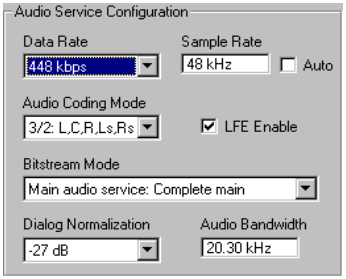
## Encoding AC-3 5.1 Audio

Encoding audio in 5.1 format is no different than encoding stereo audio, except that the source format is in a 6-channel configuration (Left, Center, Right, Left Surround, Right Surround, Subwoofer).

> *Note: To encode 5.1 surround, you must have the Spruce Technologies ACX5100 5.1 Encoder Board installed in your system.*

The audio source for 5.1 can be any form of multitrack audio, but typically it is a digital audio multitrack tape in the "DA-88" 8mm format supported by Tascam and Sony. This has become nearly standard practice in the industry, and is recommended.

The source tape deck also needs to support serial machine control in RS-422 format, a requirement that is met by the Tascam and Sony tape decks.



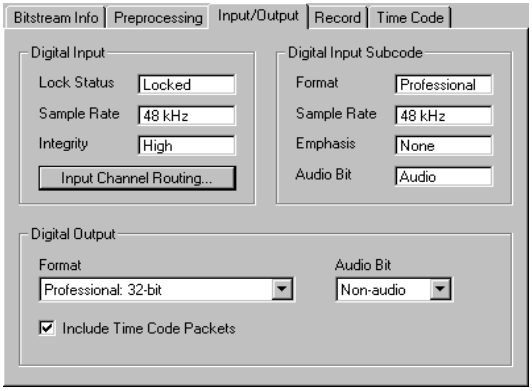

In the AC-3 Encoder Setting portion of the Setting window, you will need to make sure that the Audio Coding Mode setting is configured for 5.1, as shown above. Appropriate Bit-Rate settings are either 384 or 448 kbps. (The former is recommended by Dolby. The latter is preferred by some producers.)

To set up the audio encoder for 5.1 surround encoding:

1. In the Encoder Control section, set the Encode Source for Audio to ***AC-3 (5.1 Ch.)***.
2. Open the Settings window via the View pull-down menu (keyboard shortcut: ***Alt - V - S***).
3. In the Settings window, select the AC-3 Encoder Settings tab.
4. In the Audio Service Configuration section of the AC-3 Encoder Settings tab, set the Audio Coding Mode to 3/2.
5. If the Subwoofer channel is present, select ***LFE Enable***.
6. Set the Data Rate to either ***384*** or ***448*** kbps.

Of course, you will also need to make sure that all six source audio channels are connected to the inputs of the ACX5100. There is no defined standard for which tape channel will correspond to which speaker channel in the surround field. The AC-3

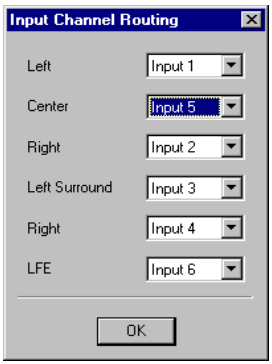
Encoder Settings window provides a means to define this.




To define channel routing for 5.1 surround encoding:

1. In the AC-3 Encoder Setting tab of the Settings window, select the Input/Output sub-tab
2. In the Digital Input section of this tab, click on the Input Channel Routing button
3. In the Input Channel Routing dialog, select the input channel that corresponds to each of the six speaker channels in the surround sound field.
4. Click ***OK***.

As with stereo audio, 5.1 surround audio may be encoded at the same time as video or in a separate audio-only pass. The difference is that with 5.1 audio, the audio will be coming from a separate multitrack audio tape deck that is synchronized to the video tape deck — rather than from audio tracks on the video tape deck.




The Spruce encoding system is unable to control two tape decks simultaneously via serial machine control. In this situation, the best method to use is to feed timecode from the video deck to the audio deck. You can then place the audio deck into its “timecode chase” mode. It will then follow the video deck as it is controlled by the encoding system.

*Note: Your multitrack audio tape deck must be able to synchronize to external timecode in order to accomplish timecode chase. And to do so, your multitrack audio tape deck may require an optional synchronizer card or external synchronizer box. If in doubt, please check with the manufacturer of your audio tape deck.*

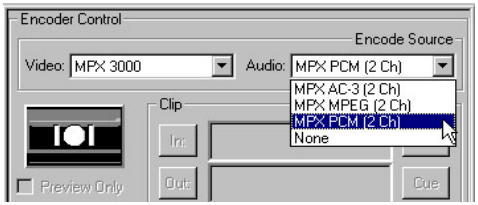
To encode 5.1 audio synchronized with video:

1. Connect the multitrack audio tape deck to timecode feed from the video tape deck. Place the audio tape deck in timecode chase mode. Connect the timecode out of the audio tape deck to the timecode input of the ACX5100 timecode input. See the *Spruce General Hardware Installation Guide* for connection details.
2. Configure the Encoder Control section as described above.
3. Make sure that audio settings and connections are correct.
4. Set the timecode In and Out points.
5. Click the Encode Start/Stop button.
6. In the Save File dialog, define the name and location of the files to be captured.
7. Click ***OK***. The system will now cue the source tape decks and capture audio and video together.

If surround audio is captured in a separate pass, the procedure is the same as for capturing stereo audio independent of video. The only difference is that the audio settings and connections must be defined as for surround audio.

## Encoding Audio in PCM

Selecting ***MPX SDI/PCM (2Ch)*** as the audio setting for the Encode Source causes the Audio Encoder tab of the Encoder Settings dialog to be removed, since PCM audio is not compressed.




PCM audio is uncompressed, producing excellent quality, and is fully compatible with all DVD players. The drawback is that it also produces far larger audio files than MPEG-1 layer 2 or AC-3 audio (about 6 times the size with typical encoding rates).

When you select ***MPX SDI/PCM (2Ch)*** and perform an encode, the audio file that is produced will have an ".aif" extension. Its resolution will be 16-bits with a 48kHz sample rate.

> *Note: You cannot perform audio-only PCM encodes – you must encode video as well (even if it is a simple test signal). Once the encode completes, you can delete the resulting video file and use the PCM audio file as desired.*

### MPX3000/ACX5100 Configuration Note

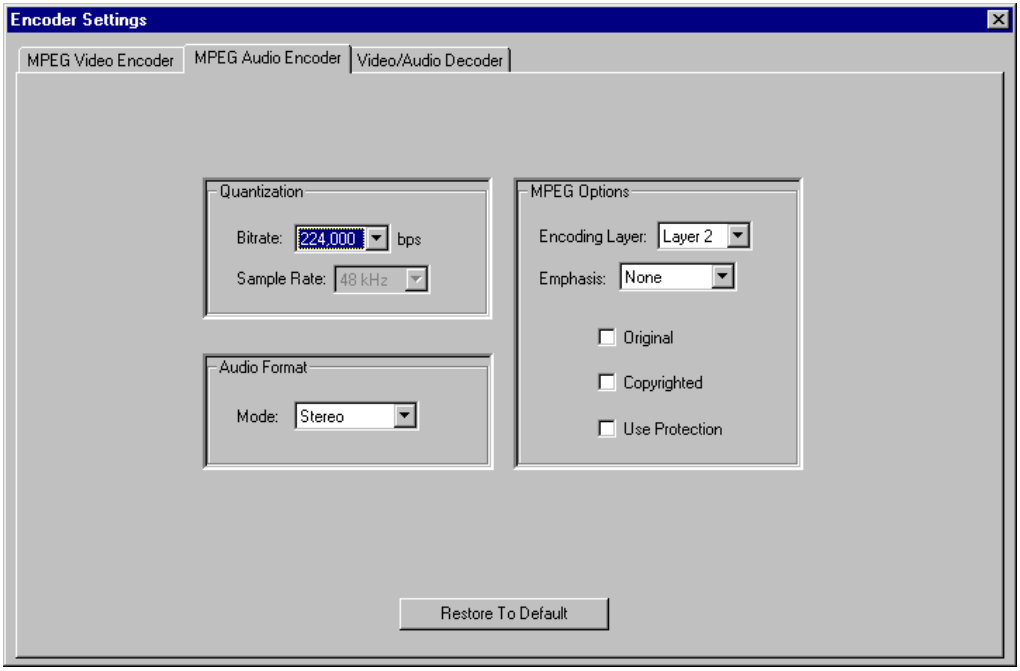
The PCM audio source must be connected to the CH1/2 input of the MPX3000 breakout cable. The ACX5100 cannot process PCM audio.

## Encoding Audio in MPEG-1 Layer 2

Selecting ***MPX MPEG (2Ch)*** as the audio encode source (in the Encoder Control section of the Encode/Decode Control Panel) opens a tab of the Encoder Settings window labeled ***MPEG Audio Encoder***.

The MPEG Audio Encoder tab of the Encoder Settings window assigns all of the parameters associated with audio encoding in the MPEG-1 Layer 2 audio format.

*Note: There are a few DVD players that do not support MPEG-1 Layer 2 audio.*




*When encoding MPEG-1 Layer 2 audio, the key setting is the bit-rate; the sample rate is restricted to 48 kHz as long as **DVD Compliant Only** is selected in the Options pull down menu.*

The settings are divided into three sections, as follows. . .

### Quantization

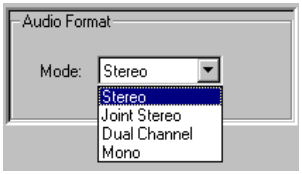
- **Bit-rate:**
  This is the most important setting in the MPEG Audio Encoder tab. The recommended bit-rates for MPEG 1 Layer 2 audio are 192 or 224 kbps. Higher rates provide somewhat better quality at the expense of larger file sizes.

- **Sample Rate:**
  Per the DVD-Video Specification, the sample rate for DVD-Video use is restricted to

***48 kHz***. Disabling the Option pull-down menu's DVD Compliant Only setting allows you to set this to ***32 kHz*** and ***44.1kHz*** in addition to the default ***48 kHz***.

### Audio Format

- **Mode:**
  ***Stereo*** mode is the default format for MPEG 1 Layer 2 audio. The other options are:




  ***Joint Stereo***: Provides more efficient encoding of stereo sources, compared to the ***Stereo*** mode.

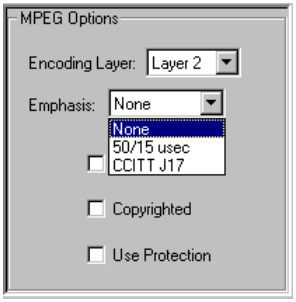
  ***Dual Channel***: Use this when encoding separate mono tracks.

  ***Mono***: Use this to encode a single channel audio source.

### MPEG Options

- **Encoding Layer:**
  ***Layer 2*** is the only valid option.

- **Emphasis:**
  Emphasis may be selected as ***None*** (default), ***50/15 usec***, or as ***CCITT J17***.




- **Original, Copyrighted, Use Protection:**
  MPEG audio copy protection is not ordinarily used for DVD, as DVD-Video Specification's own protection provisions are much more robust. Therefore, we recommend you leave these checkboxes unchecked (their default state).

## Summary of Encoding

Although we've presented a wide range of encoding-related options and configuration issues in this manual, you'll find that basic video and audio encoding is very simple to perform.

There may be, however, situations where you're called upon to encode varying configurations of audio and video, possibly with different timecode situations. You may also be called upon to optimize video image quality in situations of varying difficulty. The information in this chapter provides guidelines for many common situations, but as you'll learn, real skill in solving production problems and optimizing compression results will come with experience.

• • •

# Appendix A: Using the Digital Connect Box

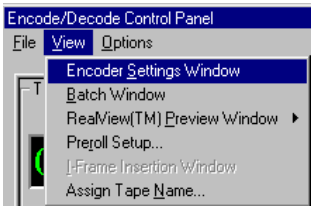
This appendix provides information to for those who have the Spruce Digital Connect Box. While it is no longer available, it continues to be supported by the encoding software.

If you are using an analog source with the DBH100 Digital Connect Box, then you will need to verify the correct setting of the unit before you can encode. The Digital Connect Box is controlled by connecting its serial port to the computer's COM port. Your Spruce authoring software communicates directly to the Digital Connect Box to determine which of its inputs is selected. Be sure to turn the Digital Connect Box on before starting the Spruce authoring application.

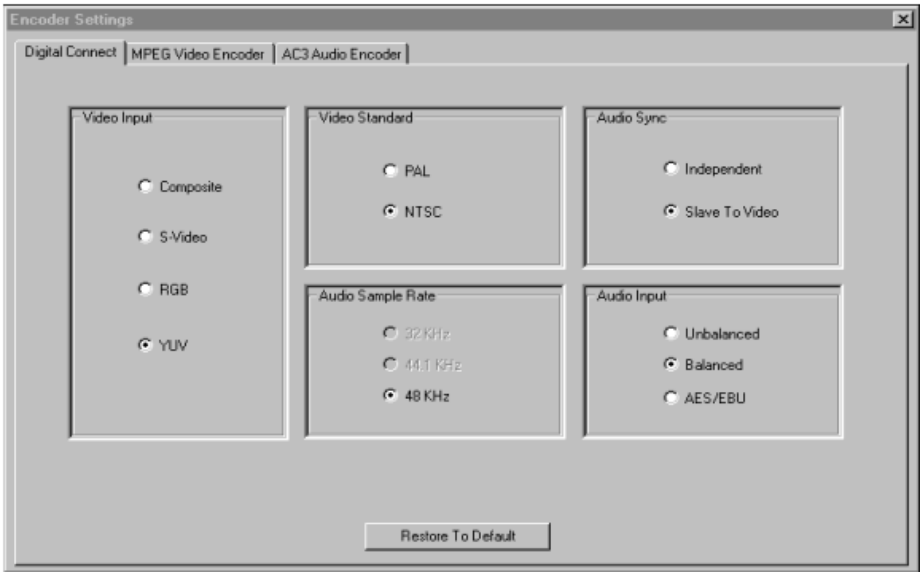
### Setting Up the Digital Connect Box

The following describes setting up the Spruce Digital Connect Box.

1. Within the Encode/Decode Control Panel, click on ***View*** then select ***Encoder Settings Window***.




2. This opens the Encoder Settings Window. This window has several tabs – for now, select the ***Digital Connect*** tab.




3. Set the Video Input to the appropriate analog video connection.

   *Note: For analog video input, a 3-wire component video connection (either **RGB** or **YUV**) is recommended for best quality. If your source tape deck does not provide these you can use time-base corrected **S-Video** or **Composite**.*

4. Set the Video Standard (***PAL*** or ***NTSC***) to match the source material and tape deck.

5. For the audio input, select ***Balanced*** (+4 dBu) or ***Unbalanced*** (–10 dBu) as appropriate.

6. Set the Audio Sample Rate to ***48 kHz*** .

   *Note: The only legal values available in the DVD Video specification for compressed audio are 48kHz and 96kHz.*

7. As long as an analog video source is connected to the Digital Connect Box, set the Audio Sync setting to ***Slave To Video***. This setting is important for encoding longer segments (long–form encoding), as drift in audio/video sync can result if the audio sample rate is not locked to a video clock reference. Select ***Independent*** if you have no analog video source connected.

8. Once you have completed these settings, you're ready to verify the video and audio input, as described earlier in this manual.

**Is the Digital Connect Tab Missing?**

If you do not see the Digital Connect tab in this window, check the following points:

- Ensure that the Digital Connect box is properly connected to the correct serial port (either COM port on the computer).
- Ensure that the Digital Connect box was powered on prior to opening the Encode/Decode Control Panel.

Once you have located and corrected the fault, close the Encode/Decode Control Panel completely and reopen it. This re-initializes its link to the Digital Connect Box. Then open the Settings window again.

If the encoding application still does not recognize the Digital Connect Box, switch the unit off and on again, then close and reopen the Encode/Decode Control Panel and Settings window. If you cannot establish communication with the unit (as shown by the Digital Connect tab in the Settings window) after carefully verifying all connections and power–cycling the unit, contact Spruce Technologies Technical Support for assistance.

# Index

## Numbers



## A



## B



## C

*Blank Page*

*(mostly)*