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AN INSIDER'S GUIDE TO CASIO® CZ SYNTHESIZERS

THE MOST COMPLETE HANDS-ON APPROACH TO PROGRAMMING ALL CZ SYNTHS

ANDREW SCHLESINGER
SYNTHETIC PRODUCTIONS

APPROVED BY CASIO

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for Leslie and Adam

BIOGRAPHY

Andrew Schlesinger is a synthesist/composer who has worked extensively in the field of synthesizer programming for the last 12 years. He studied synthesizer basics at the Boston School of Electronic Music in the late '70s, and in 1985 founded Synthetic Productions, an independent programming company dedicated to the production of a high-quality voice library for the Casio CZ line of synthesizers.

He is now recognized as one of the foremost authorities on CZ programming, and his CZ Super Casio Program voice cartridges are considered to contain some of the best patches available for these synthesizers. He currently resides in New York with his wife and son, and is creating a voice library for Casio's new VZ series of synthesizers.

CZ SUPER CASIO PROGRAMS

The CZ Super Casio Programs are a series of three different 64-voice RAM cartridges, each containing a wide variety of studio-quality patches that can be used in all of the CZ synthesizers.

For more information, please contact:

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PREFACE

Why another book on the CZ? Well, the main reason is that, although there are quite a few books and manuals that provide an abundance of technically oriented information on the CZ, there seems to be a definite lack of practical how-to, hands-on information on programming high-quality sounds using the Casio Phase Distortion method of synthesis. In fact, another title for this book might be "How to Program the Casio CZ Synthesizers by Yourself."

This book was written to provide you with a better understanding of how your CZ synthesizer generates sounds and with the necessary information for translating the sounds in your head into musically satisfying patches for your CZ synthesizer. The programming concepts discussed will focus mainly on the sound-generating sections that are common to the CZ-101/1000, 3000/5000, and CZ-1 machines, and will be applicable regardless of which machine you own.

The CZ synthesizers are deceptive machines, in that they can be both extremely simple and extremely complex to program at the same time. The fact that the sound-generating process of the CZ loosely resembles the more traditional analog method of synthesis (as opposed to, say, FM) makes comprehending the workings of the CZ much easier. In fact, once you understand the functions of the 10 or so basic modules, or building blocks, of the CZ's sound chain and how they interact, you will have a relatively easy and enjoyable time of creating some truly complex and musically satisfying patches.

ACKNOWLEDGEMENTS

Thanks to: my wife, Leslie, for all her encouragement and support, and for giving me such a beautiful son; Jerry Kovarsky and Ed Alstrom at Casio for their technical support; Jim Kahler at Micro R&D for cartridge support; Bruce Frausto for creative editing; David Schilling for a great logo; Alfred Publishing for making it real; Brent Hurtig at GPI Publications for the idea; and, my parents.

INTRODUCTION

Throughout this guide we have attempted to present the information in as simple a manner as possible, using musical rather than technical terms. Where it's been necessary to make use of technical terms in order to explain some basic concepts (as in the first chapter, "Sound Made Simple") we've tried to explain, along with the term itself, the value in learning the term and the advantage in using it over a more familiar, musical one. (These terms are introduced in **boldface**.) In these sections we've often included diagrams to illustrate the concepts being discussed. When direct reference is made to the use of a button on your CZ or to what you would see on the LCD window, it will appear in capital letters. You will notice that we've used the symbol "*n*" to represent a numeric variable on the LCD window.

If you are a beginner and have had little experience programming synthesizers, we urge you to read the first two chapters, "Sound Made Simple" and "Concepts of Control & Modules," as the information covered therein will make the understanding of your CZ, and, in fact, much of your audio-related equipment, much easier. By the time you have finished reading through this guide and have programmed the demonstration patches, you should have a much greater understanding of how your CZ works and be well on your way to enjoying many hours of successful sound creation.

We hope that you find this book both infomative and inspirational in your musical endeavors. Happy synthesizing!

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AN INSIDER'S GUIDE TO
CASIO CZ SYNTHESIZERS

1. SOUND MADE SIMPLE

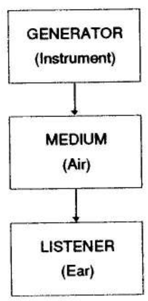


Figure 1

One of the keys to truly understanding how to program your CZ, or any synthesizer for that matter, lies in the understanding of some basic concepts regarding sound. A good, simple definition of **sound** is "vibration in the air." Three elements are needed for sound: a **generator** (i.e., anything capable of producing physical vibrations, such as a flute, a guitar, or a singing bird), a **medium** (i.e., the air itself), and *a listener* (fig. 1). To elaborate, the vibrations produced by a generator are transmitted through a medium (air) via the compression and expansion of air molecules. This intensification and relaxation of air pressure produces an acoustical **waveform** that is perceived by the listener as a sound.

The waveform representing a sound can exist in both acoustic and electronic forms. A common example would be a voice (i.e., an acoustical waveform) picked up by a microphone and transformed into electrical signals. Also common is the reverse process when an electrical signal (e.g., the one generated by your CZ) is fed through an amplifier, routed through speakers, emerging as an acoustical waveform.

The process of attempting to emulate or duplicate sounds that exist acoustically (e.g., a piano sound, the sound of a babbling brook) through electronic means (your CZ) is one that you'll frequently be engaged in when programming your synth. The closer you get to replicating on your synth the sound of, say, a piano, the closer the waveform generated by your synth will resemble that of the piano.

One concept that is helpful when attempting to analyze sounds is that of **visualization**. Essentially what is meant by the "visualization of a sound" is analyzing the sound and drawing a mental picture of the waveform's shape as it changes over time. As you read through this section this concept should become clearer, so for the moment put it in the back of your mind and read on.

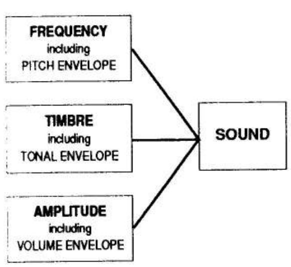


Figure 2

All waveforms have certain basic properties in common: **envelope, amplitude, frequency**, and **timbre**. Although these terms may be unfamiliar to you, you are probably already familiar with the ways in which they are commonly thought about: envelope corresponds to the shape of a sound over time, amplitude to loudness or volume, frequency to pitch, and timbre to tone color. These correspondences are somewhat approximate and are presented here as a way of easing you into these new ways of thinking about sound. What follows is a discussion of each of these properties in detail (fig. 2).

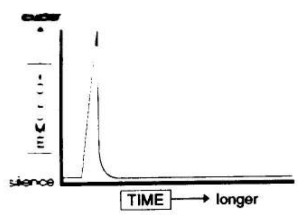


Figure 3a
Volume envelope of handclap

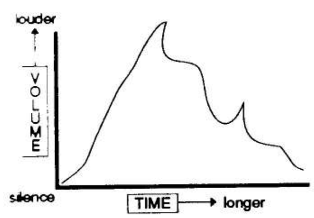


Figure 3b
Volume envelope of ocean waves

ENVELOPE

The concept of envelope is an important one, in that it directly relates to the amplitude, pitch and timbre of a sound. It is a key element in understand the how and why of a sound's character, and for this reason we'll discuss it first.

All sounds occur over time. They all have a beginning, middle, and end and occupy some definable amount of time, be it three milliseconds or three minutes. When we refer to the envelope of a sound we are refering to the way in which the amplitude, timbre, and pitch change over time. Although it is possible and likely that a sound might have a pitch envelope, timbre envelope, and an amplitude envelope, all occurring simultaneously, it is the amplitude envelope that is most often associated with the envelope concept and the one that will best illustrate this concept.

As a waveform occurs, its amplitude and the loudness of the corresponding sound will rise and fall over time. Figures 3a and 3b show the amplitude envelopes of two different waveforms: that of the sound of a handclap and that of the sound of an ocean wave.

The handclap happens over a short period of time, rising and falling quickly. The ocean wave, on the other hand, happens over a relatively long period of time, with a slower rise and a rolling decay. These diagrams are a graphic, or visualized, representation of how the amplitudes of these two waveforms change over time, and the shapes represent the speed and amount of amplitude change, i.e., the amplitude envelope of the waveform.

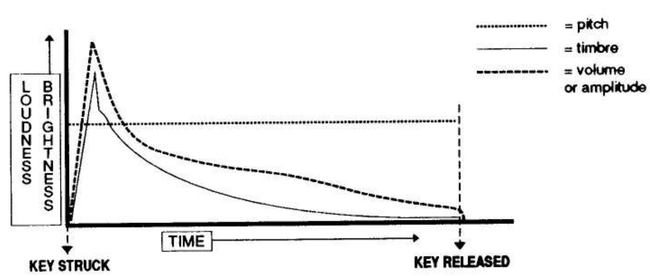


Figure 4
Envelope of a piano note

By carefully listening, you should be able to draw a graph of how the amplitude of a sound changes over time. (This is an example of the visualition concept we previously mentioned.) Try drawing the amplitude envelopes of some of the sounds around you, such as:

- a piano note (fig. 4)
- a train passing by
- the echoing yell for "Help!" in a canyon
- the "ribbitt" of a frog

This is a good exercise and one that will get you into the practice of "thinking envelope."

AMPLITUDE

Amplitude refers to the relative size of a waveform. A bigger waveform, i.e., one with a larger amplitude, results when a greater amount of energy is produced by a generator; when this higher-energy waveform is transferred to the air, it moves a larger mass of air than a smaller waveform does, and this results in a greater **sound pressure level** (SPL) and greater perceived loudness to our ears. Amplitude, then, is the acoustical term for **loudness.**

When you turn up the volume control on your CZ, what you're really doing is increasing the amplitude of the electronic signal (i.e., waveform) at the output of the instrument. This results in more energy being transmitted from your synth, to your amp, through speakers into the air. You perceive this increase in energy as an increase in volume or loudness.

FACTS:

A sound's amplitude or SPL is measured in increments called **decibels** (dB).

The smallest change in amplitude that the human ear can perceive is a decibel change of 3 dB.

A decibel change of 3 dB is equal to a doubling of the amplitude level or sonic power of a sound.

Although it is not necessary to know the actual decibel change that occurs in a sound, it is important to recognize how the amplitude of the sound changes over time. To faithfully emulate a sound, it is necessary to be able to recreate the amplitude envelope using the components of your synthesizer. Visualization of the amplitude envelope shape will help a great deal as you attempt to program your sound.

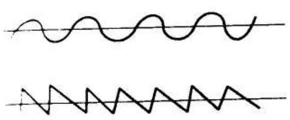
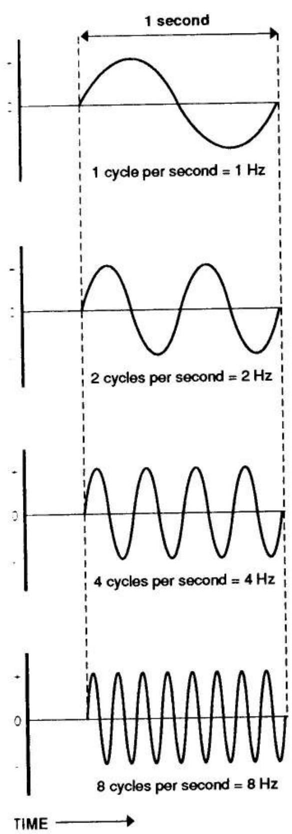


Figure 5
"Pitched" Waveforms



NOTE: moving up one octave is equal to doubling the frequency of the waveform

Figure 6

FREQUENCY

Frequency may be defined as the number of times an event occurs over a specific period of time. In the case of sound, which travels through the air as waveforms, the term frequency actually refers to the number of times a waveform repeats over a one-second period of time. This is measured in increments called **hertz** (Hz). So if we say that a sound has a frequency of 20 Hz, what we are really saying is that the sound's waveform is repeating 20 times per second.

Our ears are capable of perceiving frequencies that fall between roughly 20 and 20,000 Hz. Frequencies that occur within this range are called **audio frequencies**. Those sounds that we usually think of as being musical, such as those that can be sung, are perceived by our ears as having a definable **pitch**. The higher the pitch, the higher its frequencies (Hz); the lower the pitch, the lower the frequencies per second. The waveforms of pitched sounds have a reoccurring shape (fig. 5).

FACTS:

The frequency that determines the actual pitch of the sound (e.g., C, C#, D, D#, etc.) is called the **fundamental frequency.**

The amplitude of the fundamental frequency is the loudest component of a sound with a definable pitch.

Moving an **octave** in musical terms is equal to a doubling of the fundamental frequency (fig. 6). Here is an example of this concept: Let's say that you play concert A (440 Hz) on the piano. The fundamental frequency that defines the pitch of this note is 440 Hz. If you play the note an octave above concert A, the fundamental frequency of this note will be 880 Hz. If you play an A one octave below A 440, the fundamental of that note will be 220 Hz, and so on.

Some sounds do not have a definable fundamental frequency and thus no definable pitch. These sounds may have *many* frequencies of equal amplitude, all occuring at the same time. These fall into a category of untuned or "clangerous" sounds and include nonpitched instruments such as drums, woodblocks, cymbals, some types of bells and other metallic-type sounds. In contrast to figure 5, the waveforms for these nonpitched sounds do not have a reoccurring pattern (fig. 7).

When you attempt to re-create the sounds you hear using your synthesizer, there are two items that are good to keep in mind: a sound's frequency range and its pitch envelope. Frequency range refers to the frequency area that a sound falls into (i.e., bass, lower-midrange, midrange, upper-midrange, or treble). It's a good idea to start with your instrument set to the frequency range that is most similar to that of the sound you wish to emulate.

Many sounds rely on a change of their pitch over time, or pitch envelope, for much of their character. Instruments like the sitar, koto, and blues guitar all have some type of strong pitch bend or envelope that is an important element of their sound. When you attempt to emulate these types of sounds, be sure and consider their pitch envelopes. It will add a great deal of realism to the sounds you create.

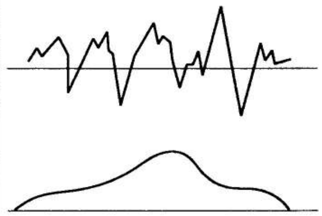


Figure 7
"Nonpitched" Waveforms

TIMBRE

Timbre refers to the tonal quality of a sound. When we describe a sound as being "bright" or "mellow," what we are really describing is the harmonic content of the sound's waveform.

The harmonic content of a waveform is made up of a group of frequencies called **harmonics** or **overtones**. These frequencies occur as **sine waves** (fig. 8), and their frequencies are mathematically related to the fundamental frequency of the sound. (A sine wave is the simplest type of waveform and consists only of a fundamental frequency; it has no harmonics other than the fundamental.)

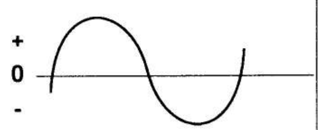


Figure 8
Sine Wave.
The most simple of waveforms, consisting of a fundamental with no harmonics

For example, if you play a piano note that has a fundamental frequency of 220 Hz (A below concert A), there will be a series of additional waveforms present in the sound (generally at lower amplitudes than the fundamental) whose frequencies are whole-number multiples of the fundamental frequency (i.e., 220 x 1 = 220 Hz, 220 x 2 = 440 Hz, 220 x 3 = 660 Hz, 220 x 4 = 880 Hz, 220 x 5 = 1010 Hz, etc.). These frequency multiples of 440 Hz, 660 Hz, 880 Hz, and 1010 Hz are the harmonics of the sound (fig. 9).

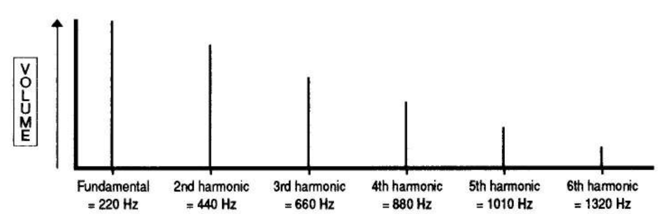


Figure 9
Harmonics

The amount and amplitudes of the harmonics that are present determine the timbre or tonal character of the sound. The larger the number of harmonics and the greater their amplitudes, the brighter the sound. The fewer the harmonics and the lower their amplitudes, the mellower the sound.

Another factor that is very important in determining the timbre of a sound is the way in which the amplitudes of these harmonics vary over time. This is known as the **harmonic envelope** of the sound. The amplitudes of each of these harmonics will individually increase and decrease over the life of the sound, and it is this harmonic change over time that is responsible for much of the sound's timbral or tonal character.

When you approach your synthesizer with the intention of re-creating a sound, it is important to replicate as accurately as possible the harmonic characteristics and the harmonic envelope of the sound in order to produce a realistic re-creation. As we stated earlier, the closer you get to replicating on your synth the waveform of the sound you're trying to duplicate, the closer the resultant sound will be to the original. Thus, it's a good idea to start with a waveform whose harmonic structure most closely resembles the harmonic structure of the sound you wish to emulate. Using the various modules of your synthesizer, you can then mold and shape the waveform to approximate the harmonic changes that takes place in acoustic sounds. Again, visualizing the overall shape of the harmonic envelope will be very useful as you attempt to construct your sounds.

2. THE CONCEPTS OF CONTROL & MODULES

The definition of **control** is to regulate, dominate, or to effect a change. The Casio CZ synthesizers are digitally controlled machines. This means that all of the sound-generating and programming functions are controlled or directed by an internal computer. In fact, the CZ is really nothing more than a computer that has been designed as a musical instrument.

When you push a button on the CZ's front panel, the computer "looks" to see what button you have pushed, then checks its operating system to see what function that button performs, and finally tells the synthesizer to respond in a particular way. All of this computation takes place in an incredibly short period of time, but all of the functions of the synthesizer are under the control of, or are being directed by, the computer. It is important to understand this idea of control, as it appears in many forms throughout the CZ synth.

In the CZ, there are certain components of the machine's circuitry that direct or "effect a change" in other components. Part "A" is used to direct, regulate or effect a change in some manner of Part "B," and the outcome of this process will have a predetermined effect on the sound that is produced by the synth. A good example is the keyboard "telling" the DCOs (Digitally Controlled Oscillators) what pitches to play. As you approach your CZ to program or modify a sound, it is helpful to try to determine which part of the synth is doing the controlling and which part is being controlled. If you are clear on these functions, it will be easy to predict the type of change that will occur in the sound as you change the parameters within a particular section of the synthesizer.

MODULES

At face value, your CZ synthesizer appears as a complicated myriad of buttons and switches, each with a different name and a different function. If, however, you understand that the "whole" of the synthesizer is the sum of the different parts, and you understand the functions of and interactions between those parts, the whole wil no longer appear so complex.

Even though different synthesizers from different manufacturers appear on the surface unique, they more often then not contain a great many simularities. All will have sections that provide some type of control over frequency, timbre, amplitude, and envelope. If you approach these different sections as discreet **modules**, or building blocks, and comprehend the function of each module individually, it becomes an easy task to decipher the way in which the synth as a whole creates sounds.

This modular approach can be carried over to almost all of your other audio gear; once you understand the functions of and interrelations between the different sections, the capabilities presented by the whole become much clearer.

The different modules that are used to create sounds in the CZ (and, in fact, most synthesizers) generally fall into one of three broad catagories. Any given module will be either a **generator**, a **modifier**, or a **controller**.

GENERATORS

A generator is a module that is directly involved in the generation of audio signals, which are used as the basis for the sounds created within the synthesizer. The main generators in the CZ's sound chain are the DCOs, which provide the raw audio signals used to create a sound.

Audio signals are one type of signal found in synthesizers. An audio signal would directly produce audible frequencies (sound) if it was amplified through an amp and speaker. Audio signals follow the "audio path" through the synthesizer and are represented in the block diagrams by arrows that move from left to right (——→).

MODIFIERS

A modifier is a module that performs some type of modification to either the timbre or amplitude of the audio signal. The main modifiers in the CZ include the DCW (Digitally Controlled Waveshaper), which modifies the harmonic content of the audio signal produced by the DCO, and the DCA (Digitally Controlled Amplifier), which modifies the amplitude of the audio signal. The Ring Modulator is also a type of timbre modifier but will be discussed in further detail later.

CONTROLLERS

Control modules in the synthesizer are the theoretical "directors" in the sound chain. They produce control signals, which are responsible for directing, regulating, and controlling the functions of the generators and modifiers. In fact, the generator and modifier modules are really kind of "static" in and of themselves. They need the controllers to "tell" them how to perform their respective functions. Again, the keyboard telling the DCOs what pitches to play is a good example of a control function.

Control signals are the second type of signal found in the synthesizer; these produce no audible frequencies (sound). The control signals follow the control path through the synthesizer, which is totally separate from the audio path. Control signals are represented by broken arrows (----▸) in the block diagrams used in this book.

The main controllers in the CZ include:

- the Keyboard
- the Envelope Generators
- the Low Frequency Oscillator (LFO)
- the Pitch Bend Wheel

As you approach your CZ, it is very helpful to take some time and examine the various sections to determine the types and numbers of the the different modules. This will give you a general idea of the capabilities of the machine. As always, however, only direct experience will really reveal the true potential of any piece of equipment.

3. PHASE DISTORTION EXPLAINED

Phase distortion, or PD for short, is a unique method of digital synthesis employed in the Casio CZ synthesizers. Although PD is a relatively new type of synthesis (about three years old), it bears more than a passing aural resemblence to the more traditional method of synthesis known as **subtractive synthesis**. Explaining how subtractive synthesis works is helpful in understanding how phase distortion creates sounds.

Most analog synthesizers utilize subtractive synthesis as their primary means of timbral modification. The term subtractive synthesis refers to the process of "taking away" or subtracting varying amounts of harmonics from a waveform.

The sound chain in analog synthesizers generally begins with a Voltage Controlled Oscillator, or VCO, that is capable of producing a number of harmonically rich waveforms. The most common of these waveforms are the **sawtooth** and the **square** (pulse) **waves**. These waveforms are fed

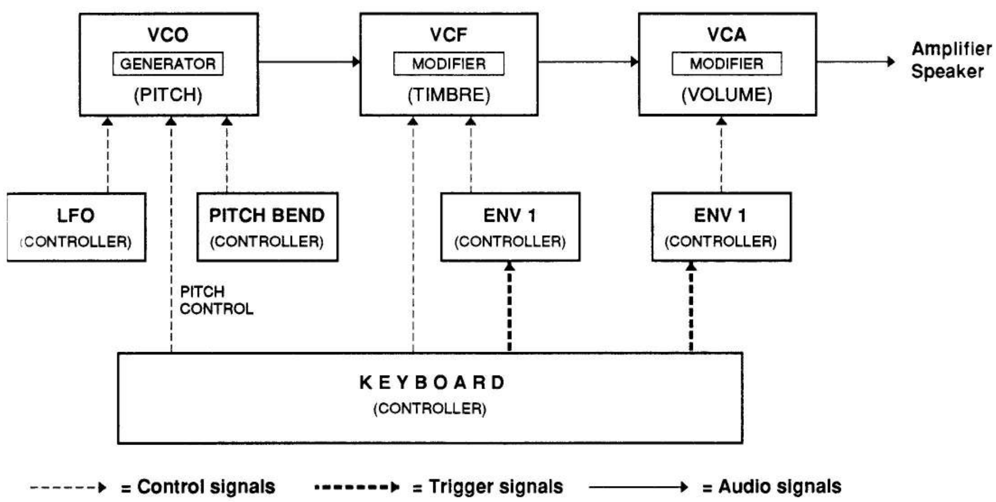


Figure 10
Typical analog synth sound source

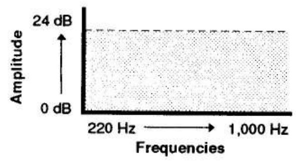


Figure 11a
220 Hz sound w/ harmonics

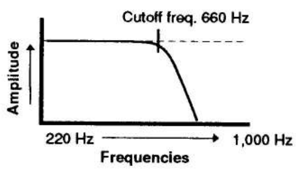


Figure 11b
Filter w/ cutoff at 660 Hz
(no sound present)

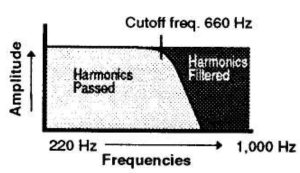


Figure 11c
Sound w/ filter effect

from the VCO into a modifier module called the Voltage Controlled (lowpass) Filter, or VCF. It is here in the VCF that the main part of the subtractive synthesis process takes place and where the aural resemblance to PD lies (fig. 10).

At this point, it might be helpful to distinguish between **voltage control** and **digital control**. Essentially, what voltage control refers to is using an actual electrical current to effect a change in some aspect of an electrical circuit. A simple example of voltage control might be a dimmer circuit on a lamp. As you turn the dimmer knob, you are varying the amount of electrical current that is going to the bulb and are controlling the bulb's brightness with voltage. A voltage-controlled synthesizer follows the same principle, in that as you turn a knob on the synthesizer, you are actually varying the electrical current within the synthesizer that is used to control some aspect of the synthesizer's circuitry (such as the frequency of the oscillators).

As we mentioned previously, digital control refers to using a computer to manipulate or vary some aspect of the sound. Most digital synthesizers use the computer to emulate the functions of voltage control, but actually program these manipulations in the digital domain (i.e., by altering numbers).

A lowpass VCF passes or "lets through" all of the frequencies contained in a waveform that fall below a certain specified frequency and filters out all of the frequencies that lie above this specified frequency. The frequency or point at which this filtering process begins is called the **cutoff frequency** or **cutoff point**. Figures 11a, b and c demonstrate the filtering action of a lowpass VCF (with its cutoff point set to 660 Hz) on the harmonic spectrum of an imaginary sound.

As you can see, all of the frequencies that fall below the cutoff point of 660 Hz are passed and remain in the signal, and all of the frequencies that lie above the cutoff frequency of 660 Hz are filtered out. Since the filter is voltage controlled, it is possible to move the cutoff point using a control module.

If you control the cutoff frequency with the signal from an envelope generator (a common controller for a VCF), it is possible to emulate the harmonic envelope of a sound. As the controlling envelope's waveform forces the cutoff frequency higher along the frequency spectrum and "opens" the filter, more and more harmonics are passed and the timbre of the sound gets brighter. As the envelope generator signal moves the cutoff point lower and "closes" the filter, a larger portion of the harmonics are subtracted from the sound. Using this process, it is possible to emulate the harmonic changes that take place in a sound over time.

Phase distortion is a way of generating and modifying waveforms that produces the sonic equivalent of subtractive synthesis. However, although the aural effect achieved using PD is very similar to that attained using subtractive synthesis, PD waveforms are generated using a totally unique, digital process. There are also a number of significant technical differences between these two processes.

Since the CZ is a digitally controlled machine, its audio chain begins with a Digitally Controlled Oscillator, or DCO. The DCOs in the CZ are only capable of producing one, harmonically simple type of waveform, the sine wave. As we mentioned previously, a sine wave consists *only* of the fundamental frequency and has no other harmonics.

Although these DCOs are only capable of generating sine waves, they are also capable of storing the "code information" for eight different, harmonically rich waveshapes in their ROM memory. Some of these waveforms are common, such as the sawtooth and square waves, some are combination waveshapes, and some are **resonant waveshapes** (or waveforms) whose purposes will be discussed later on. Each of these eight waveshapes has different harmonic characteristics; together they provide a large tonal palate with which to construct sounds.

The sine waves generated by the DCO flow into the Digitally Controlled Waveshaper, or DCW. This DCW is the sonic equivalent of the analog lowpass VCF, and it is here that the CZ's phase distortion process occurs and its timbre modification takes place.

In place of the VCF's controllable cutoff point, the CZ's DCW has a level setting whose effect is somewhat similar. When the level setting on the DCW is increased, the shape and phase angle of the sine wave generated by the DCO become increasingly more distorted. The way in which the DCW distorts this sine wave is determined by the DCW's reading of the code information of the waveform stored in the DCO's memory.

As the distortion of the sine wave becomes greater, the sine wave's shape is gradually transformed into the waveshape that has been selected on the DCO's Waveform Select parameter. This increase in the phase distortion (i.e., waveshape change) introduces more and more of the waveform's harmonics into the sound. The greater the degree of PD, the larger the number of harmonics generated and consequently the brighter the timbre.

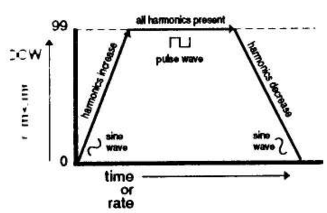


Figure 12
DCW level value effect on DCO waveform

When the highest level setting is reached on the DCW (99), the waveform appears at the DCW's output fully distorted into the waveshape chosen on the DCO. At this peak level setting, all of the harmonics characteristic of the particular waveform are present at their full amplitudes (fig. 12). Thus you can see that the level setting acts somewhat like the VCF, except, that as the level is increased, harmonics are *generated* and added to the waveform, as opposed to the operation of the filter's cuttoff which only passes varying amounts of harmonics *already* present in the waveform. The aural results produced by subtractive synthesis and phase distortion are incredibly similar, even though their methods of sound generation and timbre modification are completely different.

One other item worth noting is in regards to the resonant waveforms provided on the CZ. Since we are not dealing with a filter as such, there is no way to create a **resonant peak** to accentuate specific harmonics of the waveform. Instead, the CZ provides three resonant waveforms. Each of these waveforms contains a different accentuated harmonic content. If you use these waveforms in the construction of your sounds, it is possible to approximate the effect of having a VCF with its resonance control turned up. This control is one found on most VCFs.

As you increase the resonance, a certain amount of the filter's output is fed back into its input. This feedback increases the amplitude of a small section of the waveform just below the filter's cutoff frequency; this increase is called a resonant peak.

As the cutoff point of this resonant filter is moved up and down along the frequency spectrum, the harmonics whose frequencies fall just below the cutoff frequency get "caught" in this peak and are accentuated (fig. 13). The aural effect is that of these harmonics being "picked out" of the sound as the cutoff point is moved.

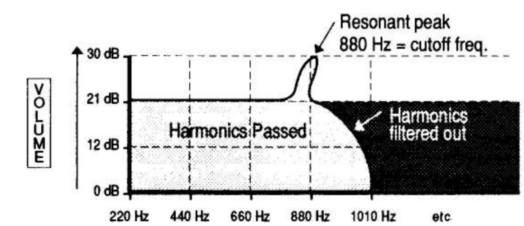


Figure 13
Effect of resonant peak of VCF on harmonics accentuated around 880 Hz

4. INSIDE THE ENVELOPES

The CZ's Envelope Generators (EGs for short) are without a doubt the single most complex component in the CZ's signal path. These EGs provide an incredible amount of dynamic control over the CZ's sound and can be individually programmed to generate a pitch envelope for the DCOs, a harmonic (or timbre) envelope for the DCWs, and an amplitude (or volume) envelope for the DCAs (fig. 14).

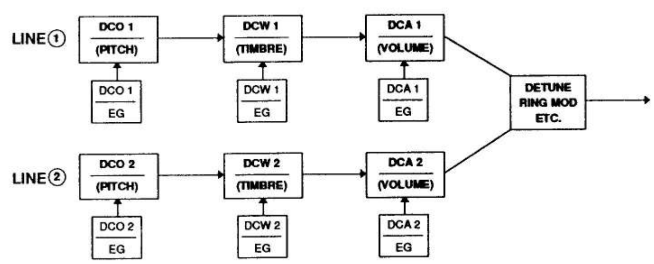


Figure 14
6 envelopes of the CZ

Although there are a total of six independent EGs in the CZ, they are all functionally identical; that is, once you understand the functions and programming of one, you will understand the functions and programming of all six.

Before going into detail on how to actually program these EGs, a few terms and concepts relative to envelopes should be touched on to aid you in your comprehension of this section. As mentioned previously, the envelope of a sound can be visually depicted by drawing a graph to represent the way in which the sound changes over time. By doing this, you will have a graph of the envelope's shape.

ENVELOPE SHAPES

The envelope shapes that are produced by most envelope generators can also be graphically represented. The most common type of EG is the **four-stage envelope generator**. This type of EG, found in most older analog synths, provides control over four main components (stages) of an

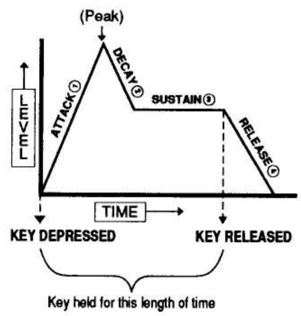


Figure 15
Typical 4-stage envelope

envelope's shape. These stages are the **attack, decay, sustain**, and **release** of the envelope. Refer to figure 15, which shows a graph of a typical four-stage envelope shape. This diagram should help to clarify the definitions of the different sections of the envelope that follow. (Note: Casio uses the term "step" instead of "stage" to describe the various sections of the envelope.)

ATTACK

This portion of the envelope occurs at the very beginning of a sound, as, for example, when you first press a key on your CZ keyboard. The attack section starts at the envelope's lowest level (00), and increases in amplitude to some "peak" setting. The speed at which the level of the envelope moves from the lowest point to its peak is called the **attack rate**, and the attack section ends when the peak is reached.

DECAY

With the key still depressed, the envelope moves from the peak level and begins to decrease in amplitude, or "decay." The speed at which the waveform travels in this portion of the envelope is called the **decay rate**. During the decay section, the level of the envelope will either travel back to the initial setting (00) or will stop at the next section of the envelope, known as the sustain section.

SUSTAIN

In the sustain section there is no change in the amplitude of the envelope. During this stage, while the key is still being depressed, the envelope remains (sustains) at some programmable level called the **sustain** level. The sustain time is governed by how long the key continues to be depressed. Once the key is released, the envelope moves into the release stage.

RELEASE

The release stage is the section where the level of the signal or envelope "dies away" after the note has been released. The release stage can also be refered to as the "final decay" stage. The speed at which the envelope moves from the sustain level back down to the initial setting (00) is called the **release rate**.

An important point to be aware of is that, although in the traditional four-stage envelope generator we have just discussed attack, decay, sustain and release are frequently thought of as equal sections of the envelope, they don't all represent the same thing. Attack, decay and release all refer to time or rate of change, while sustain refers to level or amplitude. This difference often proved a source of both confusion and frustration in the past. Much to their credit, Casio, as we will soon see, has designed the CZ EGs to provide much greater control over both rate and level throughout all stages of the envelope.

FACTS:

The envelope will cycle through these stages every time a key is depressed, providing the key is held long enough to accomodate the programmed rates of the different stages of the envelope. If the key is released before a stage of the envelope has time to travel its programmed length, the envelope will skip the remaining portion and move immediately to the release stage.

The envelope shape need not always follow the same pattern of attack, decay, sustain, and release.

By programming different envelopes for the timbre and amplitude, it is possible to better approximate the envelope characteristics of acoustic sounds.

The EGs that are provided in the CZ synthesizer are considerably more complex than the normal, four-stage EGs found in most synthesizers. The major difference lies in the fact that they offer the possibility of programming a total of eight different stages for each envelope. It is also possible to set the sustain section of the envelope anywhere within these eight stages. This allows you to program some incredibly complex envelope shapes, with a number of different attack and decay sections both *before* and *after* the sustain section.

Considering that there are a total of six different eight-stage envelopes, you could be faced with the task of programming a total of 48 different envelope sections. Needless to say, this could be a pretty overwhelming task even for the most experienced programmer. However, since it is not always necessary or useful to use all eight sections of each envelope, the CZ's designers were smart enough to provide a way to choose how many or how few sections you wish a particular envelope to have. You can have, for example, one envelope with eight sections, one envelope with two sections, and one envelope with six sections, all occurring at the same time and controlling different parameters of a sound.

ENVELOPE STEPS

As noted above, Casio uses the term "step" to refer to what we have been calling an envelope's "stage." Each of the CZ's envelopes can contain a total of eight different steps. These can be programmed to perform different functions within the envelope. The first things you need to know regarding the programming of the envelopes are how to access the various EGs, and what the different editable parameters are within each of the envelope steps.

Accessing an Envelope and Programming the Steps:

Press one of the buttons marked ENV in the Parameter section of the CZ that corresponds to the module you wish to program (i.e., DCO, DCW, or DCA). The LED above the button will light to let you know that the envelope is activated and can be programmed, and at the same time the parameters for STEP 1 of the envelope will appear in the LCD window. The LCD window will display the type of envelope selected (PITCH, WAVE, or AMP) along with the envelope step number (STEP = *n*). Rate and level are the two programmable parameters that make up an envelope step and will appear in the window along with the other information.

Rate

The value of the rate parameter (00-99) determines how quickly the envelope will travel from one level of the envelope to the next, or in other words, the length of time between two levels. The higher the rate value, the faster the rate of change; the lower the rate value, the slower the rate of change.

Level

The level value (00-99) determines the amplitude or degree of change for a particular step. As the level value increases, the effect on the module being controlled by the envelope (DCO, DCW, or DCA) will increase. For example, if you increase the level of the DCO envelope, the pitch of the DCO will rise in proportion to the amount of increase in level. If you lower the level setting, the pitch will return to its normal setting.

There are two things that should be noted regarding the first step of the envelope:

- In the first step, the envelope always starts from LEVEL 00 and travels up to the programmed level setting of this step.
- The rate of travel from LEVEL 00 to the programmed level setting is determined by the RATE value in the first step.

To Alter the Values of RATE or LEVEL:

1. Use the CURSOR buttons (< and >) in the Data Entry section to position the cursor (the flashing bar) under the RATE or LEVEL parameter you wish to change.

2. By pressing the VALUE buttons (**v** or **^**), you can decrease or increase the selected parameter's value. Pressing the VALUE button once will increase the value one step at a time; holding the button down will cause the value to scroll at a quick rate, allowing you to make large changes in a parameter's value relatively quickly.

One tip regarding the changing of envelope values: holding down any notes on the keyboard while you are attempting to scroll through the values of a parameter will slow down the speed of the scrolling process. It is best to first alter your values and then play the keyboard to hear what effect the change has had on the sound.

At this point it should be mentioned that you can only view and program one envelope step at a time. To program the values in one of the other steps, you must first call up that step on the LCD window using the ENV STEP buttons. You can use these buttons to cycle through the various steps of the envelope, one by one.

To Cycle through the Different ENV STEPs:

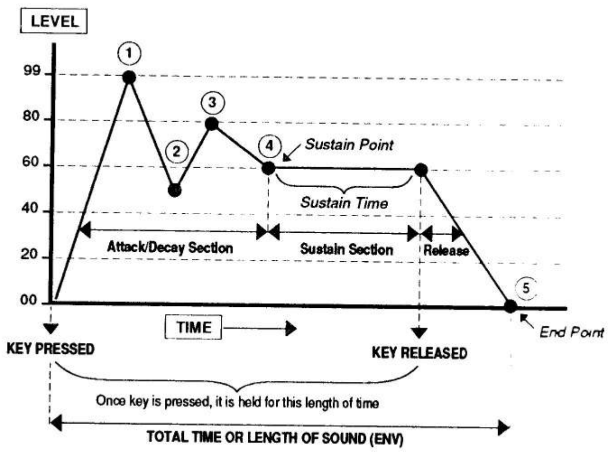
1. By pressing the buttons marked **v** (DOWN) and **^** (UP) under the ENV STEP heading to the right of the LCD window, it is possible to cycle through the different steps of the envelope in ascending or descending order. The envelope steps will automatically "wrap around" to the first step once you reach the last step in the envelope.

2. As you cycle through the various steps of the envelope, the RATE and LEVEL settings for each step will appear in the LCD window, along with the step number to let you know which ENV STEP you are viewing. Once you reach the step that you wish to program or edit, stop pressing the ENV STEP buttons, and the parameters for that step will immediately become active. At this point it is possible to program a new value for the RATE and LEVEL, or to alter an existing value.

3. To move to another step of the envelope use the ENV STEP buttons to cycle to the desired step number.

ENVELOPE POINT

If you look at figure 16 on the next page, you will notice that there are actually six segments to the envelope, even though only five steps were used. In addition to being the "second decay" section of the envelope, STEP 4 also functions as the **sustain point**.



STEP	RATE	LEVEL	STAGE	REMARKS
①	50	99	1st attack	....
②	40	50	1st decay	....
③	50	80	2nd attack	....
④	40	60	2nd decay	SUSTAIN POINT — point at which env remains until key is released
⑤	35	00	release	END POINT — level is 00

Figure 16
5-step envelope

SUSTAIN POINT

What sustain point (fig. 16) refers to is this: once a key is depressed, the envelope will travel through STEP 1, STEP 2, STEP 3, *and* STEP 4, and upon reaching the LEVEL value programmed into STEP 4 (a value of 60), the envelope will sustain, or remain at the programmed LEVEL (60), for as long as the key is held down (STEP 4). Thus, STEP 4 has been programmed as the sustain point. It follows then, that the level setting that has been programmed for whatever step is chosen as the sustain point automatically becomes the sustain level.

To Program and Set the Sustain Point:

1. Using the ENV STEP buttons, cycle through the envelope to the step number you wish to program as the sustain point.

2. Press the button labeled SUSTAIN under the Envelope Point heading. This will automatically set the step that is currently selected as the sustain point; the word SUS will appear in the LCD window to confirm this.

3. To turn the sustain point off, simply press the SUSTAIN button a second time.

FACTS:

The sustain point can be set to any step except the last step of an envelope.

There can only be one sustain point within an envelope. It is also possible to have no sustain point in an envelope.

The sustain point is "volatile" and will change any time you press the SUSTAIN button during the programming of an envelope. For example, if you program an envelope's sustain point to be set to STEP 3 and then cycle through the envelope to STEP 1 and hit the SUSTAIN button, STEP 1 will now be set and remembered as the sustain point, not STEP 3.

END POINT

The last programmable function or parameter of the EG is known as the **end point**. Setting the end point will determine which step will be the last one of the envelope. If you don't wish to use all eight envelope steps, you will need to shorten the envelope by setting the end point to a lower-numbered step.

Programming the End Point:

1. To select any of the eight possible steps as the end point, press the button marked END under the Env Point heading to the left of the LCD window. This automatically sets the currently displayed step as the end point.

2. The step number that has been selected as the end point will determine the total number of steps within the envelope. If you set STEP 5 as the end point, for example, only STEPs 1 through 5 will appear on the LCD as you cycle through the various envelope steps.

3. Pressing the END button a second time while the current lower-numbered end point (below STEP 8) is being displayed in the LCD window will automatically reset the end point back to STEP 8. Pressing the END button while any other step is being displayed will automatically set that step as the end point.

4.The end point's level parameter will automatically be set to a value of 00 when the end point is selected. No other value can be programmed for this step. The end point functions as the Release section of the envelope, and the RATE value of this step will determine the envelope's release rate.

INSIDER'S TIPS ON EG's

There are a number of quirks to the CZ's EGs that should be mentioned. These are not evident at face value, and can be very useful to know while programming an envelope:

1. The RATE and LEVEL values for all eight steps of the envelope are remembered as part of the patch, even if you set the end point to a lower-numbered step and store the patch with this lower-numbered end point.

For example, let's say that you have programmed a complex, eight-step envelope for the DCA. Now you want to hear what the envelope will sound like with only four steps, so you move the end point to STEP 4, listen to the sound, and decide that you liked the patch better with the end point at STEP 8. Pressing the END button a second time while STEP 4 is being displayed on the LCD will automatically move the end point back to STEP 8. If you cycle through the envelope, all of the previously programmed steps will appear with their RATE and LEVEL values intact.

The only problem you might encounter during this process is when you shorten an already shortened envelope. The end point is always reset to STEP 8 when it is moved from a lower-numbered end point. Always make a mental note of where the previous end point was set if you are editing an envelope with less than eight steps.

2. *You can turn any of the envelopes off by moving the end point to STEP 1.*

Since the LEVEL value for the end point is automatically set to 00, setting the end point to STEP 1 will cancel the envelope's effect. If you do this to the DCA envelope, it will shut off the sound of the line completely. If you are not getting any sound from one of the lines, check to see if the DCA envelope's end point is set to STEP 1.

3. There must be at least a one-increment difference between the LEVEL settings of successive envelope steps for the EG to "recognize" that the second step exists.

If the LEVEL of STEP 1 is 33, and the LEVEL of STEP 2 is 33, and the LEVEL of STEP 3 is 34, the computer will ignore and bypass STEP 2 and move directly to STEP 3, since it cannot detect any LEVEL change between STEP 1 and STEP 2. Always shorten your envelopes to include only the steps that have a change in the value of the LEVEL parameter from the previous step. This will make viewing the various steps within an envelope much clearer and quicker.

That about covers the basic programming tips regarding the CZ's EGs. By now you should have some idea of how the envelopes are programmed and understand what the different sections and functions of the envelope are. Figure 17 displays several possible envelopes one could program, however the possibilities are endless.

The envelope generators are really the heart of the CZ. Generally, the largest amount of programming time is spent setting up and refining the different envelopes within a sound. As with anything, only practice, trial and error, and time will provide the experience necessary to become an effective CZ EG programmer.

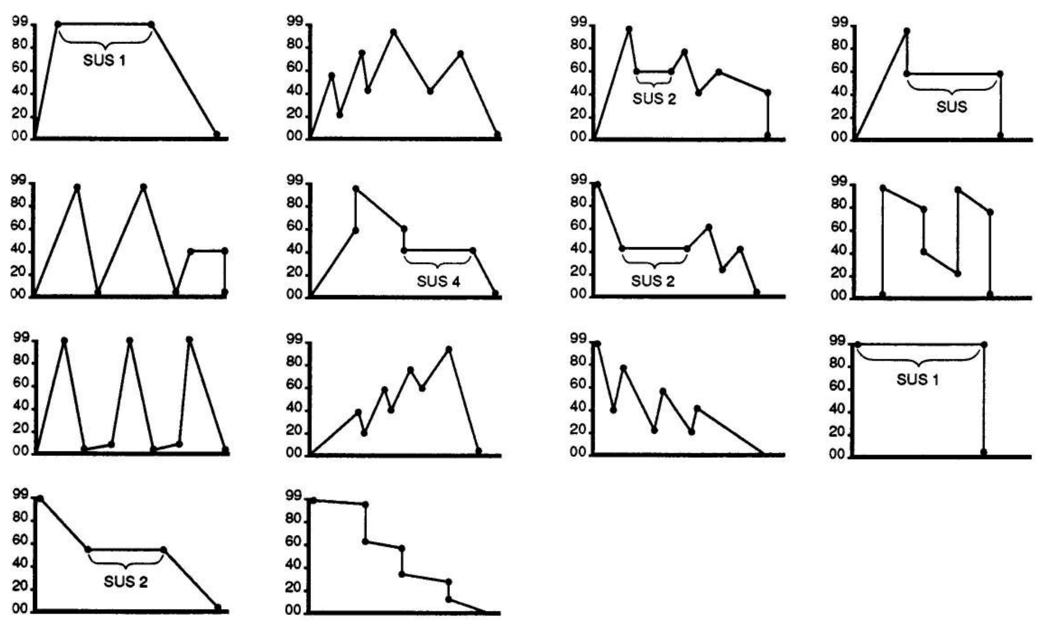


Figure 17
Possible CZ envelopes

5. ANATOMY OF THE CZ

This section will describe in detail the different modules and components of the CZ (see fig. 18) and will provide a number of facts and figures about each section that might not be readily apparent. This information should answer many questions you might have regarding the functions of the various sections of the CZ.

All CZ synthesizers are comprised of essentially four main sections: the Effect, Programmer, Data Entry, and Parameter sections. Each of these sections houses a group of controls that govern one of the major aspects of the CZ's programming. Starting from the CZ's extreme left is the Effect section.

THE EFFECT SECTION

The Effect section of the CZ houses the synth's performance-oriented controls. These include Vibrato On/Off, Pitch Bend Range, Portamento On/Off, and Portamento Time. Also found in this area is the Pitch Bend Wheel, which provides real-time control over the "bending" of pitch.

VIBRATO ON/OFF

The VIBRATO button allows you to turn the vibrato effect on and off at any time. There are a few facts specific to each CZ model that govern the use of this button.

FACTS:

(CZ 101/1000)

The CZ 101/1000 do not provide any real-time control over the depth of the vibrato; vibrato depth is programmed in the Parameter section of the synth.

Any patch that has been programmed to include any amount of vibrato depth will always appear with the vibrato on whenever it is selected. Pressing the VIBRATO button once will turn the vibrato off; pressing it a second time will turn the vibrato back on. Remember, this button has no effect on the depth of the vibrato, it only turns the effect on and off.

It is possible to control the Vibrato On/Off function from an external MIDI controller. The Mod Wheel (Modulation Wheel) of most larger synthesizers (CZ-1, DX-7, etc.) will turn the vibrato on as you raise the Mod Wheel and turn it off as you lower the Mod Wheel. Various synthesizers require different amounts of Mod Wheel "travel" to turn the vibrato on and off. Again, this will only turn the vibrato on and off and will have no effect on its depth.

(CZ-3000/5000 & CZ-1)

These CZ models provide a Mod Wheel, which *does* allow real-time control over the depth of the vibrato effect. There are a few differences in the functioning of this button on these models.

The ON/OFF switch located above this wheel allows you to choose whether vibrato depth will be controlled by the Mod Wheel (vibrato on) or by the setting programmed in the Parameter section (vibrato off, as on the CZ 101/1000).

When the Mod Wheel is being used to control the depth of the vibrato, the programmable Vibrato Delay in the Parameter section is disabled. (The function of the Vibrato Delay is covered later in this chapter.)

When the vibrato is on, its depth can be controlled by an external MIDI controller as well as by the Mod Wheel.

PITCH BEND RANGE

Pressing the BEND RANGE button allows you to set the maximum range of pitch shift that will occur when the CZ's Pitch Bend Wheel is moved to its maximum setting. This setting affects both the positive and negative travel of the Pitch Wheel--e.g., if the range is set at 7, the pitch will rise a 5th when the wheel is moved up to its full extension and will drop a 5th when the wheel is moved down to its full extension.

FACTS:

BEND RANGE is set in half-step increments using the VALUE buttons in the Data Entry section.

Pitch Bend always affects both DCOs.

Pitch Bend can be controlled by an external MIDI controller.

The BEND RANGE setting governs the maximum pitch shift that is "receivable" from an external controller.

BEND RANGE is a "global" setting, i.e., it affects all of the CZ's patches the same and cannot be individually programmed for each patch.

PORTAMENTO

Turning the Portamento on causes the pitch of a note to "glide" to the next as you play the keyboard instead of there being an instantaneous change from one note to the next. This "slurring" effect is most noticable between long note distances.

FACTS:

PORTAMENTO ON/OFF turns the effect on and off. This function can be remotely controlled via MIDI.

Pressing the PORTAMENTO GLIDE button allows you to program the "glide time" between notes. The higher the value, the longer the glide time; the lower the value, the shorter the glide time.

PORTAMENTO TIME is a global setting.

In the Solo Mode, the portamento effect will only be heard if you play legato (i.e., if your articulation of the notes is smooth and continous). If you play stacatto (i.e., short and "choppy"), you will not hear any portamento.

When the CZ is played polyphonically, the portamento will not always travel from the last note you play to a new note. It can be difficult to predict where the pitch will actually glide from when you are playing polyphonically.

THE PROGRAMMER SECTION

The Programmer section contains all of the patch storage and recall functions. This section enables you to select patches from either the preset, internal or cartridge areas, and to selectively swap and store different patches within these locations.

PRESETS

The CZ 101/1000 each contain 16 preset sounds as part of their patch memories; the CZ 3000/5000 contain 32.

FACTS:

(CZ 101/1000)

Presets are permanent and cannot be "written over."

It is possible to edit the presets and store them in an internal or cartridge location.

Presets are the only patches that will appear with names in the LCD window. Names cannot be assigned to internal or cartridge sounds.

Presets will respond to MIDI patch numbers 01-16 and 17-32. Choosing patch 17 on an external MIDI keyboard will call up PRESET NO. 01 on the CZ; choosing patch 18 will call up PRESET NO. 02, etc. Thus, each preset responds to two MIDI patch numbers.

(CZ 3000/5000)

Nearly all aspects of programming presets for the CZ 101/1000 are the same for the CZ 3000/5000 except that there are 32 presets arranged in four banks (A, B, C, D) each containing eight sounds (1-8).

Presets respond to MIDI patch numbers 1-32.

INTERNAL (CZ 101/1000)

The CZ 101/1000 provide 16 internal RAM locations for additional patch storage.

FACTS:

Internal locations can be used to store edited versions of the presets, original sounds created using the Parameter section, or patches transferred from RAM catridges.

Internal locations respond to MIDI patch numbers 33-48 and 49-64. As with the presets, the MIDI patch numbers will "wrap around," so that MIDI patch 49 will call up INTERNAL NO. 33 on the CZ, MIDI patch 50 will call up INTERNAL NO. 34, etc.

Although you can write over the internal sounds that come with the machine, these factory sounds are permanently stored in the CZ's memory. To recall all of the original internal CZ sounds, turn the CZ over and insert a sharp object (such as a pencil or pen) into the little hole with a "P" next to it, located under the CASIO name on the underside of the machine. Be aware, however that this will erase any sounds that you may have stored in the internal memory locations and replace them with the original factory sounds. If there are any sounds in the internal bank you wish to save, store these at some other memory location.

CARTRIDGE

All of the CZs provide a cartridge port that allows you to store your patches using any of the types of RAM cartridges available for your particular CZ. Cartridges provide a convenient way to access a large number of patches and range in memory capacity from 16 to 64 patches. Pressing the CARTRIDGE button in the Programmer section allows you to access any one of the 16 cartridge patches available per bank.

FACTS:

(CZ-101/1000)

A cartridge must be inserted into the cartridge port at the back of the CZ to access any of the cartridge patches.

The CZ-101/1000 allow you to access 16 cartridge patches one at a time.

The cartridge locations respond to MIDI patch numbers 65-80 and 81-96.

(CZ-3000/5000)

The CZ-3000/5000 do not allow you to access the cartridge patches directly. They must first be transferred or "dumped" into the internal locations.

COMPARE/RECALL

The COMPARE/RECALL button is used to "toggle" back and forth between an edited and unedited version of a patch.

FACTS:

Altering any parameter in the Parameter section of the CZ will immediately light the LED above the COMPARE/RECALL button. This indicates that you have edited one or more of a patch's parameters.

The edited version of the patch is automatically sent to a temporary buffer inside the CZ, which is a memory location that is used to temporarily hold the altered version of the patch.

Pressing the COMPARE/RECALL button on and off will switch between the edited and unedited versions of the sound, allowing you to compare them.

The edited version of the patch will remain in this temporary buffer indefinately, even if the power is turned off.

To recall the edited version of the patch, simply press the COMPARE/RECALL button and the altered version will automatically appear.

The only way in which the edited version of the patch can be erased from the buffer is by editing a different patch. This will erase the old patch and replace it with the new one you've decided to edited.

You can use the COMPARE/RECALL buffer as a "mock" 17th internal patch.

If you like the edited version of a patch, it is a good idea to store it into an internal or cartridge location, as it is very easy to forget that the sound is only *temporarily* held in this buffer. If you begin to edit a new patch, the old one will be lost forever.

SOLO

Pressing the SOLO button puts the CZ's keyboard in a monophonic mode. In this mode you can only play one note at a time. This mode is particularly useful for lead sounds or bass sounds that have a long release time.

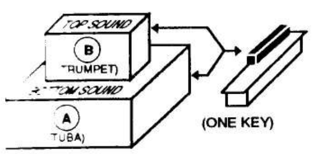
FACTS:

(CZ-101/1000)

Solo Mode is a global setting and cannot be programmed for each patch.

(CZ-3000/5000)

Same as the CZ-101/1000 except that when using the Spilt Keyboard Mode, either half of the keyboard can be set to Solo Mode.



A - patch must be selected prior to entering TONE MIX
- LED's in Programmer section stay lit indicating patch choice
- patch can only be changed if you exit TONE MIX

B - patch selected displayed on LCD window
- patch can be changed in Tone Mix Mode by pressing different PRESET/INTERNAL/CARTRIDGE buttons
- volume can be changed (lowered) for top sound to balance against bottom sound

Figure 18
Typical Tone Mix

TONE MIX

The Tone Mix Mode allows you to "stack" one patch on top of another, or in other words, to play two sounds at the same time (see fig. 18). This mode is very useful for creating more complex, composite sounds that would otherwise be unachievable. It is also useful for creating a thicker sound by stacking the same patch on top of itself.

FACTS:

(CZ-101/1000)

When you press the TONE MIX button, the patch that is currently displayed will become the bottom tone in the "stack." This patch cannot be changed while in the Tone Mix Mode and the LED above this patch will become "frozen." This is to let you know which patch has been selected as the bottom sound.

It is possible to use a preset, internal, or cartridge patch as the bottom tone.

At the same time, the LCD window will display the patch that has been selected as the top tone of the Tone Mix stack and will indicate whether it is an internal, preset, or cartridge patch along with the patch number. It is possible to change the top tone simply by pressing any patch number in any of the patch groups (internal, preset or cartridge). The LCD window will display these patch changes.

The LCD will also display the TONE MIX LEVEL. This determines the volume of the top sound only and can be set to a value from 1 to 9 (9 being the loudest).

The only way to choose a different bottom patch is to exit the Tone Mix Mode, choose a new patch (this will become the new bottom patch), and then press the TONE MIX button again. The new bottom patch will "freeze," and the patch that was previously chosen as the top sound will automatically be reset, along with the TONE MIX LEVEL. In fact, the top sound and the TONE MIX LEVEL will be remembered until new values are chosen, even after the machine is turned off.

The only way to change the volume of the bottom patch is to exit the Tone Mix Mode and edit the DCA values of the patch. Before you do this, try switching the top and bottom patches using the TONE MIX LEVEL to create the right balance.

Pressing the TONE MIX button on the CZ-101/1000 creates a type of "pseudo-mono" mode on the keyboard. In theory, this mode should halve the number of notes that you can play. Since the CZ-101/1000 are four-voice polyphonic, using the Tone Mix Mode should cut the polyphony down to two notes. Unfortunately this is not the case, as we are only allowed to play one note at a time in this mode, i.e., monophonically. But there is a curious phenomenon that occurs in this mode: if you are using a sound that has a long release time, playing a second note will *not* cut off the release of the first note (as usually happens in a monophonic mode); only by playing a third note will the "trail" of first note be cut off. This can cause a problem when you are using patches with long release times. For example, with bass sounds, having every other note's release cut off instead of every note's release will create a "muddy" sound. Thus, you can't really use this mode to create thicker sounds if the individual sounds of the mix have long release times in the bass register.

(CZ-3000/5000)

The CZ-3000/5000's Tone Mix function is similar to that of the CZ-101/1000 except that here you can adjust the volume levels of both the top and bottom sounds individually. The values of the level parameter range from 0 to 15, with 15 being the loudest setting. It is not possible to actually boost the level of the patches; you can only attenuate or lower their respective volumes so as to create a proper balance between them.

If the overall volume of the composite sound is too low, turn up the CZ's master volume control to compensate.

As you move the cursor under each of the two different tones in the LCD window, the LED in the Programmer section will change to indicate which patch has been selected for that particular tone (e.g., tone A = INTERNAL NO. 5; tone B = PRESET NO. 8). To choose a different patch, simply move the cursor under the tone you wish to change (A or B), and call up a different internal or preset patch.

It is possible to play four-note polophony in the Tone Mix Mode on these instruments.

It is possible to use both the presets and the internal patches in a Tone Mix, and the Tone Mix remembers the last combination of patches that were chosen.

To Set a Tone Mix:

1. Press the TONE MIX button in the Mode section near the upper-left portion of the synthesizer. The CZ will enter the Tone Mix Mode and the LCD will read TONE MIX LEV 1 = *n*, LEV 2 = *n*.

2. LEV 1 = *n*: Placing the cursor under this parameter allows you to adjust the output level of Tone 1.

3. LEV 2 = *n*: Moving the cursor under this parameter allows you to perform all of the previously discussed functions for Tone 2.

KEYBOARD SPLIT (CZ-3000/5000)

The CZ-3000/5000 offer the ability to split the keyboard, allowing you to play two different sounds, each on a different half of the keyboard. In addition it is possible to program where the "split point" will occur along the keyboard. In this way you can determine how much of the keyboard you would like to allocate to each sound. The CZ will automatically allocate four voices to each side of the split keyboard, allowing you to play four-note chords on each section, each with a different patch.

To Set a Keyboard Split:

1. Press the KEY SPLIT button in the Mode section. The LCD window will display three items of information which are explained in procedures 2, 3 and 6 below.

2. SP *n* (Split Point number)--This parameter allows you to set the note number where the keyboard split will occur. To change this value simply move the cursor under the number associated with SP, and press the VALUE keys in the Data Entry section. For example, setting this value to

24 will split the keyboard at "C3" (the third C from the bottom), which is a good split point for having a bass sound on the left and a lead sound on the right.

3. LOWER/LEVEL = *n*--Moving the cursor one step to the right will place it under the LOWER/LEVEL function. There are two parameters that can be set here, explained in the next two procedures.

4. You can select the patch that will sound on the lower half of the keyboard. The LEDs above the currently selected lower patch will automatically light to let you know which patch has been set. To set a different patch, press the appropriate buttons for the one you want. This will now become the patch for the lower half and will be remembered until another patch is chosen.

5. It is also possible to program a LEVEL setting for each half of the keyboard. This allows you to balance the mix between the Lower and upper sounds. This parameter (*n*) can have a value from 1 to 15 with 15 being the loudest setting. Let's note again that you can only attenuate or cut a sound's volume by choosing a lower value; you cannot actually boost the volume, as a LEVEL setting of 15 is equal to a patch's normal volume.

6. UPPER/LEVEL = *n*--Moving the cursor one more step to the right allows you to set all of the previously mentioned parameters for the upper half of the keyboard.

KEY TRANSPOSE

The Key Transpose function allows you to transpose the entire range of the keyboard up six and one-half steps or down five steps in half-step increments.

FACTS:

KEY TRANSPOSE is a global setting and cannot be programmed for individual patches.

Altering the KEY TRANSPOSE setting *will* affect the pitch of incoming MIDI information. If you find the CZ is transposing information, check the KEY TRANSPOSE setting to be sure it reads for the key of C. Altering the Key Transpose function will not alter MIDI note transmission.

WRITE

The WRITE button performs a record function on the CZ and is used in conjunction with the INTERNAL and CARTRIDGE buttons to save and transfer single patches, edited versions of patches, or groups of patches

CAUTION

1. This process, along with the ones that follow, will erase the data located in the "destination" memory location (the location where you are going to store the patch), and replace it with the new "source" data (the actual patch you want to store), although it *won't* erase the patch from its original memory location. Always check to make sure that you are willing to erase the patch in the destination location, as it will be lost forever!

2. If you are storing a patch into locations #9 to #16 on the CZ-101/1000, be sure to press the SELECT button *before* pressing the patch number!

3. The Write Protect Switch at the back of the CZ must be in the off position *prior* to saving or loading internal or cartridge patches.

between these two memory locations. There are a number of different options available when storing sounds using the WRITE button. Since it can be very easy to erase patches while storing or transferring them, we will cover these options in detail so that you won't lose that "one great patch" that is irreplaceable.

If the COMPARE/RECALL LED is lit during the transfer process, you will be storing the edited version of the patch that is being held in the temporary buffer, not the original version. So if you *want* to store an edited version of a patch, make sure that the COMPARE/RECALL button's LED is lit.

Writing to Internal--Single Patch (CZ-101/1000):

This process allows you to store a sound into one of the 16 internal patch locations.

1. Choose the source sound you wish to store from its internal, cartridge, or preset location.

2. Press the WRITE button and hold it down.

3. While holding down the WRITE button, press INTERNAL, then the destination patch number (1-16) where you wish to store the sound.

4. The LCD window will read WRITE OK! to let you know that the sound has been stored in the desired location. Release all buttons.

Writing to Cartridge--Single Patch (CZ-101/1000):

This process allows you to store any one patch to any of the 16 cartridge locations. A CZ-compatible RAM cartridge must first be inserted to perform this and all other functions involving the transfer of patches to and from a cartridge.

1. Turn the CZ's power off and insert the cartridge in the cartridge port.

2. Turn the CZ back on.

3. Choose the source patch.

4. Press and hold down the WRITE button.

5. While holding the WRITE button, press the CARTRIDGE button, then the destination patch number. (see CAUTION)

6. The LCD window will read WRITE OK! Release the buttons.

CAUTION

Always turn off the CZ *before* inserting or removing the cartridge. Failure to do so may result in the loss of your patches!

REMEMBER

SAVE is *always* used to transfer sounds *to* the cartridge from the CZ (either internal or preset).

Saving 16 Internal Patches to Cartridge (CZ-101/1000):

This process allows you to transfer a set of 16 internal or preset sounds to a 16-voice cartridge. If you are using a 32- or 64-voice cartridge, this process will write the sounds into whichever bank of the cartridge you select. Sixty-four voice RAM cartridges usually contain four banks of 16 patch locations each, and provide switches to move between the banks. Make sure that you have selected an empty bank or a bank containing sounds that you are willing to lose, as this process will erase any patches located in the bank you have chosen and replace them with the internal sound data.

1. Turn the CZ's power off and insert the cartridge in the cartridge port. (see CAUTION)

2. Turn the CZ back on.

3. Press the INTERNAL button to select the internal sounds as your source group.

4. Press and hold the WRITE button.

5. While holding the WRITE button, press the CARTRIDGE button, then the SAVE button. The LCD window will read SAVE OK! when the internal patches are transferred to the cartridge. Release all buttons.

6. Compare cartridge patch 1 to internal patch 1. They should be the same, since the internal sounds are not erased during this process.

Loading 16 Cartridge Voices into Internal Memory (CZ-101/1000):

This process allows you to transfer a bank of 16 cartridge patches into the 16 internal memory locations. As with the last process, the source sounds (cartridge patches) will not be erased, but any sounds that are stored in the internal locations will be replaced with the cartridge patch data. If there are any internal sounds that you want to save, make sure that you transfer them to a blank cartridge or to a computer librarian before proceeding.

1. Turn the CZ off and insert the cartridge into the cartridge port.

2. Turn the CZ back on.

3. Set the switches on the cartridge to the appropriate bank. (This step is only applicable if you are using a 64-patch cartridge.)

4. Press the CARTRIDGE button to choose cartridge patches as the source data.

REMEMBER

LOAD is *always* used in transferring sounds *from* the cartridge to the CZ's internal locations.

5. Press and hold the WRITE button.

6. While holding the WRITE button, press INTERNAL and then the LOAD button. The LCD window will read LOAD OK! when the cartridge patches are transferred to the internal locations. Release all buttons.

7. Compare internal patch 1 to cartridge patch 1. They should be the same, since the cartridge patches will not have been erased.

Writing to Internal--Single Patch (CZ-3000/5000):

Writing a single patch into one of the internal locations on the CZ-3000/5000 works much the same way as with the CZ-101/1000. This process allows you to store any preset or internal patch or an edited version of a patch into one of the 32 internal patch locations. As with the CZ-101/1000, if the COMPARE/RECALL LED is lit, you will be storing the edited version of the patch that is currently selected, not the original version.

1. Select your source patch.

2. Press and hold the WRITE button.

3. While holding the WRITE button, press one of the four internal patch bank buttons (A, B, C, D), then the number of the destination location (1-8). Release all buttons.

4. Compare the source location and the destination location sounds. They should be the same.

REMEMBER

The patch that is stored in the destination location will be erased and replaced with the patch data of the source sound.

Writing to Cartridge (CZ-3000/5000):

It is not possible to write single patches directly to the cartridge in these instruments. It is only possible to transfer banks of 16 patches between the cartridge and the internal locations. These CZ models allow you to transfer two different banks of 16 patches between the cartridge and the internal positions. One bank is composed of the 16 patches in banks A and B; the other of the patches in banks C and D.

There are a few things to keep in mind regarding the storing of patches to cartridge in the CZ. If you are using Casio RA-3 RAM cartridges for storage, remember that they will hold a total of 32 sounds, stored as two sets of 16 voices. However, you'll only be able to access all 32 sounds via the CZ-3000/5000; if you plug these RA-3 cartridges into a CZ-101/1000, you will only be able to access the first bank of 16 sounds, not the second.

The second item is regarding the use of the 64-voice RAM cartridges that are available. These cartridges can hold four banks of 16 sounds. To store all 32 internal voices, it will be necessary to use two banks of the cartridge: one bank for internal A & B (16 sounds), and a second for internal C & D (16 sounds).

Saving Internal Banks A & B to Cartridge:

1. Turn the CZ off and insert the cartridge. If you are using a 64-patch RAM cartridge, set the switch on the cartridge to BANK A or 1.

2. Turn on the CZ.

3. Press the INTERNAL button and the BANK A button.

4. Press the CARTRIDGE button. The LCD window will read CARTRIDGE SAVE OR LOAD.

5. Press the SAVE button. The LCD window will read SAVE CARTRIDGE BANK A, B (Y/N)?

6. Press the YES button in the Data Entry section. You have just saved internal banks A & B to the cartridge.

Saving Internal Banks C & D to Cartridge:

If your cartridge is still plugged in and the power is still on, proceed. If the cartridge is not plugged in, turn the CZ off and insert the cartridge, then turn the power back on. If you are using a 64-patch RAM cartridge, switch it to BANK B or 2 now. If you are using a Casio RA-3 RAM cartridge, you do not have to do anything at this point.

1. Press the CARTRIDGE button. The LCD window will read CARTRIDGE SAVE OR LOAD.

2. Press the SAVE button. The LCD display will read SAVE CARTRIDGE BANK A, B (Y/N)?

3. Press the NO button in the Data Entry section. The LCD window will now read SAVE CARTRIDGE BANK C, D (Y/N)?

4. Press the YES button in the Data Entry section. You have now saved banks C & D to the second bank of your 64-patch RAM cartridge, or to the second 16-patch location of your Casio RA-3 RAM cartridge.

Loading a Set of 16 Cartridge Patches into Internal Banks A & B:

1. Turn the CZ off and insert the cartridge.

2. Turn the CZ on. If you are using a 64-patch RAM cartridge, set the bank switch to the bank you wish to load into the synthesizer.

3. Press the CARTRIDGE button. The LCD window will read CARTRIDGE SAVE OR LOAD.

4. Press the LOAD button. The LCD window will read LOAD CARTRIDGE BANK A, B (Y/N)?

5. Press the YES button in the Data Entry section. You have now loaded the 16 cartridge patches from the selected bank of your 64-patch RAM cartridge into Internal Banks A & B. If you are using a Casio RA-3, the first 16 patches of the cartridge will be loaded into internal banks A & B.

Loading a Second Set of 16 Cartridge Patches into Internal Banks C & D:

1. If your cartridge is already inserted and the power is still on, proceed. If not, turn off the power, insert the cartridge and turn your CZ back on. Also, if you are using the same 64-patch RAM cartridge, switch it to the second bank that you wish to load into the CZ.

2. Press the CARTRIDGE button. The LCD window will read CARTRIDGE SAVE OR LOAD.

3. Press the LOAD button. The LCD window will now read LOAD CARTRIDGE A, B (Y/N)?

4. Press the NO button. The LCD window will read LOAD CARTRIDGE C, D (Y/N)?

5. Press the YES button. You have now loaded the second set of 16 patches from your Casio RA-3, or the currently selected bank oι your 64-patch RAM cartridge.

That covers nearly all of the major cartridge storage functions for the CZ-3000/5000. The only other type of storage is with a computer librarian, which will not be covered here.

THE DATA ENTRY SECTION

The Data Entry section is where the values of the various editable parameters can be altered and, during the voice-editing process, is probably the most consistantly used section of the CZ. This is also the easiest section of the CZ to understand, as there are only two functions that are controlled here: the cursor movement and the value change. This section also contains the LCD window.

CURSOR

The cursor is the little flashing bar that appears in the LCD window whenever an editable parameter is called up. Some of the editable functions in the CZ are comprised of more than one editable parameter. By using the two CURSOR buttons, it is possible to move the cursor between the various parameters of a particular function. Placing the cursor under one of these parameters "activates" that parameter and allows its values to be edited.

VALUE

The function of these two buttons should be pretty apparent. The button with the arrow pointing down (**v**) allows you to decrease the values of the active parameter; the one with the arrow pointing up (^) allows you to increase the active parameter's values. Pressing a button once moves the value one increment. Pressing and *holding* the button will cause the values to scroll at a rapid pace, allowing you to make large value changes quickly. As we mentioned before, holding down any keys on the keyboard while scrolling will slow down the process.

LCD WINDOW

The LCD (Liquid Crystal Display) window provides the CZ with a means of communicating to the outside world; it displays much of the information concerning the CZ's various functions and parameters. The displays on the CZ-101/1000/3000/5000 are not backlit and do not offer any contrast control. It is generally necessary to view these displays at a certain angle to provide the best possible readability. Only experimentation will determine what is the best viewing angle for your particular setup.

THE PARAMETER SECTION

The Parameter section is dedicated to the actual creation of sound. This section houses all of the CZ's sound-generating modules, and provides access to all of the parameters used in the sound-editing process.

VIBRATO

There are four programmable parameters that determine how the vibrato will affect a particular sound. Pressing the VIBRATO button in the Parameter section of the CZ will call up and display these parameters. They are WAVE, DELAY, RATE and DEPTH.

Wave

This parameter allows you to choose which of the four different waveshapes will be used for the vibrato effect. These waveforms are the sine, reverse sawtooth, sawtooth and square.

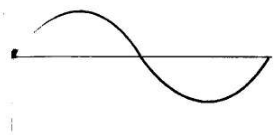


Figure 19a
Sine wave

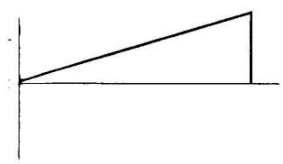


Figure 19b
Reverse sawtooth wave

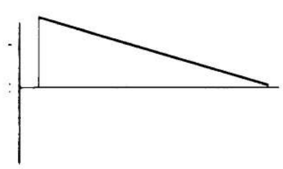


Figure 19c
Sawtooth wave

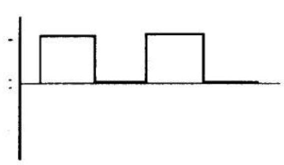


Figure 19d
Square wave

Sine (fig. 19a)--This is probably the most commonly used vibrato waveform, as it produces the smoothest, most realistic type of pitch modulation.

Reverse Sawtooth (fig. 19b)--Also known as a "reverse ramp" wave; this will cause the pitch of the oscillators to gradually rise and then instantaneously drop back to the "base" pitch, then rise again, etc. This waveform produces a rather unnatural sounding vibrato and is most often used as an effect.

Sawtooth (fig. 19c)--This wave is the exact opposite of reverse sawtooth.

Square (fig. 19d)--This wave will produce a trilling type of pitch modulation in the DCOs. This waveform will instantaneously raise and hold the pitch of the DCO for half of the wave's cycle, then instantaneously drop the pitch back down to the base pitch for the other half of the cycle. Using this waveform you can program the pitch to alternately switch between a predetermined upper pitch (determined by the DEPTH value) and the base pitch. The RATE value will set the speed of the trill.

Delay

This parameter determines how much time will elapse between the pressing of a key and the onset of the vibrato's effect. The DELAY parameter can have a value between 00 and 99. A setting of 00 will cause no delay to occur. As the value increases, the length of the delay will increase.

Rate

This parameter determines the frequency of the vibrato waveform (how many times a second the vibrato waveform will repeat). A setting of 00 represents the slowest rate, a setting of 99 the fastest.

Depth

This parameter determines the amount or depth of the pitch modulation effect. The higher the value, the greater the amount of modulation to the DCO's pitch. The DEPTH parameter must be set to a value of 01 or higher for the vibrato effect to be active. If the DEPTH value is set to 00 the vibrato will effectively be turned off.

FACTS:

The vibrato effect only works in a "positive" direction when WAVEFORMS 2, 3, and 4 are chosen (see the section on DCOs). This means that the pich will start at a "base" pitch and move upward. Only WAVEFORM 1 will cause the pitch to move alternately positive and negative around a base pitch.

The vibrato is retriggered every time a key is depressed. If one key is pressed and held and then another key is pressed, the vibrato will restart,

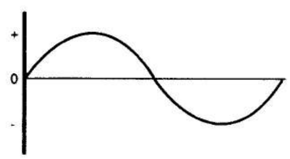


Figure 19a
Sine wave

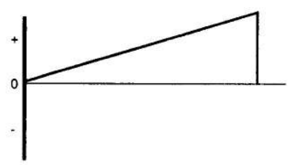


Figure 19b
Reverse sawtooth wave

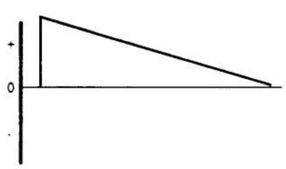


Figure 19c
Sawtooth wave

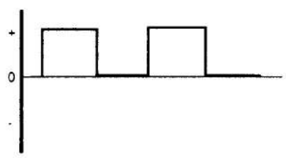


Figure 19d
Square wave

Sine (fig. 19a)--This is probably the most commonly used vibrato waveform, as it produces the smoothest, most realistic type of pitch modulation.

Reverse Sawtooth (fig. 19b)--Also known as a "reverse ramp" wave; this will cause the pitch of the oscillators to gradually rise and then instantaneously drop back to the "base" pitch, then rise again, etc. This waveform produces a rather unnatural sounding vibrato and is most often used as an effect.

Sawtooth (fig. 19c)--This wave is the exact opposite of reverse sawtooth.

Square (fig. 19d)--This wave will produce a trilling type of pitch modulation in the DCOs. This waveform will instantaneously raise and hold the pitch of the DCO for half of the wave's cycle, then instantaneously drop the pitch back down to the base pitch for the other half of the cycle. Using this waveform you can program the pitch to alternately switch between a predetermined upper pitch (determined by the DEPTH value) and the base pitch. The RATE value will set the speed of the trill.

Delay

This parameter determines how much time will elapse between the pressing of a key and the onset of the vibrato's effect. The DELAY parameter can have a value between 00 and 99. A setting of 00 will cause no delay to occur. As the value increases, the length of the delay will increase.

Rate

This parameter determines the frequency of the vibrato waveform (how many times a second the vibrato waveform will repeat). A setting of 00 represents the slowest rate, a setting of 99 the fastest.

Depth

This parameter determines the amount or depth of the pitch modulation effect. The higher the value, the greater the amount of modulation to the DCO's pitch. The DEPTH parameter must be set to a value of 01 or higher for the vibrato effect to be active. If the DEPTH value is set to 00 the vibrato will effectively be turned off.

FACTS:

The vibrato effect only works in a "positive" direction when WAVEFORMS 2, 3, and 4 are chosen (see the section on DCOs). This means that the pich will start at a "base" pitch and move upward. Only WAVEFORM 1 will cause the pitch to move alternately positive and negative around a base pitch.

The vibrato is retriggered every time a key is depressed. If one key is pressed and held and then another key is pressed, the vibrato will restart, and any DELAY that has been programmed will occur before the vibrato begins.

The vibrato waveform always starts from the same position in its cycle every time a new key is pressed. This allows you to create a repeatable type of pitch envelope when the RATE is slow, the DEPTH value high, and the DELAY set to 00.

The VIBRATO parameters are programmable for each individual patch.

OCTAVE

Pressing the OCTAVE button allows you to transpose the register of a patch up or down by one octave using the VALUE UP/DOWN buttons. Altering the OCTAVE setting will automatically send the patch to the Compare/Recall buffer. The OCTAVE setting is programmable for each patch.

THE LINE: THE CZ SOUND CHAIN

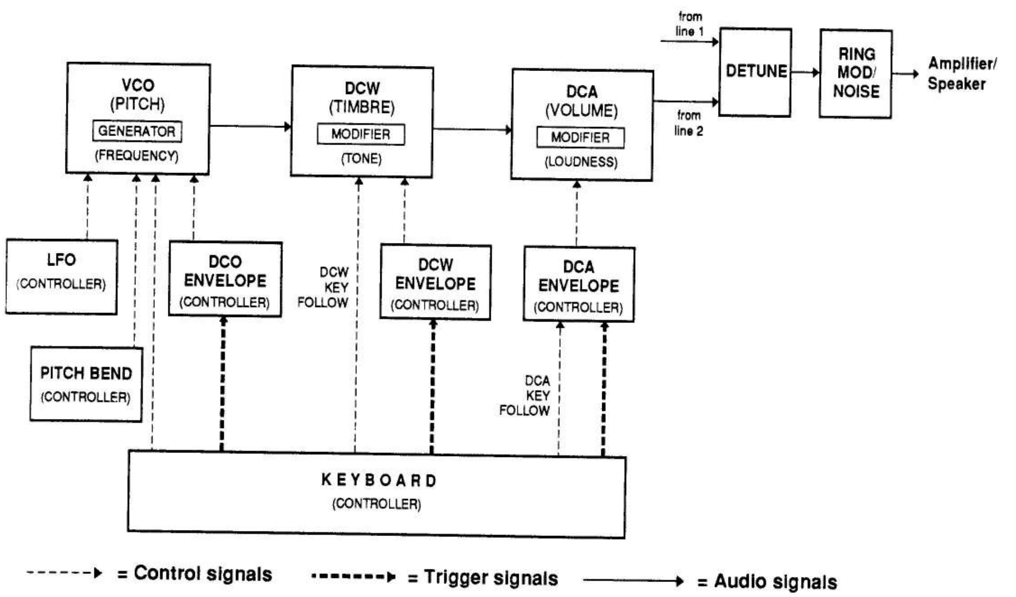


Figure 20
The CZ line

The basic sound chain in the CZ is comprised of a group of modules known as a **line**. Figure 20 is a diagram that shows the various modules that make up a line and the relationships between them. Although we will go into detail about the functions of the individual modules in a moment, it's important to emphasize here that the lines are the overall "sound sources" in the CZ and that each is capable of producing a complete sound. It is also important to know how the different output combinations of the lines affect the final sound.

The CZ provides two completely independent lines, cleverly called LINE 1 and LINE 2. These lines can be individually programmed to produce two completely different sounds, or they can be programmed to combine in different ways to produce one single, composite sound.

There are four possible choices as to how the lines can be arranged to produce a sound. These are LINE 1 only, LINE 2 only, LINE 1 + LINE 2, and LINE 1 + LINE 1.

LINE SELECT

The LINE SELECT button is found to the extreme right of the Parameter section. This button allows you to select one of the four possible line output combinations.

FACTS:

LINE SELECT is independently programmable per patch.

Repeatedly pressing this button will cycle through the four line combinations one at a time and will cycle back to the first position once the last position has been reached.

The LEDs above this button will light, indicating which line combination has been chosen.

The CURSOR buttons have no effect on this function and the LCD window will not display which line has been chosen. The LEDs above this button are the only indication as to which line has been chosen.

It is possible to edit any of the parameters in either of the two lines, regardless of which line's output is selected. If you find yourself editing a sound and do not hear any audible change, make sure that LINE SELECT is set to the line you wish to hear.

LINE 1 Only

When this position is chosen, only the output of LINE 1 is sent to the CZ's output. Editing any of the parameters in LINE 1 will be audible in this mode. This mode also allows 8-note polyphony on the CZ-101/1000 and

16-note polyphony on the CZ-3000/5000. Any alteration of the parameters in LINE 2 will not be audible in this mode.

LINE 2 Only

When LINE SELECT is set to this position, only the output of LINE 2 is sent to the CZ's output. The editing of any parameter in LINE 2 will be audible in this mode. As with LINE 1 only, this mode allows the CZ-101/1000 8-note polyphony and the CZ-3000/5000 16-note polyphony. Any alteration of the parameters in LINE 1 will not be audible in this mode.

LINE 1 + LINE 2

This is probably the most complex position of LINE SELECT and offers the most interesting and varied sound possibilities. In this mode, the outputs of both LINE 1 and LINE 2 are mixed together into a composite mono signal that appears at the CZ's output.

This mode cuts the CZ's polyphonic capabilities in half, by allocating half of the voices to LINE 1 and half of the voices to LINE 2. Thus, in this mode the CZ-101/1000 is capable of playing only 4-note polyphony instead of 8, and the CZ-3000/5000 is capable of playing 8-note polyphony instead of 16. Although the polyphonic capability is diminished, the greater overall sound complexity that is offered in this mode compensates nicely for this loss.

Each of the two lines is independently programmable in this mode, and any parameter editing that is performed on either line's parameters will be audible. The thing to remember here is that you are provided with the capability of using each line to generate two completely independent tones. These two tones can be combined in a number of different ways.

Programming Possibilites for the Lines:

1. You can program the lines as two completely separate tones to sound like two different instruments playing at the same time.

2. You can program the two lines as two portions of a single sound, using each line to generate a different section of the sound's overall waveform.

3. You can use the above combinations along with the DETUNE function to create chorusing and organ-type effects.

4. You can use the two lines along with the RING MODULATOR function to enhance the harmonic content of the composite sound.

5. It is possible to turn LINE 2 into a noise source by pressing the NOISE button while in this mode.

The DETUNE, RING MODULATOR, and NOISE functions will be covered in greater detail after the discussion of the functions of the different modules within the lines. We have mentioned them here because they provide for some additional output possibilites when using this mode.

LINE 1 + LINE 1

This mode is similar to using LINE 1 + LINE 2 except for the fact that whatever sound you have programmed on LINE 1 will appear twice. It works like this: instead of having the second line be LINE 2 which produces a completely different tone, the second line is set to produce exactly the same sound as LINE 1. So in a sense you still have two lines, but they both produce the same tone by using the parameters that are programmed on LINE 1 (see fig. 21). Programming LINE 2 in this mode will have absolutely no effect on the sound.

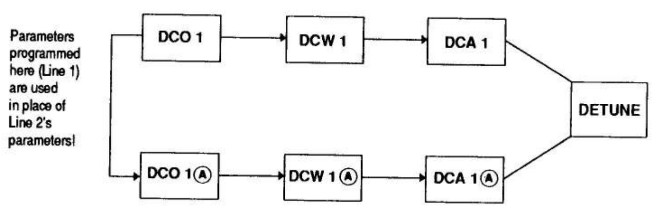


Figure 21
Line 1 + 1
(Both lines used - 4 voices)

You still are provided with the same type of polyphony as with the LINE 1 + LINE 2 mode, only the parameter section of LINE 2 is inactive and the parameters of LINE 1 are imposed on it. As with LINE 1 + LINE 2, you can also use the DETUNE, RING MODULATOR, and NOISE functions, although you will not have as much control over the way these functions affect the sound. Again, the upcoming sections covering these functions will explain them more thoroughly.

If you want to create a tone where both lines are producing exactly the same sound (and you will), this is the mode that you use. It's a lot easier than having to reprogram all of LINE 2's parameters to be the same as LINE 1's, and will save you a great deal of time. Some of the patches in the "Tricks and Tips" chapter will use LINE 1 + LINE 1; these should help to further clarify the purpose and value of this mode.

WAVEFORM HARMONIC CONTENT

It is important to have an idea of the harmonic content of each of the eight individual waveforms before discussing the DCOs in detail. Whether you attempt to emulate an already existing sound, or construct an imaginary sound from scratch, it is very helpful to know what the basic waveforms you are using sound like. It's much easier to recreate a sound when you start with a waveform whose harmonic content most resembles that of the sound you wish to copy.

There are a few things to keep in mind during this discussion of the different waveforms. The first is that these waveforms will only appear in their full "splendor and glory" (all harmonics present at the correct amplitudes) when the DCW's LEVEL value is set to 99. Any value lower than this will alter the harmonic content of the waveform. Therefore, it might be a good idea to set the first step on the DCW as the sustain point, and to set a LEVEL value of 99 for that step. If you then switch between the different waveforms, you will hear each with all of its harmonics present. It is also a good idea to only listen to one DCO at a time and to only use WAVEFORM 1. Keep WAVEFORM 2 off, as it will interfere with the harmonic content of the first. Following these suggestions will make comparing the different waveforms easier.

Figure 22
WAVEFORM 1

WAVEFORM 1: Sawtooth Wave (fig. 22)

This is probably the most common waveform, as it is found on almost all synthesizers. The sawtooth wave contains all harmonics, the amplitudes of which are successively weaker the farther they are from the fundamental. The sawtooth wave is characterized by its full sound and provides a good starting point for creating brass, string and other sounds that require a full harmonic content.

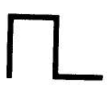


Figure 23
WAVEFORM 2

WAVEFORM 2: Square Wave (fig. 23)

The square wave is probably the second-most common waveform and is also found on a large majority of synths. The square wave contains only the odd-numbered harmonics (i.e., 3rd, 5th, 7th, 9th), the amplitudes of which are also dependent on their closeness to the fundamental frequency. None of the even-numbered multiples of the fundamental frequency ("even" harmonics), are present in this waveform and are, therefore, inaudible.

The square wave (also known as the pulse wave) is a "hollow-sounding" waveform, and provides a good starting point for flute sounds, electric piano sounds, bell sounds (with the Ring Modulator), and many ethnic/metallic percussion-type sounds.

Figure 24
WAVEFORM 3

WAVEFORM 3: "Tri-pulse" (fig. 24)

This waveform is unique to the Casio CZ-series synths and has no generic name. For purposes of discussion, we have chosen the name "tri-pulse" since the waveform appears to be a combination of a thin triangle waveform and the "low" portion of a pulse wave. This waveform is characterized by a larger concentration of higher harmonics and a fundamental whose amplitude is much lower in comparison to the pure sawtooth waveform. This waveform has a very thin, "reedy" type of sound. We have found this waveform to be most useful when it is used in conjunction with another waveform that contains a stronger fundamental. Adding this waveform to a sawtooth wave, for example, will produce a composite waveform that is full-sounding, with an accentuated upper-harmonic content.

We'd like to mention once again that sound is a very subjective area. What sounds good to one person may very well sound lousy to another. This discussion on the sounds of different waveforms is only intended to be a guideline. Only through listening and experimentation will you be able to determine what sounds best to your ears. It is also important to keep in mind that it is possible to create flute-type sounds with waveforms other than the pulse wave (to use only one example). These are only suggestions to indicate which waveform has usually or most often been used to create a specific sound. There are no rules!

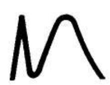


Figure 25
WAVEFORM 4

WAVEFORM 4: "Tri-sine" (fig. 25)

Here again we have suggested a name for this waveform since it is one that is unique to the CZ. This wave appears to be a combination of a thin triangle wave and a sine wave. This waveform has one characteristic that sets it apart from all of the others in the CZ. Its fundamental frequency is an octave higher than those of the other waveforms. This means that when you call up this waveform it will sound an octave above any of the other waveforms and that all of its harmonics will consequently be raised by an octave.

At high DCW level settings, this waveform is the fullest of all of them, providing both a strong fundamental and an accentuated high harmonic content. This waveform is excellent for creating that classic "full, open-filter, analog synth sound." This wave's harmonic characteristics also make it excellent for constructing organ-type sounds (at lower DCW level settings and when combined with one of the other "full" waveforms).

Figure 26
WAVEFORM 5

WAVEFORM 5: "Sine-pulse" (fig. 26)

As above, this waveform, as well as the following three, is unique to the Casio CZ, so once again we have been forced to create a name. This waveform most resembles one quarter of a sine wave attached to half of a square wave. The resultant waveform sounds very much like a mellower version of the sawtooth wave, with a fairly strong fundamental and a slightly high harmonic content. This waveform will produce a fairly rich, mellow sound and functions well as an "all-purpose" waveform. We have found that this waveform usually ends up being used in conjunction with other waveforms, rather than on its own. Of course, you might find otherwise. Experiment.

Figure 27a
WAVEFORM 6

WAVEFORMS 6, 7, & 8: "Resonant Waves" (fig. 27a, b, c)

These three waveforms are all unique to the CZ synthesizers and are

Figure 27b
WAVEFORM 7

Figure 27c
WAVEFORM 8

useful in a number of different ways. As we mentioned in the section on phase distortion, the CZ does not employ any type of low-pass filter, and therefore isn't able to create the effect of a resonant cutoff/peak that accentuates or "picks out" individual harmonics of a waveform. However, by including these "resonant" waveforms, the CZ provides a way for you to approximate this type of effect, while at the same time increasing the variety of sounds that can be created.

Each of these "resonant" waveforms has a different accentuated harmonic content. As the LEVEL of the DCW increases and decreases, the harmonics of each of the waveforms will "pop out" and will appear slightly louder than the surrounding harmonics. This creates a rather "buzzy," "sweeping" effect that is extremely similar to the one created by a "resonant filter." The harmonic contents of these three waveforms differ slightly from one to the next and we can only describe the differences subjectively.

WAVEFORM 6 seems to have a somewhat lower-amplitude fundamental frequency, and the upper-harmonic content appears to resemble that of a sawtooth wave. This waveform has a "buzzy," "sharp" quality. WAVEFORM 7, on the other hand, has a stronger fundamental, or at least appears to, since it has a lower concentration of upper harmonics. This wave is the mellowest of the three and most resembles a sine wave. The last resonant waveform, WAVEFORM 8, is the fullest of the three, combining both a fairly strong fundamental with a full, even-sounding upper harmonic series. We have found this waveform to provide the strongest "resonance" effect.

THE DCO

Each of the two lines begins with a DCO (Digitally Controlled Oscillator). These DCOs are the primary audio signal generators and provide the audio signals which are subsequently modified to produce the final sound of the line.

Waveform Select

Since we have already discussed how the different waveforms are created in the "Phase Distortion Explained" chapter, we won't go into detail about this process again. Just remember that the DCOs produce sine waves that are distorted into different waveshapes by the DCW. The DCW reads the code information stored in the DCOs' waveform memories and distorts the sine waves acording to these "blueprints." For the moment, let's assume that the DCOs are generating different waveforms.

Each of the DCOs is capable of producing two different waveforms at one time, providing a greater selection of harmonically rich tones. Pressing the WAVEFORM SELECT button activates the two programmable waveform locations and displays them on the LCD window. The LED above the button will also light to let you know that you have activated this function.

FACTS:

WAVEFORM SELECT is independently programmable for each of the two DCOs per patch.

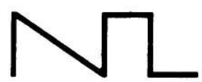


Figure 28
Combination of WAVEFORM 1 and WAVEFORM 2

It is possible to select two different waveforms by moving the cursor to the FIRST parameter in the LCD window, pressing the VALUE buttons to choose one of the eight possible waveforms, then repeating the process only positioning the cursor to the SECOND parameter. The different waveforms are printed under the LCD window with their corresponding numbers. Two examples of combined waveforms are shown in figures 28 and 29.

If two waveforms are chosen, their mix will automatically be set; it will not be possible to alter the balance between them.

Figure 29
Combination of WAVEFORM 5 and WAVEFORM 6

It is not possible to turn off both waveforms. WAVEFORM 1 is always active. It is possible, however, to turn off WAVEFORM 2 by setting its value to 0.

Setting both waveforms to the same value (i.e., FIRST = 2, SECOND = 2) is exactly the same as setting only WAVEFORM 1 to that value and turning WAVEFORM 2 off. In other words, it's a waste of time to set both values the same, as there is no audible difference from only using one waveform.

The pitch of the DCOs can be controlled by four different control sources. These are the LFO (or vibrato), which can be turned on or off, the pitch bend which is always active for both DCOs, the keyboard which is also always active for both DCOs, and finally the DCO Envelope Generator which can be programmed to alter the pitch.

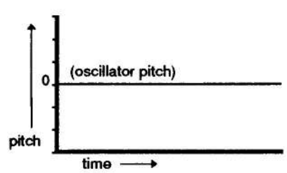


Figure 30a
Normal oscillator pitch

The DCO Envelope Generator

Each of the DCOs has an independent, eight-stage envelope generator that can control and alter the pitch of the DCO; the effect is shown in figures 30a, b and c. This allows you to program some truly complex pitch envelopes that are totally separate from the DCW and DCA envelopes. Since we have already covered the workings of the envelopes we won't go into depth about them here.

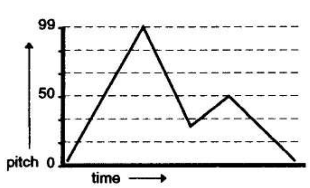


Figure 30b
DCO envelope

FACTS:

The DCO Envelope Generators (DCO EGs) are independently programmable for each of the two DCOs per patch.

As you raise the level of the DCO EG, the pitch will rise.

The DCO EG can only travel in a positive direction and thus can only raise the pitch. It is not possible to invert the envelope so that the pitch will drop.

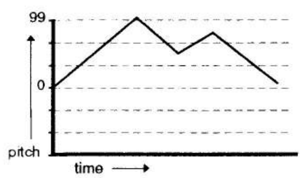


Figure 30c
DCO envelope's effect on pitch

To turn off the DCO EG quickly, simply set STEP 1 to the END POINT. This will cancel the effect of the DCO EG.

The effect that the DCO EG has on the pitch is logarithmic. This means that a LEVEL change from 00 to 16 will raise the pitch a whole step, and a LEVEL change from 66 to 67 will also raise the pitch a whole step. The LEVEL value must change in greater increments at lower LEVEL setting to generate the same amount of pitch change as occurs at higher LEVEL settings. So the ratio of pitch change to LEVEL change gets much greater at higher envelope LEVEL settings. This proves to be benificial, in that, as you have much finer control of the pitch change at lower LEVEL settings, it allows you to perform some very subtle pitch change/bend effects that would be difficult to program without this degree of control.

Some of the effects that can be created with the DCO EG are: Automatic Chorusing, Automatic Pitch Bend, "Pitch Steps," and "Pitch Transient-Enhancement." There will be examples of each of these types of pitch envelopes in the "Tricks & Tips" chapter.

THE DCW

The DCW, or Digitally Controlled Waveshaper, is the main timbre modifier in the CZ. The audio signals travel from the DCO into the DCW, where their shapes are "phase distorted" and their harmonic contents altered. Again, the section on phase distortion covered the technical aspects of the way in which the DCW alters the waveforms, so we won't reiterate here.

The DCW Envelope Generator

The DCW Envelope Generator (DCW EG) is the main (and really the only) controller for the DCW. The DCW EG provides the means for creating a timbre envelope by varying the envelope LEVEL over time, thus creating a harmonic change over time.

FACTS:

The LEVEL setting in the DCW EG is the most important parameter in determining the harmonic content of the sound. As the envelope LEVEL value increases, the harmonic content increases; as the envelope's LEVEL value decreases, the harmonic content decreases.

The DCW EG affects the harmonic change by the DCW in a logarithmic fashion, although this effect is not quite as pronounced as in the DCO EG. You will find, however, that you get a finer degree of control over the harmonic change at lower LEVEL settings and that there will be a greater degree of change in the timbre between higher consecutive LEVEL settings. This can present a problem when you are trying to create slow, smooth harmonic attacks, where the LEVEL moves from a low to a high value (e.g., 2-95). It sometimes is necessary to use two steps of the envelope to create a smooth change by having each step cover a part of the distance between the two levels.

The degree of effect that the DCW EG will have on the harmonic content of a sound is directly related to the waveform selected on the DCO. The greater the harmonic content of the waveform, the greater the potential effect of the DCW EG.

DCW Key Follow

Pressing the KEY FOLLOW button allows you to program the "response curve" of the DCW. This control allows you to gradually attenuate the higher harmonics of the sound as you play up the keyboard. The aural effect of this is that the sound will become duller, or less bright as you play farther up the keyboard.

FACTS:

The DCW Key Follow is independently programmable for each of the two lines and for each patch.

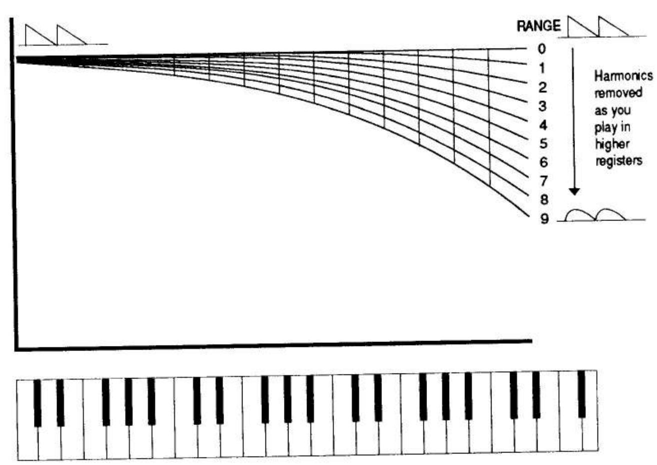


Figure 31

The VALUE range of this parameter is from 1 to 9, with 9 being the highest setting.

As the VALUE increases, the Key Follow "response curve" gets steeper. This affects the sound in two ways: first, the attenuation of the harmonics begins *lower* on the keyboard, and second, the *degree* of attenuation increases, causing the sound to get duller faster (see fig. 31). The aural effect of increasing the DCW Key Follow would be similar to setting different, progressively lower DCW EG levels for every few notes up the keyboard.

THE DCA

The DCA, or Digitally Controlled Amplifier, is the main amplitude modifier module in the CZ and is used to shape the overall volume of the sound. The audio signal travels from the DCW into the DCA, where the signal's amplitude envelope is created using the DCA Envelope Generator (DCA EG).

The DCA Envelope Generator

The DCA EG is an independently programmable eight-stage envelope generator that is dedicated to controlling the amplitude of the DCA. As with the other envelope generators, you are dealing with two programmable parameters, LEVEL and RATE.

FACTS:

As the LEVEL of the envelope increases or decreases, the amplitude (volume) of the signal responds accordingly. The RATE parameter determines how quickly the envelope will move from one level to another.

The DCA EGs are individually programmable for each line and per patch.

The DCA EG affects the amplitude in a logarithmic manner. At higher LEVEL settings, the amplitude change is more pronounced between sucessive values than at lower settings. This is both good and bad in that you have greater control of the amplitude at lower LEVEL settings but greater difficulty in programming slow, smooth amplitude changes if the LEVEL value change is great (e.g., from a setting of 15 to a setting of 98). This is especially problematic when trying to program a slow initial attack for the amplitude envelope--it is usually necessary to use two or more steps of the envelope, each covering a smaller LEVEL change. (There is a patch devoted to this problem in the "Tricks & Tips" chapter.)

One of the benefits provided by the DCA EG lies in its ability to emulate some of the more complex and intricate amplitude envelopes found in acoustic instruments. It allows you to program, for example, some of the multiple attacks found brass instruments like the trumpet, or the complex decay characteristics that are common to many keyboard instruments. Another control in the DCA section that helps to simulate the amplitude characteristics of acoustic instruments is the KEY FOLLOW function.

DCA Key Follow

The amplitude envelopes of many acoustic instrument will get shorter as you play in the upper registers of that instrument. The decay of a piano note, for example, will be considerably shorter in the upper octaves than in the lower octaves. The DCA KEY FOLLOW is used to simulate this type of envelope change by shortening the rates of the DCA EG as you move up the keyboard. Pressing the KEY FOLLOW button activates this function and allows you to program its value using the VALUE buttons in the Data Entry section.

FACTS:

The KEY FOLLOW is individually programmable for each of the DCAs per patch.

The VALUE range of this parameter is from 0 to 9.

The higher the VALUE of KEY FOLLOW, the greater the degree of rate increase (shortening of the envelope times) as you move up the keyboard. At the higher values (7-9), the amplitude envelopes at the top of the keyboard will be significantly shorter than those at the bottom the keyboard. At lower values the effect of the envelope shortening is less pronounced.

DETUNE

Pressing the DETUNE button when the LINE SELECT has been set to one of the dual-line modes (i.e., LINE 1 + LINE 2, LINE 1 + LINE 1) provides a way of altering the overall pitch of the second line in each of these modes. Pressing the DETUNE button will light its LED and display this function's programmable parameters on the LCD window. There are four different parameters that can be programmed in the DETUNE mode.

(+) or (-)

This parameter determines the direction of the DETUNE function. When (+) is selected, the pitch of the second line will be raised; when (-) is chosen, the pitch will be lowered. The setting of this parameter determines the direction of change for the next three parameters.

OCT = *n*

This parameter allows you to transpose the pitch of the second line in octave increments. *n* represents the number of octaves the pitch will be transposed and can have a value from 0, representing no octave change, to a value of 3, representing a three-octave change. Again, the "direction" parameter determines whether the pitch will be raised or lowered.

NOTE = *n*

This parameter works exactly like the OCTAVE parameter, except that this parameter raises or lowers the pitch in half-step increments. *n* represents the number of half steps that the pitch is transposed, and can be set between 0 and 11, with 0 representing no change and 11 representing a pitch change of 11 half steps. This parameter can function in combination with the OCTAVE parameter, and its value in this case will be added to that of the OCTAVE parameter. In other words, if you set the DETUNE parameter to (+), the OCTAVE parameter to 1, and the NOTE parameter to 7, the pitch of the second line will be transposed up an octave and a fifth (seven half steps).

FINE = *n*

This parameter allows you to alter the pitch of the second line in increments smaller than a half step. This parameter can have a value from 00 to 60, with 60 equaling a change of one half step. Any value between these values will cause the pitch of the second line to be set sharp or flat to varying degrees, depending on how the DIRECTION parameter is set. Again, the value of this parameter can be added to the values of the OCTAVE and NOTE parameters, increasing the effect of the DETUNE accordingly.

FACTS:

The DETUNE function can be programmed for each patch.

Altering the DETUNE function will send the edited version of the patch to the Compare/Recall buffer.

The DETUNE function can only be accessed when one of the dual-line modes is chosen.

Only the second line of these modes is affected by the DETUNE parameters.

The DETUNE function can be useful in creating organ sounds, chorusing effects, harmony effects, and in the general "fattening" or "thickening" of sounds. DETUNE also plays an important role in the effect of the Ring Modulator, allowing you to create a much wider range of sounds.

THE RING MODULATOR

The CZs Ring Modulator is a timbre modifier that allows you to enhance the harmonic content of your sounds. A Ring Modulator takes the frequencies of two separate signals (in this case LINE 1 + LINE 2 or LINE 1 + LINE 1) and *adds* and *subtracts* the entire frequency content of each signal to and from the other. As the frequencies of the two are added

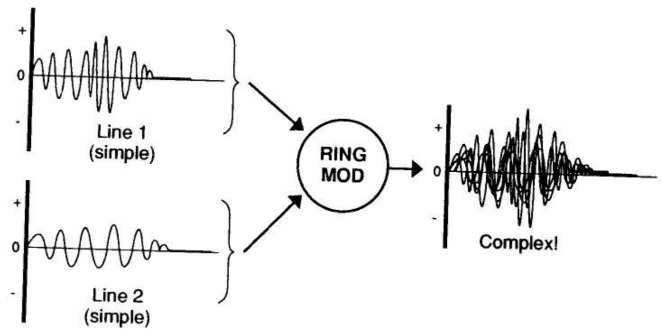


Figure 32
Ring modulator - effect of ring mod on harmonic content of sound

together, "sum" frequencies are generated (e.g., a 220 Hz fundamental + a 330 Hz fundamental = a 550 Hz "sum" tone) as shown in figure 32. As the frequencies of the two are subtracted, "difference" frequencies are generated (e.g., a 880 Hz harmonic - a 220 Hz fundamental = a 660 Hz "difference" tone). The thing to remember is that this addition and subtraction process affects all of the harmonics contained in the two sounds. Thus, the greater the harmonic content of the two sounds, the greater the number of "sum" and "difference" tones.

The CZ's Ring Modulator circuit greatly increases the number of different sounds you can create by offering a simple means of generating and altering the harmonic content of the the two lines. There are a great many sounds that would otherwise be unobtainable if it were not for the CZ's Ring Modulator circuit.

FACTS:

The Ring Modulator can only be use when the LINE SELECT is set to LINE 1 + LINE 2 or LINE 1 + LINE 1. This is because it needs two inputs, which are only available in these dual-line modes.

Pressing the RING button located under the LINE SELECT button turns the Ring Modulator effect on. Pressing it a second time will turn it off.

Turning the Ring Modulator on or off will send the edited patch to the Compare/Recall buffer.

The Ring Modulator On/Off is programmable per patch.

Using the Ring Modulator will automatically create a composite sound. It becomes very difficult to distinguish what the two lines are "doing" separately.

When LINE SELECT is set to LINE 1 + LINE 2, the amplitude of LINE 2 will control the amount of RING MOD effect. In other words, if you lower the DCA LEVEL of LINE 2, the overall amplitude of the Ring Modulator-generated harmonics will decrease. If you lower the DCA LEVEL of LINE 1, on the other hand, you lower the *overall level* of the sound.

It is not possible to alter the amplitude of the Ring Modulator effect when LINE SELECT is set to LINE 1 + LINE 1, since the parameters that are programmed in LINE 1 are used for both lines.

It is possible to generate nonharmonic frequencies ("out-of-tune" harmonics) by detuning the second line in one of the dual-line modes to certain "odd" intervals (e.g., a minor second, a flat fifth, etc.)

It can be difficult to predict how the Ring Modulator will affect the overall sound. The easiest way to find out is to turn it on and listen.

The Ring Modulator is exceptionally useful for creating metallic, bell, plucked, acoustic, and ethnic percussive-type sounds. There will be examples of these in the "Tricks & Tips" chapter.

THE NOISE MODULATOR

Pressing the NOISE button when LINE SELECT is set to one of the dual-line modes will turn the DCO of the second line into a noise source. A noise signal is comprised of all audio frequencies at constantly varying amplitudes and therefore has no definable pitch or timbre. Using one of the lines as a noise source allows you to create percussive and "wind"-type effects.

FACTS:

NOISE can only be selected in one of the dual-line modes.

The NOISE and RING functions cannot be used at the same time. It is an either/or type of situation. Of course, neither of the two has to be used.

The NOISE function is programmable per patch.

Turning the NOISE on or off will send the altered version of the patch to the Compare/Recall buffer.

If LINE SELECT is set to LINE 1 + LINE 2, the LEVEL of LINE 2's DCA will control the amplitude of the Noise Modulator.This allows you to set the amplitude of the Noise Modulator separately from the tone that is being generated in LINE 1.

If LINE SELECT is set to LINE 1 + LINE 1, you will not be able to separately control the level of the noise signal, as the parameters that are programmed in LINE 1 will control both lines.

If LINE SELECT is set to LINE 1 + LINE 2, it is possible to create sounds with the Noise Modulator as the only audio signal. If you set LINE 1's DCA envelope to STEP 1 and then press the END button, you will turn the output of LINE 1 off. LINE 2, on the other hand, will still appear at the CZ's output, and since LINE 2 is being used as the noise generator in this LINE SELECT mode, the Noise Modulator will now be your only audio signal.

Also, the waveform that is selected on the DCO *will* have an effect on the overall harmonic spectrum of the noise signal. The only way to tell what each waveform will sound like as a noise source is to cycle through them and listen. Using two waveforms will increase the number of possible timbral choices for the Noise Modulator signal.

Altering the DETUNE parameters will affect the overall frequency range of the noise signal. If you transpose the pitch of the second line up with the NOISE button on, the noise signal will become brighter, as there will be a larger concentration of high-frequency material present. If you transpose the pitch of the second line down, the noise signal will become more bass heavy, as there will be a larger concentration of low-frequency material present.

There will be a number of examples on how to implement the NOISE function into your patches in the "Tricks & Tips" chapter. The NOISE and RING functions greatly increase the tonal palate of the CZ and consequently the number, and types of patches that the CZ can generate.

INITIALIZE

The INITIALIZE button is used to reset any of the programmable parameters to a "vanilla" setting. If you hold the INITIALIZE button down and press one of the Parameter buttons, the values of that parameter will be set to a simplified "starting point." Using the INITIALIZE button makes it very easy to "undo" a complex envelope, for example, and reset the values so as to simplify the reprogramming of that envelope.

To experience the effect of the INITIALIZE button, take one of your patches and initialize all of the parameters and then look to see how they have been reset. This will automatically send the edited (initialized) version of the patch to the Compare/Recall buffer. To recall the original version, simply turn the COMPARE/RECALL button off.

MASTER TUNE

Pressing these two buttons sets the overall tuning of the CZ. Pressing the right-hand button lowers the overall pitch; pressing the left button raises pitch. The MASTER TUNE is a global setting and cannot be programmed for individual patches. Use KEY TRANSPOSE if you need to drastically alter the basic pitch of the CZ.

MIDI & THE CZ

The CZs were really the first low-cost synthesizers to include MIDI implementation. Not only do they offer MIDI control, they also include the ability to be used in a **Multi-Timbral Mode**. What this means is that you can assign a different patch to each of your CZ's voices. In the case of the CZ-101/1000, this feature will allow you to play four different monophonic (one voice per patch) parts at one time. Also, each of the four different patches can be assigned a different MIDI channel. If you use a sequencer to control the CZ you will have the ability to control the musical parts of each of the four sounds independently. The CZ-3000/5000 provide a total of eight different voices to work with, each of which can be assigned a different patch and MIDI channel.

THE CZ-101/1000

The two areas that we will discuss involving the CZ-101/1000 are accessing the MIDI parameters and the using the Multi-Timbral Mode.

Accessing the MIDI Parameters:

1. Press the MIDI button in the Programmer section. The LCD window will display two different parameters discussed in the next two procedures.

2. MIDI BASIC CH = n--This parameter determines which of the 16 MIDI channels the CZ will send and receive MIDI data on. n represents the MIDI channel number and can have a value from 1 to 16. Use the VALUE buttons to select the desired channel.

3. PROG CHANGE = ENA/DIS--This parameter determines whether or not the CZ will send and receive MIDI patch change commands. When this parameter is set to ENA, the CZ will send and receive MIDI patch changes; when it is set to DIS, the CZ will not send or receive MIDI patch change commands. Use the VALUE buttons to select the desired parameter.

FACTS:

The MIDI parameters are global settings and cannot be set for individual patches.

It is not possible to set separate send and receive channels.

The MIDI BASIC CH setting determines the MIDI channel for all of the CZ's functions (i.e., Pitch Bend, Vibrato On/Off, and Portamento On/Off). The only MIDI function that can be disabled is the PROG CHANGE. All of the other MIDI functions are always active. The only way to not have the CZ respond to these MIDI functions is by disabling them at the controlling source (sequencer, external controlling keyboard, etc.).

As we stated earlier, it is possible to have the CZ-101/1000 generate four different monophonic voices, each with a different patch and MIDI channel assigned to it.

Using the Multi-Timbral Mode:

1. Press the MIDI button.

2. Press the SOLO button. Pressing this button automatically sets the CZ to the Multi-Timbral Mode, also known as the MIDI-Mono Mode. This means that you are using separate MIDI channels to control the individual voices of the synth.

3. You will notice that there are different parameters displayed in the LCD window, explained in the next three procedures.

4. MIDI CH = _n_ --This parameter determines the "base" MIDI channel for the four voices, with _n_ representing a value from 1 to 16.

5. VO = _n_ -- This parameter determines which of the four voices is active at the moment; the _n_ represents a value from 1 to 4.

6. PROG CHANGE = ENA/DIS --The function of this parameter is the same as in step 3 of *Accessing the MIDI Parameters.*

7. There are four voices that appear in sequential order (i.e., VO = 1, 2, 3 and 4). Each of these four voices will need to have its own individual MIDI channel. Programming the MIDI CH = _n_ parameter will determine the MIDI receive channel for voice 1, also known as the "base" MIDI channel.

8. Once you have set this base MIDI channel for voice 1, the CZ will automatically set the MIDI channels for the other three voices in ascending sequential order. In other words, if you set MIDI CH = 08, voice 1 will respond to MIDI channel 8, voice 2 will respond to MIDI channel 9, voice 3 will respond to MIDI channel 10, and voice 4 will respond to MIDI channel 11. (see fig. 33)

9. You will notice that as you increase the value of MIDI CH = _n_, the values of VO = _n_ will also increase. This can be somewhat confusing, but the thing to remember is this: voice 1 will always be represented by the same value as the MIDI CH = _n_ value. In other words, if MIDI CH = _n_ is set to a value of 06 (MIDI CH = 06) voice 1 will be represented by VO = 06.

MIDI BASIC CHANNEL = 01

MIDI CH	= 01,	VO = 01	(voice 1)
automatically set by choosing MIDI CH = 01	= 02,	VO = 02	(voice 2)
	= 03,	VO = 03	(voice 3)
	= 04,	VO = 04	(voice 4)

OR

MIDI BASIC CHANNEL = 05

MIDI CH	= 05,	VO = 05	(voice 1)
automatically set by choosing MIDI CH = 05	= 06,	VO = 06	(voice 2)
	= 07,	VO = 07	(voice 3)
	= 08,	VO = 08	(voice 4)

Figure 33
MIDI-Mono Mode
voice assignment

The other three voices will be VO = 07 (voice 2), VO = 08 (voice 3), and VO = 09 (voice 4). The CZ always follows a sequential pattern of voice assignment.

10. Once you have set the MIDI channels, choose which patches will be assigned to each of the four voices. To set the patch for voice 1 (make sure that the VO = n value is the same as the MIDI CH = n value), simply move the cursor under the VO = n parameter and choose a patch by pressing the appropriate memory location buttons (e.g., PRESET 8, INTERNAL 2, CARTRIDGE 4).

11. Press the VALUE UP button in the Data Entry section to move to voice 2, and choose a different patch using the same procedure.

12. Use this same procedure to assign patches to voices 3 and 4. You now have four different voices on four different MIDI channels, each with a different patch. Now all you need is a sequencer to play a Bach four-part fugue. Have fun!

THE CZ-3000/5000

The CZ 3000/ 5000 offer a MIDI implementation similar to the CZ 101/1000's, with an added feature: with these synths it is also possible to assign some of the voices to the MIDI-Mono Mode while using the others polyphonically.

Using the MIDI-Mono Mode:

1. Press the MIDI button in the Mode section to the right of the LCD display. There will be four different items of information displayed on the screen, explained in the next four procedures.

2. P MODE--This determines whether the CZ is in the normal, Polyphonic Mode (P) or in the MIDI-Mono Mode (M). When you move the cursor under this parameter, you can toggle back and forth between the two modes using the VALUE UP/DOWN keys.

3. KBCH = *n* --The CZ 3000/5000 allow you to assign separate MIDI transmit and receive channels. This determines the transmit channel and can have a value from 1 to 16.

4. CH = *n*--This value determines the CZ's receive channel and can be any number from 1 to 16.

5. PRG = ENA/DIS --This parameter determines whether or not the CZ will transmit and receive program changes over MIDI. When this is set to ENA, the CZ will respond to program changes; when set to DIS, this function is disabled.

6. Now move the cursor under the P MODE parameter, and using the VALUE UP key, change this parameter to read M MODE. You have now entered the MIDI-Mono Mode.

7. As you perform the operation in the last procedure you will notice that the LCD information will change. The CH = *n* parameter in the lower left of the display will be replaced with a new set of parameters that should read something like CH = 01 (1). These new parameters allow you to configure the CZ's eight voices in a number of different ways: the *n* parameter determines the basic MIDI channel number in the Mono Mode and can have a value between 1 and 16; the (*n*) parameter determines how many of the voices will be allocated to individual, monophonic MIDI channels, and can have a value from 1 to 8.

Let's say that the display reads CH = 02 (4). This tells us that there will be four monophonic MIDI/voices (represented by the parameter (4)) and that their MIDI channel assignments will begin with channel 2 (represented by CH = 02) and move upwards consecutively. In other words, voices 1 through 4 will appear on MIDI channels 2, 3, 4, and 5, and each of these voices will be monophonic (fig. 34). Thus we have, in our example, four different monophonic parts playing at the same time, each responding to its own individual MIDI channel, and each with its own patch. Before we get into how to set a different patch for each voice, however, let's do something with the remaining four voices (8 total voices - 4 monophonic voices = 4 "free" voices).

VOICE NO.	MIDI CHANNEL	POLYPHONY
Voice 1	MIDI CH = 02	(mono) 1 Note
Voice 2	MIDI CH = 03	(mono) 1 Note
Voice 3	MIDI CH = 04	(mono) 1 Note
Voice 4	MIDI CH = 05	(mono) 1 Note
Voice 5-8	MIDI CH = 06	(poly) 4 Note

Figure 34
CZ-3000/5000
MIDI-Mono Mode
voice assignment

8.The "unassigned" voices have remained polyphonic and will automatically be assigned to the next consecutive MIDI channel. In our example (CH = 02 (4)) the remaining four voices will respond to information on MIDI channel 6, since channels 2, 3, 4, and 5 are being used for the first four monophonic voices.

As we're sure you can see (and hear), this feature of the CZ-3000/5000 offers a great deal of power in regards to the real-time "orchestration" of your music, especially when used in conjunction with a sequencer. There is, however, an important point to keep in mind regarding the Mono and Polyphonic Modes and how they transmit information to a sequencer. If you are using a sequencer to control the various individual monophonic voice channels, it is important to remember that these voices will only play one note at a time. Therefore, if you record a sequence, *while playing polyphonically*, onto a channel that the CZ has been set to *receive* monophonically, you will encounter problems, in that when your sequencer plays this information back through the CZ, it will probably sound nothing like what you originally played. Thus it is important to *play* monophonically into the sequencer if the CZ voice/channel that will receive the information is set to a monophonic mode. However, the "free" voices that are available on the keyboard *can* be played polyphonically and will respond polyphonically from the sequencer. Just make sure that the transmission channel is set to the correct MIDI channel (channel 6 in our example) and that you don't play more than the total number of available notes (four in our example). Playing a five-note chord into the sequencer when there are only four notes available on the CZ that can respond to the information will most certainly result in some rather strange music.

Another area we'd like to elaborate on concerns the PRG = ENA parameter. As we stated earlier, this parameter determines whether the CZ as a whole will respond to program changes via MIDI. It is not possible to set this function for individual channels in Mono Mode--they all will respond or none will respond.

There are two different ways to change the patch assignments in a Mono Mode setup. The easiest way is to tell your sequencer to generate a MIDI patch change command that relates to the particular channel/voice that you wish to alter. In this way, you can have each individual channel/voice play a different patch in a composition. There is also another, rather convoluted method of setting a different patch for each of the different MIDI channels.

Setting Different Patches for Each MIDI Channel:

1. Disconnect all the MIDI cords.

2. Take a single MIDI cable and insert one end into the CZ's MIDI OUT and the other end into the CZ's MIDI IN.

3. Call up the MIDI page on the LCD screen by pressing the MIDI button to the left of the screen.

4. Set up a Mono Mode configuration. (Let's use CH = 01 (3) as an example.)

5. Move the cursor to the KBCH = *n* parameter and set it to read KBCH = 01.

6. Now choose the patch that you want to respond to channel 1 by pressing the appropriate memory location. You have just preset that patch to respond to MIDI channel 1. (When you do this you will notice that the MIDI screen will disappear and the LCD will display the patch name/location. Simply press the MIDI button again and the MIDI information will reappear.)

7. Move the cursor under the KBCH = *n* parameter and change it to read KBCH = 02.

8. Now choose the sound you want to respond to MIDI channel 2 by pressing the appropriate patch location buttons. You have just preset the patch that will be heard (monophonically) on MIDI channel 2.

9. Now recall the MIDI page again. Move the cursor to the KBCH = *n* parameter and set it to read KBCH = 03.

10. Choose the patch that you wish to hear on channel 3 by pressing the appropriate patch location buttons. You have just preset the sound for channel 3.

11. Again recall the MIDI screen. Set the KBCH = *n* parameter to read KBCH = 04.

CAUTION

If you press any of the patch buttons with the KBCH = _n_ parameter set to any channel other than the polyphonic channel, you will automatically set this patch as the sound for the currently chosen channel.

12. Once again choose a patch; this will be assigned to the five remaining voices, allowing you five-note polyphony with this patch.

Unfortunately, as you change the KBCH = _n_ parameter back down through channels 3, 2, and 1, the patches that you chose for these channels will not be displayed--the patch that was chosen for the polyphonic channel will remain on the screen. Thus, it may be a good idea to write down the patch locations that you have chosen for the various channels as you set them.

6. CZ-1 EXTRAS!

This section is devoted to the extra features on the CZ-1 that are not found on the other CZs. The CZ-1 is the most professional model of the CZ line and offers quite a few features and refinements not found on the smaller CZ synths. We will for the most part work from left to right across the machine and describe the various new and enhanced functions in each section of the synthesizer.

THE TOTAL CONTROL AND THE PROGRAMMER SECTIONS

MIDI ON/OFF

This button allows you to turn the MIDI Send/Receive function of the CZ on or off. In the ON position the CZ will both send and receive all applicable MIDI information. In the OFF position the CZ won't send or receive any MIDI information.

EXCHANGE

The EXCHANGE button allows you to exchange an internal and a cartridge patch that are located in the same "patch location" (e.g., bank A/patch 3). This process will send the internal patch to the cartridge while at the same time transferring the cartridge patch to the internal location. The main use for this function is to transfer sounds to internal locations so they may be accessed in the MIDI-Mono mode, since it's not possible to access cartridge voices in this mode.

Transferring a Cartridge Voice to Internal Using the EXCHANGE Button:

1. Determine which cartridge voice you wish to transfer to the internal location.

2. Press the CARTRIDGE button and the appropriate bank letter for this sound.

3. Press and hold the EXCHANGE button. The LCD window will read EXCHANGE SELECT MEMORY.

4. While holding the EXCHANGE button, press the same patch bank letter and patch number as the cartridge voice. It is not necessary to press any

button other than the patch bank letter/patch number. At this point the cartridge voice and the internal voice have switched locations.

5. To switch the sounds back to their original locations, simply repeat the process a second time.

PATCH MEMORY

The CZ-1 has 64 internal patch locations, divided into 8 banks of 8 sounds each. These internal patches will respond to MIDI patch change numbers 1- 64, starting with bank A/patch 1, and ending with bank H/patch 8. The CZ-1 also has 64 cartridge locations, which also respond to MIDI patch change numbers 1 - 64.

NORMAL KEYBOARD MODE

In this mode the CZ-1 will play a single patch across the entire keyboard. If LINE SELECT is set to a single-line mode, the CZ will be capable of 16-note polophony. If LINE SELECT is set to one of the dual-line modes, the CZ-1 will be capable of 8-note polophony.

TONE MIX KEYBOARD MODE

In this mode the CZ-1 allows you to stack two patches on top of one another, i.e., to play two sounds on one note. This function is similar to that found in the CZ-3000/5000 except that here you are provided with the ability to detune the second patch. It is also possible to edit the parameters of the two patches while in the Tone Mix Mode.

To Detune the Second Patch Using TONE MIX:

1. Press the TONE MIX button. The LCD window will display the two LEVEL = n settings for each of the two tones, with n representing a value from 1-15.

2. As in the CZ-3000/5000, you can only attenuate the output of patch--it isn't possible to boost the amplitude. Moving the cursor back and forth between the two LEVEL parameters will indicate which patches have been chosen for each of the two tones by lighting the LEDs above the appropriate bank/patch locations in the Programmer section.

3. The only way to actually see the names of the patches is to press the NORMAL button, check the names of the patches, and then go back to the Tone Mix Mode. It is possible to use both cartridge and internal patches for a Tone Mix.

4. To detune TONE 2, press the PAGE UP button in the Data Entry section to the DETUNE page. This Detune function is similar to the one in the

NOTE

If you have used both an internal and a cartridge voice and have stored the combination as an operation memory, the cartridge *must* be inserted to have the Tone Mix appear with both sounds. If the cartridge is not inserted, the LCD window will read NOT READY INSERT CARTRIDGE and the cartridge voice will not be heard.

Parameter section except that here you are detuning the entire patch (TONE 2), not just one of the lines.

5. Pressing the PAGE UP button a second time will call up the CHORUS ON/OFF page. If the Chorus is off for both of the tones, they will appear at separate outputs (A and B) on the back of the synth. TONE 1 will appear at Output A, and TONE 2 will appear at Output B. This allows you to pan the two tones in stereo. If the Chorus is on for either of the two tones, the tone with the Chorus on will appear at both Outputs A and B while the tone with the Chorus off will appear at only one output. If both tones have the Chorus on, they will be mixed together and appear at both outputs.

To Edit the Parameters of the Two Patches:

1. To edit either of the patches, simply move the cursor under the patch you wish to edit (TONE 1 or TONE 2).

2. Change any parameter(s) you wish.

3. If you want to save the edited version of the patch you must store it in one of the patch locations.

4. To return to the Tone Mix Mode, press the TONE MIX button.

KEY SPLIT KEYBOARD MODE

The Key Split function on the CZ-1 is set up essentially the same way as the Key Split on the CZ-3000/5000, with a few extra features added.

FACTS:

Pressing the KEY SPLIT button allows you to set the individual LEVELS and patches for the upper and lower tones along with the keyboard Split Point (SP = _n_).

Pressing the PAGE UP button will call up the SUS PEDAL page. This allows you to individually set the sustain pedal response for both the upper and lower tones. ENA means that the sustain pedal is active; DIS means that the sustain pedal is inactive for that particular half of the keyboard.

Pressing the PAGE UP button again will call up the OCT SHIFT function. This function allows you to raise the pitch of the lower half of the keyboard by up to two octaves and to lower the pitch of the upper half of the keyboard down by two octaves.

Pressing the PAGE UP button again will call up the CHORUS page. The Chorus in the Key Split Mode responds the same way as the Chorus function in the Tone Mix Mode. The lower and upper sections will appear at separate outputs when their respective Chorus settings are off. When the Chorus is turned on for either half of the keyboard, the sound on that half of the keyboard will appear at both outputs. If both Chorus settings are on, the two sounds will be mixed and both sounds will appear at both outputs.

As in the Tone Mix Mode, it is not possible to view the names of the patches while in the Key Split Mode. You must first enter the Normal mode to see the names and reenter the Key Split Mode.

It is also possible to edit either of the two patches while in the Key Split Mode. Follow the same procedure as was described in the Tone Mix section, only reenter KEY SPLIT after you have edited the sound.

OPERATION MEMORY MODE

The CZ-1 has the ability to store a total of 64 different Key Split or Tone Mix keyboard combinations within the Operation Memory Mode.

To Access the 64 Different Operation Memories:

1. Press the OPERATION MEMORY button. The patch memory locations will now call up the operation memories.

2. As you press the different BANK/PATCH buttons, the LCD window will display OPEM, indicating that you have called up an operation memory as opposed to a patch memory.

3. The LCD window will display two patch locations which will read something like this: I H-8. This represents "Internal Patch H-8." The patch location to the left indicates which patch has been chosen as the lower sound in a Key Split Mode, or TONE 1 in a Tone Mix Mode. The patch location to the right indicates which patch has been chosen for the upper sound in a Key Split Mode, or TONE 2 in a Tone Mix Mode.

4. The cursor can be moved between these two patch locations, which will cause the window to display the name of the respective patch. The LED lights above the KEY SPLIT or the TONE MIX buttons will also light to indicate whether the OPEM is a Key Split or a Tone Mix.

5. All of the parameters discussed in the Tone Mix and Key Split sections can be stored for each individual Operation Memory. Portamento On/Off, Glide On/Off, and Solo On/Off can be programmed and stored individually for each half of a Key Split Mode or Tone Mix Mode in each OPEM. These functions can be altered at any time while an OPEM is selected. It is not possible to edit the parameters of the patches while in the OPEM mode. You must first return to one of the keyboard modes to perform this type of editing.

One of the small drawbacks of the Operation Memory locations in the CZ-1 is that you cannot alter the relationships of the sounds to one another (e.g., volumes, sustain pedal responses, detuning, etc.) for either a Key Split setting or Tone Mix setting once they are stored in an Operation Memory location. However, there is an undocumented trick that can come in very handy if you do want to change any of these parameters.

Re-editing an Operation Memory:

1. Choose the Operation Memory that you wish to alter or edit.

2. Hold down the WRITE key to the left of the LCD display, and while holding down the WRITE key, press either the KEY SPLIT or the TONE MIX key in the Mode section at the upper left of the synth. This will automatically "write" the Operation Memory information into a RAM buffer, where you can preview and change the relationships between the two sounds. Keep in mind that you will want to write a key split into the Key Split buffer and a tone mix into the Tone Mix buffer.

3. Once you have performed the edit, simply save the altered version back into the same Operation Memory location, using the WRITE key.

GLIDE ON/OFF

This button turns the Glide on and off. The function of this button can be controlled via MIDI. If you are recording to a sequencer from the CZ-1 and you press the GLIDE ON/OFF button, the sequencer will record the action as a control change and will transmit the action via MIDI upon playback.

THE EFFECT SECTION

GLIDE

The Glide function is somewhat similar to the Portamento function in that the pitch of the synth moves smoothly from one note to the next as keys are played. The difference between the two lies in the fact that here you can program the starting point for the pitch. This means that you can program the Glide so that it will always begin from a predetermined pitch (up to a distance of an octave above or below the note you are playing), and move smoothly up or down to the pitch of the note being held. This will give you a predictable, repeatable effect that can be more useful than the Portamento for certain types of sounds. The Glide is especially useful with brass sounds, when you want to recreate the effect of a player "lipping up" to a pitch.

FACTS:

Pressing the GLIDE button to the left of the Data Entry section calls up the two programmable parameters and displays them on the LCD window.

NOTE = (+ or -) _n_--This parameter determines both the direction of the glide effect and the pitch the glide will begin on. A + sign indicates that the glide will start from _n_ amount of half steps above the note you are playing and will move down to pitch. A - sign indicates that the glide will start from _n_ amount of half steps below the note you are playing and will travel up to pitch. _n_ can have a value from 1 to 12.

TIME = _n_--This parameter determines the amount of time it takes for the Glide to travel from its starting pitch to the note currently being held down. _n_ represents a value from 00 to 99. The higher the value, the longer the glide time.

MODULATION WHEEL/AFTER TOUCH

Pressing the M WHEEL/AFTER TOUCH button allows you to program the overall depth of the vibrato effect that will be generated by either raising the Modulation Wheel or pressing down on the keyboard for After Touch.

FACTS:

When the M WHEEL/AFTER TOUCH button is pressed, the Depth parameter for the Modulation Wheel will be displayed; to access the Depth parameter for After Touch, press the PAGE UP button once. Pressing the PAGE UP button a second time will access Amplitude After Touch. This allows you to boost the amplitude of a note using the After Touch response.

The higher the value of the Depth parameter, the greater the depth of the modulation effect; the lower the value, the lower the amount of vibrato that will be generated by these two controllers.

The VIBRATO ON/OFF button must be on for the vibrato to be controlled by the Modulation Wheel and After Touch. Also, it is possible to use both the Modulation Wheel and After Touch simultaneously.

THE DATA ENTRY SECTION

The only difference between the CZ-1 and other CZs regarding the Data Entry section is that the CZ-1 does not have ENV STEP buttons. You must use the PAGE UP/DOWN buttons in place of the ENV STEP buttons when you are programming an envelope.

NOTE

Keep in mind that this process will erase all of the sounds in the cartridge and replace them with the internal voices.

THE DATA SAVE/LOAD SECTION

The CARTRIDGE/MIDI button controls the CZ-1's ability to bulk dump patch information to and from a cartridge or via MIDI. Pressing the button once enters the Cartridge Save/Load function.

To Bulk Save Internal Voices to Cartridge:

1. Turn off the CZ, insert cartridge (Casio RA-6 or compatible), then turn the CZ on.

2. Press CARTRIDGE/MIDI button. The LCD will read CARTRIDGE SAVE OR LOAD.

3. Press the SAVE button in the Data Entry section. The LCD will now read SAVE CARTRIDGE (Y/ N)?

4. Press the YES button in the Data Entry section. The LCD will read SAVE CARTRIDGE OK! You will have transferred all of the voices in the internal memory locations to the cartridge.

To Bulk Load Cartridge Voices into Internal Memory Location:

1. Turn off the CZ, insert cartridge (Casio RA-6 or compatible), then turn on the CZ.

2. Press CARTRIDGE/MIDI button. The LCD will read CARTRIDGE SAVE OR LOAD.

3. Press the LOAD button in the Data Entry section. The LCD will now read LOAD CARTRIDGE (Y/N)?

4. Press the YES button in the Data Entry section; the CZ will transfer all of the cartridge voices into the internal memory locations. As with the previous example, this process will erase all of the internal voices and replace them with the cartridge voices. Be careful!

The CARTRIDGE/MIDI button can also be used to initiate a bulk save or load of patch data as a **system-exclusive message** via MIDI. A system-exclusive message consists of MIDI information that is exclusive to one particular brand of synthesizer. In other words, system-exclusive patch data generated by a Casio CZ synthesizer cannot be read by a Yamaha DX series synthesizer, and vice versa. This type of communication allows two synthesizers from the same manufacturer to "talk" to one another and transfer data common to each back and forth. This enables you to transfer groups of voices between two CZ synthesizers, or between the CZ-1 and a computer capable of receiving/transmitting system-exclusive information. Before you can perform a system-exclusive data save or load, you must first "enable" the system-exclusive tone data function.

To Transmit System-Exclusive Patch Information:

1. Press CARTRIDGE/MIDI button. The LCD will read CARTRIDGE SAVE OR LOAD.

2. Press the PAGE UP button in the Data Entry section. The LCD will now read MIDI SAVE OR LOAD.

3. Press the SAVE button in the Data Entry section. The LCD will read SAVE MIDI DATA (Y/N)?

4. Press the YES button in the Data Entry section. The CZ-1 will now transmit the data of the internal patch memories as a system-exclusive data message via MIDI.

To Receive (Load) System-Exclusive Patch Data:

1. Follow steps 1 and 2 in the previous example. The LCD should now read MIDI SAVE OR LOAD.

2. Press the LOAD button in the Data Entry section. The LCD will now read LOAD MIDI DATA (Y/N)?

3. Press the YES button in the Data Entry section. The CZ-1 will now initiate a request for MIDI system-exclusive patch data. Under the correct circumstances (i.e., correct MIDI connections, compatible instruments, etc.), the CZ-1 will receive system-exclusive patch data and store the information (patches) in its internal memory locations. Again, this process will erase any of the patches that were previously stored in the internal locations.

THE PARAMETER SECTION

NAME

The CZ-1 is the only CZ that allows you to name your patches.

To Add a Name to a Patch:

1. Press the NAME button; the cursor will appear at the extreme left of the LCD window.

2.You can now choose the first letter of the patch name using the 16 buttons in the patch memory section. Most of these buttons will have three letters associated with them. One letter will be printed on the button, and two more will be printed underneath it.

3. Pressing the button once will display the letter that is printed on the button. Pressing it a second time will display the first letter printed directly underneath the button, and pressing the button a third time will display the second letter that is printed underneath the first.

4. Repeatedly pressing the button will cycle through the letters. Once the letter you want is displayed, move the cursor to the next position and choose the second letter. Repeat this process until the name that you want is displayed on the screen.

5. To store the name with the patch, simply press and hold the WRITE button, then choose the patch location. You now have stored the patch with its name.

PARAMETER COPY

This button allows you to copy the values of a parameter from one line into the same parameter in the other line. This is especially useful for copying complex envelopes from one line to the other.

Copying a Parameter from One Line to Another:

1. Determine which parameter you wish to copy (the source parameter) and where you want to copy the parameter to (the destination parameter).

2. Press and *hold* the PARAMETER COPY button. The LCD window will read COPY SELECT PARAMETER.

3. While holding the PARAMETER COPY button, press the source ENV button, then the destination ENV button. The LCD window will immediately display the parameter values in the destination parameter location. The copy is now complete.

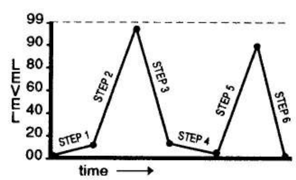
4. Check to see that the destination parameter values match those of the source parameter.

FACTS:

It is possible to copy an envelope from one line into any of the envelope locations of the other line. If you so desire, you can copy an envelope from one line into all three envelope locations of the other line, one at a time. It is also possible to copy the Key Follow parameter from one line into any of the Key Follow locations in the other line.

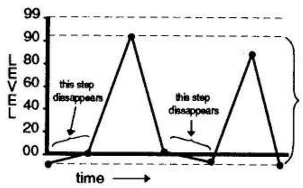
The parameters DCO Waveform Select, Velocity, and Level in one line can only be copied to the same location in the other line. For example,

Figure 35
CZ line level quirk on DCA env



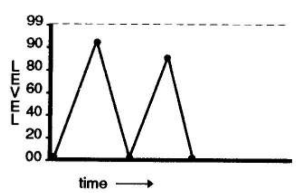
Normal envelope using STEPS 1 and 4 as delay steps

Figure 35a
DCO env / line level = 15



As level value is lowered, entire env is biased down; actual values in each step do not appear to change

Figure 35b
DCO env / line level = 10



NOTE: since there must be at least one increment difference between successive env steps when the DCA env is biased down 2, STEP 1 and STEP 4 essentially disappear as far as the computer in the CZ is concerned.

Figure 35c
Resultant envelope

you cannot copy Velocity values into a Waveform Select location. It is also not possible to copy a parameter within a single line. You can only copy parameters between lines.

Executing a Copy function will automatically send the edited version of the patch to the Compare/Recall buffer.

LEVEL

The Level parameter in the parameter section of the CZ-1 provides a quick way to attenuate the amplitude of a line's output. This Level parameter works much the same as the Level parameters in the Tone Mix function.

FACTS:

As with other Level parameters, you can only attenuate the amplitude of the line; it is not possible to actually boost the amplitude.

The Level parameter can have a value from 1 to 15, with 15 being normal amplitude.

The Level parameter works in conjunction with the DCA Envelope Generator. The maximum level setting in the DCA EG will determine the maximum amplitude of the sound. The Level parameter can only attenuate this maximum setting.

CZ-1 Line Level Quirk

One quirk that has remained undocumented in any CZ manual is the Level parameter's effect on the DCA EG. Lowering the Level parameter's value can sometimes alter the response at the DCA EG. For example, if you use two steps of a DCA EG to create a delay effect, you may find that lowering the Line Level parameter will result in a change in the delay rate. This is due to the fact that as you lower the level value, the various level settings for each individual step of the DCA EG are also scaled down (the individual level values for each step won't look any different, but they will be affected). As the levels of successive envelope steps change, the rate between these steps is affected, resulting in an increased rate between the successive steps. The closer the individual level settings of successive envelope steps, the more pronounced the perceived rate change (fig. 35).

VELOCITY

The CZ-1 is the only CZ that provides programmable velocity control in the sound-generating process. **Velocity** refers to how fast you play a given note, or the time it takes for the key to complete its travel to the key bed as you play.Velocity will generally help to enhance the range of dynamics and expression, and consequently the realism of your patches.

Most acoustic instruments are velocity-sensitive. A guitar will get louder as you strum the strings harder, a sax will get louder as you blow harder, etc. The Velocity control in the CZ-1 helps to recreate these types of changes by making the keyboard responsive to your touch.

FACTS:

Pressing the VELOCITY button in the Parameter section accesses the programmable parameters and displays them on the LCD window. The CZ-1 provides velocity control over three parameters: the amplitude of the DCA, the amount of phase distortion in the DCW and the amount of DCO envelope that controls the pitch.

AMP = n--This parameter adds velocity to the DCA, allowing you to control the amplitude of the sound with the speed with which you play a given note. n represents a value from 1 to 15. As the value increases, the amount of velocity control increases. This is probably the most useful parameter with which to use velocity control; most patches will "feel" more realistic with the addition of this control.

WAVE = n--This parameter adds velocity control to the DCW, allowing you to create timbral changes dependent on your speed of attack.

PITCH = n--This parameter determines the amount/depth of the DCO envelope's effect on the pitch (fig. 36). If the DCO envelope has not been programmed to create a pitch envelope, raising the value of the Pitch Velocity parameter will have no effect. The DCO envelope must first be programmed to create a pitch envelope before the velocity will have any effect.

The most useful range of Velocity values is from 3 to 7. Above 7 the velocity response becomes rather drastic.

If you are adding Velocity to a sound in which the LINE SELECT is set to LINE 1 + LINE 2, there are a few general guidelines that you should keep in mind which will also generally apply to Wave Velocity:

- If the Ring Modulator is on, adding Amp Velocity to LINE 1 only will provide velocity response to the entire sound. If Velocity is added to LINE 2 as well, it will generally alter the tonal balance between the two lines and will probably affect the timbre of the ring-modulated sound.

- Adding Velocity to LINE 2 will generally affect the balance and/or amplitude of the harmonics generated by the ring modulation process. This can be useful for creating a timbral change without having to alter any of the DCW's parameters.

Figure 36
Velocity effect on pitch

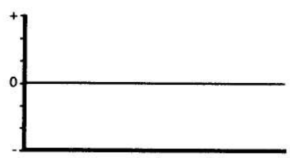


Figure 36a
DCO pitch stable,
no env modulation

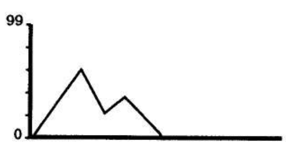


Figure 36b
DCO env shape

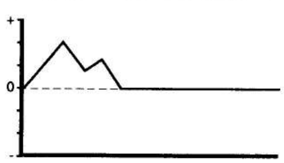


Figure 36c
DCO pitch modulated by
DCO env; pitch velocity = 00

Figure 36 (continued)
Velocity effect on pitch

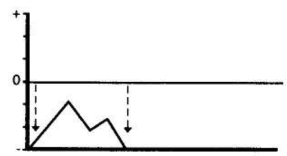


Figure 36d
Velocity = 15; as velocity is raised, pitch envelope is biased down out of modulation range

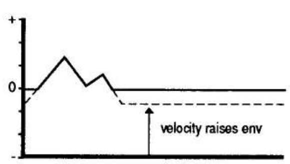


Figure 36e
As keyboard is played force-fully, DCO envelope's bias is raised by the velocity to the point of modulating the DCO's pitch

- If the Ring Modulator is not being used, it will generally be necessary to add approximately the same amount of velocity to both lines to maintain the correct tonal balance between them. The only way to really tell how much velocity should be included for each line is to experiment.

CZ-1 Velocity Quirk

The CZ-1's velocity has a major quirk: As you raise the velocity value for a given parameter, the CZ will automatically lower the overall level of that parameter. For example, let's say that the peak level setting of the DCA envelope is a value of 99. Since this is the highest amplitude setting that the DCA can have, there is no room for the velocity to take effect, i.e., the velocity can't "push" the level any higher than 99. The CZ automatically compensates for this by lowering the overall level to allow some room for the velocity effect to take place. The greater the increase in value of the Velocity parameter, the more drastic the lowering of the overall level, consequently, the greater the amount of room that is created for the level to "travel" in. The actual envelope parameter values, however, will appear unchanged.

If none of the envelope steps has a level setting of 99, it is possible to compensate for the lowering effect created by adding velocity. Simply locate either the sustain point or the envelope step with the highest relative level value, and increase the level value of that step. A rough rule of thumb: For every single-increment increase in the Velocity parameter value, increase the envelope's highest-step/sustain point's level value 5 increments.

MIDI & THE CZ-1

The MIDI implementation on the CZ-1 is a significant improvement over that on the other CZ models. The main improvement is in the way the MIDI-Mono mode can be utilized here, allowing you to split up the eight voices into separate "voice groups," each responding to its own MIDI channel.

FACTS:

Pressing the MIDI button calls up the basic MIDI parameters and displays them in the LCD window. There are four parameters that can be set here, discussed below.

POLY/MULTI = n--This parameter determines whether the CZ will be used in a Polyphonic Mode or in the MIDI Multi Mode. When the LCD displays POLY, the CZ is in polyphonic mode and will respond to a single MIDI channel. Pressing the VALUE UP button will switch to the MIDI Multi Mode, which will be discussed in detail in a moment. Also, the CZ's

Keyboard Mode must be set to NORMAL to alter this parameter, otherwise the cursor will not move under this parameter.

CH = n--This parameter sets the CZ-1's MIDI reception channel. The CZ-1 will respond to MIDI information from external controllers on this channel. n can be a value from 1 to 16.

KBCH = n--This sets the CZ-1's MIDI transmission channel. The CZ-1 will transmit all relevant MIDI information to external devices over this channel. Having separate transmission/reception channels makes MIDI communication more flexible. n can be a value from 1 to 16.

PRG = ENA/DIS--This parameter determines whether or not the CZ-1 will transmit/receive external MIDI program change commands. When ENA is chosen this function is active; when DIS is chosen this function is inactive.

Pressing the PAGE UP button while these parameters are displayed on the LCD window will call up the second MIDI parameter page. The window will now read SYSTEM EXCLUSIVE TONE DATA = ENA/DIS. This function determines whether or not the CZ-1 will send/receive system-exclusive tone data. (System-exclusive tone data is MIDI code information exclusive to the CZ-1 representing all of the programmable parameter values that are used to make up a patch.) If ENA is chosen, the CZ-1 will transmit this patch code information every time a patch is chosen. The CZ-1 will also respond to patch code information sent to it in this mode. This allows you to transfer patches between different CZ synthesizers without having to use cartridges. Also, if you have a sequencer that will record system-exclusive information, you can send this information to the sequencer as you play a musical part by pressing the PATCH button as you begin to record. Upon playback, the sequencer will transmit the appropriate sound information along with the musical information that's been recorded. If this parameter is set to DIS the CZ-1 will not transmit or receive this information.

Implementing the MIDI Mono/Multi Mode:

1. Go back to the MIDI basic parameter window on the LCD.

2. Move the cursor under the word POLY and press one of the VALUE buttons in the Data Entry section. Three things will happen: the LED above the MIDI button will begin to flash, POLY will now read MULTI, and the KBCH = n will disappear. You will now be left with two programmable parameters on this page, discussed in the next two procedures.

3. CH = n--This parameter takes on a new function in the Multi Mode. It now determines which of the 16 MIDI channels will respond to Pitch Bend and Vibrato information. Since you will be allocating different voices to different MIDI channels, it is important to decide which MIDI channel/voice group will respond to these real-time controllers, since you cannot have multiple MIDI channels responding to these effects. There is one other thing to keep in mind: this parameter will also determine the CZ-1's MIDI

transmission channel. If you are recording to a sequencer from the CZ-1's keyboard, make sure that the sequencer can "rechannelize" the incoming MIDI data to the MIDI channel you want; otherwise all of your tracks will be recorded on the same MIDI channel. Another way around this problem is to set CH = n to the MIDI channel you wish to record on. The sequencer will now receive the MIDI data on the correct MIDI channel. Just remember to reset CH = n back to the MIDI channel that you want to respond to Pitch Bend and Vibrato.

NOTE

One thing to keep in mind during this process is that you have a total of eight voices with which to work. These eight voices can be split up and arranged in a number of different ways, but remember that this is the total number of voices.

4. PRG = ENA/DIS--The function of this parameter remains the same in the Multi Mode.

Setting Up a Multiple MIDI Voice Arrangement:

1. Once you have set the LCD window to read MULTI and have chosen your keyboard channel, press the PAGE UP button to call up the next page of MIDI information. The LCD window should now display three new parameters, discussed in the next three procedures.

2. CHECK CHANNEL = n--This parameter should really read MIDI CHANNEL, since the Check Channel number really represents a MIDI channel number. There are 16 Check Channels, each representing 1 of the 16 MIDI channels. Determine the number of voices that you wish to allocate to the currently displayed Check/MIDI channel. To do this you need to move the cursor under the POLY = n parameter.

3. POLY = n--This parameter determines the number of voices (out of the eight total) that will be allocated to the current Check Channel. The n value can be a number between 0 and 8, with 0 indicating that no voices are being allocated.

NOTE

Only internal voices can be used when setting up multiple MIDI voice arrangements. It is not possible to access cartridge voices in Multi Mode.

4. The number of voices that you can allocate for any given Check Channel is dependent on the number of voices that have been allocated to the other Check Channels. If you find that you cannot set as many voices as you would like to the current channel, it will generally be due to the fact that you have reached the eight voice limit. The only way to add more voices to the current Check Channel is to decrease the number of voices that are allocated to one of the other Check Channels. To do this, simply move the cursor under the CHECK CHANNEL = n parameter, and press the VALUE UP button in the Data Entry section. Continually pressing this button will cycle through the 16 Check Channels one at a time. As each of the Check Channels appears on the screen, the number of voices allocated to that channel will be displayed in the POLY = n parameter. It is a good idea to survey how the voices have been allocated throughout the various Check Channels by cycling though them as we have just described.

5. Now, to free up one of the eight voices, all you need to do is lower any of the POLY = n values by one increment. This will release a voice that you can then allocate to any one of the 15 other Check Channels. Remember, you only have eight voices to work with, so as you survey the

voices add up the total number in all of the POLY = *n* parameters. This will tell you how many voices have been used and how many voices are still available.

6. LEVEL = *n*--This Level parameter works like all of the other Level parameters and allows you to balance the overall amplitudes of the sounds in each of the various Check Channels.

You will probably want to assign different patches to each of the different Check Channel groups.

REMEMBER

It is not necessary to use successive MIDI Check Channels. For example, you can allocate one voice to Check Channel 1, four voices to Check Channel 6, two voices to Check Channel 9, and one voice to Check Channel 16.

Setting a Patch for Each Check Channel:

1. Press the appropriate bank/patch button while one of the Check Channels is being displayed on the LCD window. The patch that you select will be remembered as the sound for the currently displayed Check Channel.

2. As you cycle through the various Check Channels assign a patch to each of the channels to which you've allocated voices. These patch choices will be remembered for each channel and will only change if you choose a different patch while the Check Channel is being displayed.

7. TRICKS &TIPS: 20 INSIDER'S PATCHES

Now that we have covered the functions of the various sections of the CZ, it's time to see how these modules can be used to create sounds. This section will provide you with some advanced programming tricks that we have discovered through our own CZ programming experience.

These techniques are intended to serve as a starting point for your own sound creation and were designed to help you in the production of better, more complex sounds. Many of the techniques that are demonstrated in this section relate directly to the concepts that were discussed in the previous sections of this guide. Again, these patches are designed to provide insight and inspiration, and are in no way the last word in CZ programming.

PATCH 1: "5TH STAIRWAY"

INTENT: Creating pitch steps using the DCO ENV

PARAMETER

LINE SELECT	MODULATION RING	MODULATION NOISE	DETUNE +/−	DETUNE OCTAVE	DETUNE NOTE	DETUNE FINE	VIBRATO WAVE	VIBRATO DELAY	VIBRATO RATE	VIBRATO DEPTH	OCTAVE +/−	OCTAVE RANGE
1+2	−	−	+	0	05	00	4	46	63	99		0
(1 2 / 1+2 / 1+1)	(ON/OFF)	(ON/OFF)	(+/−)	(0 ~ 3)	(0 ~ 11)	(0 ~ 60)	(1 ~ 4)	(0 ~ 99)	(0 ~ 99)	(0 ~ 99)	(+/−)	(0 ~ 1)

LINE 1

DCO 1

WAVE FORM FIRST	WAVE FORM SECOND
7	4
(1 ~ 8)	(0 ~ 8)

E N V (PITCH)

STEP	1	2	3	4	5	6	7	8	
RATE	03	51	99	02	99	99	06	99	(0 ~ 99)
LEVEL	01	00	56	57	72	56	57	00	(0 ~ 99)
SUS/END					SUS			END	

DCW 1

KEY FOLLOW: 0 (0 ~ 9)

E N V (WAVE)

STEP	1	2	3	4	5	6	7	8	
RATE	99	50							(0 ~ 99)
LEVEL	99	00							(0 ~ 99)
SUS/END		END							

DCA 1

KEY FOLLOW: 0 (0 ~ 9)

E N V (AMP)

STEP	1	2	3	4	5	6	7	8	
RATE	99	39	50						(0 ~ 99)
LEVEL	99	00	00						(0 ~ 99)
SUS/END	SUS		END						

LINE 2

DCO 2

WAVE FORM FIRST	WAVE FORM SECOND
1	0
(1 ~ 8)	(0 ~ 8)

E N V (PITCH)

STEP	1	2	3	4	5	6	7	8	
RATE	50								(0 ~ 99)
LEVEL	00								(0 ~ 99)
SUS/END	END								

DCW 2

KEY FOLLOW: 0 (0 ~ 9)

E N V (WAVE)

STEP	1	2	3	4	5	6	7	8	
RATE	99	35							(0 ~ 99)
LEVEL	99	00							(0 ~ 99)
SUS/END		END							

DCA 2

KEY FOLLOW: 0 (0 ~ 9)

E N V (AMP)

STEP	1	2	3	4	5	6	7	8	
RATE	99	50							(0 ~ 99)
LEVEL	99	00							(0 ~ 99)
SUS/END	SUS	END							

This patch uses the Envelope Generator in the DCO section of LINE 1 to create a number of pitch "steps." As you press a key the pitch will remain at the "root" for a short amount of time, then "step up" to the 5th above the root, and then step up another octave where it will remain as long as you hold down the key. When you release the key the pitch will step down an octave, hold there for a moment and finally step back down to the root pitch. What is important to notice is how we use two steps of the envelope to hold the pitch at a certain point.

In STEP 3, the pitch steps up to a level of 56 (which is equal to an interval of a 5th). Increasing STEP 4's Level value one increment and setting the Rate value to 02 will cause the pitch to slowly move from the level of STEP 3 to the level of STEP 4 and to remain at a 5th for the amount of time it takes for the levels to change. There is one problem: this process can only be used at lower DCO envelope settings. The actual pitch change that occurs between the level settings of 56 and 57 is very slight. At higher level settings, say 66 to 67, the pitch change between the two level settings will be too drastic, causing the pitch step to go way out of tune. Thus, you can only create in-tune pitch steps from a level setting of 57 or lower.

The last thing to keep in mind is that this process of creating steps with the Envelope Generator can be applied to the DCW ENV and the DCA ENV as well, affecting the timbre and amplitude respectively.

PATCH 2: "ORIENTAL #5"

INTENT: Creating automatic pitch bend using the DCO ENV

PARAMETER

LINE SELECT	MODULATION RING	MODULATION NOISE	DETUNE +/-	DETUNE OCTAVE	DETUNE NOTE	DETUNE FINE	VIBRATO WAVE	VIBRATO DELAY	VIBRATO RATE	VIBRATO DEPTH	OCTAVE +/-	OCTAVE RANGE
1+2	–	–	+	0	00	02	1	45	60	02	+	1
(1, 2, 1+2, 1+1')	(ON/OFF)	(ON/OFF)	(+/-)	(0 - 3)	(0 - 11)	(0 - 60)	(1 - 4)	(0 - 99)	(0 - 99)	(0 - 99)	(+/-)	(0 - 1)

LINE 1

DCO 1

WAVE FORM FIRST	WAVE FORM SECOND
4	6
(1 - 8)	(0 - 8)

E N V (PITCH)

STEP	1	2	3	4	5	6	7	8	
RATE	06	30	41	43					(0 - 99)
LEVEL	01	00	10	00					(0 - 99)
SUS/END				END					

DCW 1

KEY FOLLOW: 0 (0 - 9)

E N V (WAVE)

STEP	1	2	3	4	5	6	7	8	
RATE	49	50	50						(0 - 99)
LEVEL	55	41	00						(0 - 99)
SUS/END		SUS	END						

DCA 1

KEY FOLLOW: 0 (0 - 9)

E N V (AMP)

STEP	1	2	3	4	5	6	7	8	
RATE	99	50							(0 - 99)
LEVEL	99	00							(0 - 99)
SUS/END	SUS	END							

LINE 2

DCO 2

WAVE FORM FIRST	WAVE FORM SECOND
6	4
(1 - 8)	(0 - 8)

E N V (PITCH)

STEP	1	2	3	4	5	6	7	8	
RATE	06	30	41	43					(0 - 99)
LEVEL	01	00	10	00					(0 - 99)
SUS/END				END					

DCW 2

KEY FOLLOW: 0 (0 - 9)

E N V (WAVE)

STEP	1	2	3	4	5	6	7	8	
RATE	99	50	50						(0 - 99)
LEVEL	52	43	00						(0 - 99)
SUS/END		SUS	END						

DCA 2

KEY FOLLOW: 0 (0 - 9)

E N V (AMP)

STEP	1	2	3	4	5	6	7	8	
RATE	99	50							(0 - 99)
LEVEL	94	00							(0 - 99)
SUS/END	SUS	END							

PATCH 3: "CHORUS-LEAD"

INTENT: Creating an automatic chorusing effect

This patch is somewhat similar to Patch 1 in that the DCO ENV is used to create a shift in the pitch. The difference lies in the fact that in this patch, the DCO ENV is used to create a single pitch bend instead of multiple pitch steps. Again, two Envelope Steps are used, here to delay the onset of the pitch bend by having a single increment change between the first two steps, and by setting the Rate parameter in STEP 1 to a low value to determine the length of the delay. Once the DCO Envelope travels through STEPS 1 and 2, STEPS 3 and 4 are used to create the actual pitch bend effect. In STEP 3 the pitch rises to a Level of 10 (a half step) at a fairly quick rate; it then drops back down to a Level of 00 in STEP 4, also at a fairly quick rate. So in this patch we have created an "automatic delayed pitch bend effect" using four DCO envelope steps.

There are two important things to keep in mind with this patch. The first is that the Rate value in STEP 2 determines how much time will pass after the key is depressed and before the pitch bend occurs. The second is that although there is a change in the Level settings of STEPS 1 and 2, there is only a one-increment change and that is between 00 and 01. Setting the Level values for these steps any higher would make the sound relatively useless, as the basic pitch in the beginning of the sound would be too out-of-tune.

PARAMETER

LINE SELECT	MODULATION		DETUNE				VIBRATO				OCTAVE	
	RING	NOISE	+/-	OCTAVE	NOTE	FINE	WAVE	DELAY	RATE	DEPTH	+/-	RANGE
1+2	—	—	+	0	00	02	1	00	50	00	+	0
(1 2 1+2 1+1)	(ON/OFF)		(+/-)	(0 ~ 3)	(0 ~ 11)	(0 ~ 60)	(1 ~ 4)	(0 ~ 99)	(0 ~ 99)	(0 ~ 99)	(+/-)	(0 ~ 1)

LINE 1

DCO 1

WAVE FORM	
FIRST	SECOND
1	0
(1 ~ 8)	(0 ~ 8)

E N V (PITCH)									
STEP	1	2	3	4	5	6	7	8	
RATE	50								(0 ~ 99)
LEVEL	00								(0 ~ 99)
SUS/END	END								

DCW 1

KEY FOLLOW: 0 (0 ~ 9)

E N V (WAVE)									
STEP	1	2	3	4	5	6	7	8	
RATE	99	35	99						(0 ~ 99)
LEVEL	99	76	00						(0 ~ 99)
SUS/END		SUS	END						

DCA 1

KEY FOLLOW: 0 (0 ~ 9)

E N V (AMP)									
STEP	1	2	3	4	5	6	7	8	
RATE	99	29	99						(0 ~ 99)
LEVEL	99	00	00						(0 ~ 99)
SUS/END			END						

LINE 2

DCO 2

WAVE FORM	
FIRST	SECOND
1	0
(1 ~ 8)	(0 ~ 8)

E N V (PITCH)									
STEP	1	2	3	4	5	6	7	8	
RATE	01	01	01	01	01	01	01	01	(0 ~ 99)
LEVEL	01	00	01	00	01	00	01	00	(0 ~ 99)
SUS/END								END	

DCW 2

KEY FOLLOW: 0 (0 ~ 9)

E N V (WAVE)									
STEP	1	2	3	4	5	6	7	8	
RATE	99	35	99						(0 ~ 99)
LEVEL	99	76	00						(0 ~ 99)
SUS/END		SUS	END						

DCA 2

KEY FOLLOW: 0 (0 ~ 9)

E N V (AMP)									
STEP	1	2	3	4	5	6	7	8	
RATE	99	29	99						(0 ~ 99)
LEVEL	99	00	00						(0 ~ 99)
SUS/END			END						

PATCH 4: "SPIKEY"

INTENT: Accentuating the attack transient by adding a pitch spike

This patch continues along with the idea of using the DCO ENV to create pitch shifting effects. Where this patch differs is in the amount of pitch shift and in the number of pitch shifts. The DCO ENV is used to create four very slight "ripples" or "waves" in the pitch of LINE 2. In STEP 1 of the envelope, the Level value is raised to 01, in STEP 2 the Level is set back to 00, in STEP 3 the Level goes back up to 01, and in STEP 4 the Level goes back to 00. The Rates for each of these steps are set to low values, so that the Level of the DCO envelope, and therefore the pitch, will change relatively slowly from one step to the next. This causes a detuning effect to take place between the pitches of LINE 1 (which has no pitch change) and LINE 2 (whose pitch is constantly going up and down causing it to be alternately in tune and out of tune with LINE 1).

There are two other things that are important to notice in this patch. The first is that the actual Detune function is used to lower the overall pitch of LINE 2 so that the sound will start flat, then come up to pitch, then go flat, and then come back up to pitch. This is more effective than having the pitch go sharp, then come back down to pitch, then go sharp again, etc. The second thing to notice is that the Amplitude Envelope of the sound ends approximately around the same time that the pitch shifting process stops. So the sound decays as the chorusing occurs and is pretty much inaudible when the chorusing stops. This makes the effect a little less obvious, since the sound has pretty much died away by the time the DCO envelope has completed its travel through its steps.

PARAMETER

LINE SELECT	MODULATION RING	MODULATION NOISE	DETUNE +/-	DETUNE OCTAVE	DETUNE NOTE	DETUNE FINE	VIBRATO WAVE	VIBRATO DELAY	VIBRATO RATE	VIBRATO DEPTH	OCTAVE +/-	OCTAVE RANGE
1+1	—	—	+	0	00	01	1	50	38	03	+	0
(1 2 1+2' 1+1')	(ON/OFF)		(+/-)	(0 - 3)	(0 - 11)	(0 - 60)	(1 - 4)	(0 - 99)	(0 - 99)	(0 - 99)	( )	(0 - 1)

LINE 1

DCO 1

WAVE FORM FIRST	WAVE FORM SECOND
3	0
(1 - 8)	(0 - 8)

E N V (PITCH)

STEP	1	2	3	4	5	6	7	8	
RATE	99	97							(0 - 99)
LEVEL	88	00							(0 - 99)
SUS/END		END							

DCW 1

KEY FOLLOW: 0 (0 - 9)

E N V (WAVE)

STEP	1	2	3	4	5	6	7	8	
RATE	99	63	99						(0 - 99)
LEVEL	99	86	00						(0 - 99)
SUS/END		SUS	END						

DCA 1

KEY FOLLOW: 0 (0 - 9)

E N V (AMP)

STEP	1	2	3	4	5	6	7	8	
RATE	99	13	50						(0 - 99)
LEVEL	99	00	00						(0 - 99)
SUS/END			END						

LINE 2

DCO 2

WAVE FORM FIRST	WAVE FORM SECOND
(1 - 8)	(0 - 8)

E N V (PITCH)

STEP	1	2	3	4	5	6	7	8	
RATE									(0 - 99)
LEVEL									(0 - 99)
SUS/END									

DCW 2

KEY FOLLOW: (0 - 9)

E N V (WAVE)

STEP	1	2	3	4	5	6	7	8	
RATE									(0 - 99)
LEVEL									(0 - 99)
SUS/END									

DCA 2

KEY FOLLOW: (0 - 9)

E N V (AMP)

STEP	1	2	3	4	5	6	7	8	
RATE									(0 - 9
LEVEL									(0 - 9
SUS/END									

This is the last of the patches that feature the DCO ENV as the main subject of interest and probably the least complex of the four. In this patch we are using the DCO ENV to add a sharp "transient" to the beginning of the sound by programming a very fast rise and fall in the pitch. As you can see, only two steps of the DCO ENV are used to create this effect. In STEP 1, the Level rises to a value of 88 at a Rate of 99 to STEP 2, where the Level drops back down to 00 at a Rate of 97. This causes the pitch to rise and fall over roughly a three-octave range in an extemely short period of time. You don't actually hear the pitch's travel, but you do perceive a very distinct "spike" or "pop" at the beginning of each note. This is very useful in accentuating the attacks of short, percussive sounds and for giving bass sounds more punch. This technique can also be employed with the DCW and DCA envelopes, although you might find it more useful to set the Level of STEP 2 somewhat higher so the timbre or amplitude won't immediately die away. You can then program a second or "supplementary" decay between STEP 2 and STEP 3 that does not have such a fast decay rate.

PATCH 5: "HOLLOW SOFT"

INTENT: Using Detune to fatten a sound in a dual-line mode

PARAMETER

LINE SELECT	MODULATION		DETUNE				VIBRATO				OCTAVE	
	RING	NOISE	+/-	OCTAVE	NOTE	FINE	WAVE	DELAY	RATE	DEPTH	+/-	RANGE
1+1	—	—	+	0	00	07	1	38	35	03		0
(1·2·1+2·1+1)	(ON/OFF)		(+/-)	(0 - 3)	(0 - 11)	(0 - 60)	(1 - 4)	(0 - 99)	(0 - 99)	(0 - 99)	(+/-)	(0 - 1)

LINE 1

DCO 1

WAVE FORM	
FIRST	SECOND
2	0
(1 - 8)	(0 - 8)

E N V (PITCH)									
STEP	1	2	3	4	5	6	7	8	
RATE	50								(0 - 99)
LEVEL	00								(0 - 99)
SUS/END	END								

DCW 1

KEY FOLLOW	
0	(0 - 9)

E N V (WAVE)									
STEP	1	2	3	4	5	6	7	8	
RATE	99	51	27						(0 - 99)
LEVEL	92	73	00						(0 - 99)
SUS/END		SUS	END						

DCA 1

KEY FOLLOW	
0	(0 - 9)

E N V (AMP)									
STEP	1	2	3	4	5	6	7	8	
RATE	77	41							(0 - 99)
LEVEL	91	00							(0 - 99)
SUS/END	SUS	END							

LINE 2

DCO 2

WAVE FORM	
FIRST	SECOND
(1 - 8)	(0 - 8)

E N V (PITCH)									
STEP	1	2	3	4	5	6	7	8	
RATE									(0 - 99)
LEVEL									(0 - 99)
SUS/END									

DCW 2

KEY FOLLOW	
	(0 - 9)

E N V (WAVE)									
STEP	1	2	3	4	5	6	7	8	
RATE									(0 - 99)
LEVEL									(0 - 99)
SUS/END									

DCA 2

KEY FOLLOW	
	(0 - 9)

E N V (AMP)									
STEP	1	2	3	4	5	6	7	8	
RATE									(0 - 99)
LEVEL									(0 - 99)
SUS/END									

This patch is a good example of two concepts that were touched on in the "Anatomy of the CZ" chapter. The first is the usefulness of the dual-line mode LINE 1 + LINE 1, and the second is using the Detune function to fatten a sound. The Detune in this patch causes the pitch of the second LINE 1 to be slightly flatter than the pitch of the first LINE 1. When these two lines are added together (as they automatically are in this mode), a beating effect is created between them. The aural effect of this is similar to that of chorusing and is very useful in thickening a sound. Only the Fine Control setting is utilized, as we only want to slightly detune the pitch of the second Line. The most useful value range for the Fine Control is between 03 and 10. Values below 03 will cause more of a slow, "churning" effect in the pitch than a chorusing effect. (However, values below 03 can be very useful for bass sounds, giving them that old analog sound). Fine settings above a value of 10 will generally cause too much chorusing and will make the sound appear to be out of tune. (Values above 10 can sometimes be useful in recreating the out-of-tune effects of a "honky-tonk" piano or accordian.)

The other thing to consider in this sound is that since we want to detune the sound of LINE 1 against itself, it is easiest to use the Dual-Line Select Mode of LINE 1 + LINE 1. It would be a waste of time to go to the trouble of reprogramming all of the values of LINE 1 into LINE 2 when we can essentially have the same result using this Line Select Mode. Using the Detune in this manner makes the "two-oscillator sound" much more apparent. If you use the dual-line modes without any detuning, the sound will many times appear lifeless or flat (as in boring!). Adding Detune to a patch will generally add life to the overall character of the sound.

PATCH 6: "COMBO ORGAN"

INTENT: Using the Detune to create organ sounds in dual-line mode

PARAMETER

LINE SELECT	MODULATION		DETUNE				VIBRATO				OCTAVE	
	RING	NOISE	+/-	OCTAVE	NOTE	FINE	WAVE	DELAY	RATE	DEPTH	+/-	RANGE
1+2	—	—	+	2	0	7	1	13	54	7		0
(1 2 1+2 1+1)	(ON/OFF)		(+/-)	(0 ~ 3)	(0 ~ 11)	(0 ~ 60)	(1 ~ 4)	(0 ~ 99)	(0 ~ 99)	(0 ~ 99)	(+/-)	(0 ~ 1)

LINE 1

DCO 1

WAVE FORM	
FIRST	SECOND
2	4
(1 ~ 8)	(0 ~ 8)

ENV (PITCH)

STEP	1	2	3	4	5	6	7	8	
RATE	50								(0 ~ 99)
LEVEL	00								(0 ~ 99)
SUS/END	END								

DCW 1

KEY FOLLOW: 8 (0 ~ 9)

ENV (WAVE)

STEP	1	2	3	4	5	6	7	8	
RATE	71	56	52						(0 ~ 99)
LEVEL	23	16	00						(0 ~ 99)
SUS/END		SUS	END						

DCA 1

KEY FOLLOW: 2 (0 ~ 9)

ENV (AMP)

STEP	1	2	3	4	5	6	7	8	
RATE	99	99							(0 ~ 99)
LEVEL	99	00							(0 ~ 99)
SUS/END	SUS	END							

LINE 2

DCO 2

WAVE FORM	
FIRST	SECOND
5	4
(1 ~ 8)	(0 ~ 8)

ENV (PITCH)

STEP	1	2	3	4	5	6	7	8	
RATE	50								(0 ~ 99)
LEVEL	00								(0 ~ 99)
SUS/END	END								

DCW 2

KEY FOLLOW: 9 (0 ~ 9)

ENV (WAVE)

STEP	1	2	3	4	5	6	7	8	
RATE	99	20	52						(0 ~ 99)
LEVEL	30	22	00						(0 ~ 99)
SUS/END		SUS	END						

DCA 2

KEY FOLLOW: 2 (0 ~ 9)

ENV (AMP)

STEP	1	2	3	4	5	6	7	8	
RATE	86	99							(0 ~ 99)
LEVEL	99	00							(0 ~ 99)
SUS/END	SUS	END							

This patch uses the Detune function in a different way than the previous patches. Instead of using the Fine parameter to slightly detune the second line, both the OCT (Octave) and the NOTE parameters are used to raise the pitch of LINE 2 up an octave and a 5th. Mixing the output of LINE 1 (which generates the root pitch) with the output of LINE 2 (which is an octave and a fifth above the root pitch) creates a composite sound that is characteristic of a multiple-octave organ sound. You will also notice that the amplitude of LINE 2 is somewhat lower than that of LINE 1. This keeps the upper-octave portion of the sound from masking the lower-octave portion and results in a better overall balance. Using the dual-line mode of LINE 1 + LINE 2 allows this type of separate control, in this case over both the detuned section of the sound (LINE 2) and the normal section of the sound (LINE 1), whereas using LINE 1 + LINE 1 would not. You will also generally find that detunings that are either in octaves or octaves plus 5ths will work best in the creation of organ-type sounds.

PATCH 7: "GENERIC DIGITAL"

INTENT: Creating high harmonics using the Ring Modulator and the Detune functions

PARAMETER

LINE SELECT	MODULATION RING	MODULATION NOISE	DETUNE +/-	DETUNE OCTAVE	DETUNE NOTE	DETUNE FINE	VIBRATO WAVE	VIBRATO DELAY	VIBRATO RATE	VIBRATO DEPTH	OCTAVE +/-	OCTAVE RANGE
1+2	ON	–	+	1	9	42	1	54	49	07		0
(1, 2, 1+2, 1+1)	(ON/OFF)	(ON/OFF)	(+/-)	(0 - 3)	(0 - 11)	(0 - 60)	(1 - 4)	(0 - 99)	(0 - 99)	(0 - 99)	(+/-)	(0 - 1)

LINE 1

DCO 1

WAVE FORM FIRST	WAVE FORM SECOND
1	0
(1 - 8)	(0 - 8)

ENV (PITCH) STEP	1	2	3	4	5	6	7	8	
RATE	50								(0 - 99)
LEVEL	00								(0 - 99)
SUS/END	END								

DCW 1 KEY FOLLOW: 3 (0 - 9)

ENV (WAVE) STEP	1	2	3	4	5	6	7	8	
RATE	82	36	27						(0 - 99)
LEVEL	83	55	00						(0 - 99)
SUS/END		SUS	END						

DCA 1 KEY FOLLOW: 3 (0 - 9)

ENV (AMP) STEP	1	2	3	4	5	6	7	8	
RATE	82	58	36						(0 - 99)
LEVEL	99	92	00						(0 - 99)
SUS/END		SUS	END						

LINE 2

DCO 2

WAVE FORM FIRST	WAVE FORM SECOND
2	0
(1 - 8)	(0 - 8)

ENV (PITCH) STEP	1	2	3	4	5	6	7	8	
RATE	50								(0 - 99)
LEVEL	00								(0 - 99)
SUS/END	END								

DCW 2 KEY FOLLOW: 2 (0 - 9)

ENV (WAVE) STEP	1	2	3	4	5	6	7	8	
RATE	99	57	27						(0 - 99)
LEVEL	99	45	00						(0 - 99)
SUS/END		SUS	END						

DCA 2 KEY FOLLOW: 0 (0 - 9)

ENV (AMP) STEP	1	2	3	4	5	6	7	8	
RATE	86	30	30						(0 - 99)
LEVEL	99	45	00						(0 - 99)
SUS/END		SUS	END						

This sound is representative of one of the effects that can be created by using the Ring Modulator and the Detune functions, generating digitial-type sound by creating a series of high harmonics. This patch uses both lines to provide elements of the composite sound. LINE 2 is detuned up an octave and a sixth plus somewhere in between another half step. This produces, strictly speaking, a nonharmonic relationship in that the interval created by Detune is really not a whole-number multiple of the fundamental. Even so, the harmonics that are generated by the addition of the Ring Modulator are mostly harmonic, and more importantly, sound good. If you turn the Ring Modulator off, you will find that it is rather out of tune. The composite sound that is created by the addition of the Ring Modulator has a very "digital" quality. Changing the Detune parameters will change the character of the overtone series and thus create variations of this "digital"-type timbre. One variation that we have found that sounds good to our ears is OCT = +1, NOTE = 8, and FINE = 51.

PATCH 8: "AFRICAN #1"

INTENT: Creating ethnic-type percussion using the Ring Modulator and the Detune functions

PARAMETER

LINE SELECT	MODULATION: RING	MODULATION: NOISE	DETUNE: +/-	DETUNE: OCTAVE	DETUNE: NOTE	DETUNE: FINE	VIBRATO: WAVE	VIBRATO: DELAY	VIBRATO: RATE	VIBRATO: DEPTH	OCTAVE: +/-	OCTAVE: RANGE
1+2	ON	—	+	1	08	27	—	—	—	—	+	1
(1, 2, 1+2', 1+1')	(ON/OFF)		(+/-)	(0 - 3)	(0 - 11)	(0 - 60)	(1 - 4)	(0 - 99)	(0 - 99)	(0 - 99)	(+/-)	(0 - 1)

LINE 1

DCO 1

WAVE FORM: FIRST	WAVE FORM: SECOND
1	0
(1 - 8)	(0 - 8)

E N V (PITCH)

STEP	1	2	3	4	5	6	7	8	
RATE	99	99							(0 - 99)
LEVEL	80	00							(0 - 99)
SUS/END		END							

DCW 1

KEY FOLLOW	
0	(0 - 9)

E N V (WAVE)

STEP	1	2	3	4	5	6	7	8	
RATE	99								(0 - 99)
LEVEL	00								(0 - 99)
SUS/END	END								

DCA 1

KEY FOLLOW	
2	(0 - 9)

E N V (AMP)

STEP	1	2	3	4	5	6	7	8	
RATE	99	48							(0 - 99)
LEVEL	99	00							(0 - 99)
SUS/END		END							

LINE 2

DCO 2

WAVE FORM: FIRST	WAVE FORM: SECOND
5	0
(1 - 8)	(0 - 8)

E N V (PITCH)

STEP	1	2	3	4	5	6	7	8	
RATE	99	99							(0 - 99)
LEVEL	80	00							(0 - 99)
SUS/END		END							

DCW 2

KEY FOLLOW	
0	(0 - 9)

E N V (WAVE)

STEP	1	2	3	4	5	6	7	8	
RATE	99	99							(0 - 99)
LEVEL	75	00							(0 - 99)
SUS/END		END							

DCA 2

KEY FOLLOW	
2	(0 - 9)

E N V (AMP)

STEP	1	2	3	4	5	6	7	8	
RATE	99	54							(0 - 99)
LEVEL	99	00							(0 - 99)
SUS/END		END							

This sound also uses the Ring Modulator and the Detune functions to create an overtone series that is rather nonharmonic. There are a few things to notice about this patch. First, the interval created by the Detune is not harmonic in relation to the fundamental. Second, both DCO ENVs are used to generate short "pitch spikes" to accentuate the attack transient of the sound. Third, the DCW ENV on LINE1 is set to 00, effectively turning the waveform into a sine wave. (You will find, however, that changing the waveform on LINE 1 will have some effect on the character of the sound, especially if one of the resonant waveforms is chosen.) Last, the DCW ENV in LINE 2 is used to create a very short "timbre spike" that adds to both the attack transient and to the harmonic transient. The Ring Modulator and Detune are mostly responsible for generating the harmonic content of the sound, since the DCWs are, for the most part, simply producing sine waves. The DCA ENV is programmed for a short,

PATCH 9: "GLOCK 'N' BRASS"

INTENT: Creating a dual sound using two separate lines

nonsustaining envelope that is characteristic of many ethnic percussion instruments.

PARAMETER

LINE SELECT	MODULATION RING	MODULATION NOISE	DETUNE +/-	DETUNE OCTAVE	DETUNE NOTE	DETUNE FINE	VIBRATO WAVE	VIBRATO DELAY	VIBRATO RATE	VIBRATO DEPTH	OCTAVE +/-	OCTAVE RANGE
1+2	—	—	+	1	00	00	1	40	49	04		0
(1+2 / 1+2' / 1)	(ON/OFF)	(ON/OFF)	(+/-)	(0 - 3)	(0 - 11)	(0 - 60)	(1 - 4)	(0 - 99)	(0 - 99)	(0 - 99)	(+/-)	(0 - 1)

LINE 1

DCO 1

WAVE FORM FIRST	WAVE FORM SECOND
1	0
(1 - 8)	(0 - 8)

E N V (PITCH)

STEP	1	2	3	4	5	6	7	8	
RATE	50								(0 - 99)
LEVEL	00								(0 - 99)
SUS/END	END								

DCW 1

KEY FOLLOW: 8 (0 - 9)

E N V (WAVE)

STEP	1	2	3	4	5	6	7	8	
RATE	72	23	50						(0 - 99)
LEVEL	89	57	00						(0 - 99)
SUS/END		SUS	END						

DCA 1

KEY FOLLOW: 3 (0 - 9)

E N V (AMP)

STEP	1	2	3	4	5	6	7	8	
RATE	72	20	50	50					(0 - 99)
LEVEL	99	92	93	00					(0 - 99)
SUS/END			SUS	END					

LINE 2

DCO 2

WAVE FORM FIRST	WAVE FORM SECOND
2	0
(1 - 8)	(0 - 8)

E N V (PITCH)

STEP	1	2	3	4	5	6	7	8	
RATE	50								(0 - 99)
LEVEL	00								(0 - 99)
SUS/END	END								

DCW 2

KEY FOLLOW: (0 - 9)

E N V (WAVE)

STEP	1	2	3	4	5	6	7	8	
RATE	99	65	50						(0 - 99)
LEVEL	99	51	00						(0 - 99)
SUS/END		SUS	END						

DCA 2

KEY FOLLOW: 0 (0 - 9)

E N V (AMP)

STEP	1	2	3	4	5	6	7	8	
RATE	99	55	48						(0 - 99)
LEVEL	86	81	00						(0 - 99)
SUS/END			END						

This patch is a good example of the effective use of the dual-line mode LINE 1 + LINE 2 to create a dual sound by programming each line as a complete voice. When the two lines are combined, the composite sound sounds like two different instruments playing at the same time.

The trick to creating this type of sounds is to program each line to generate a complete sound in and of itself. If you listen to each line of this sound separately you will find that each has been programmed as a separate "instrument." You should notice, too, that the "glock" sound in LINE 2 appears an octave lower than when in the dual mode. This brings up another tip that you should keep in mind, which is that you should apply some amount of preplanning to your programming. If one of the instruments is going to need to be transposed up or down, it is a good idea to program that voice into LINE 2, as this line is controlled by the the Detune function in dual-line mode LINE 1 + LINE 2. Another point especially important for this type of sound is that it is necessary to use the dual-line mode LINE 1 + LINE 2 to really be able to program two completely separate instruments. The last tip that should be mentioned in regards to programming a dual-instrument patch is that you will have better results if the sounds you program into the two lines are distinctly different timbres. If the timbres of the two sounds are too much alike, you

PATCH 10: "FLUTEY"

INTENT: Using Noise to add realism to a dual-line flute sound

won't really hear the effect of two separate instruments. The more distinct each sound is from the other, the more pronounced the dual-instrument effect.

PARAMETER

LINE SELECT	MODULATION		DETUNE				VIBRATO				OCTAVE	
	RING	NOISE	+/-	OCTAVE	NOTE	FINE	WAVE	DELAY	RATE	DEPTH	+/-	RANGE
1+2	—	ON	—	0	00	39	1	33	52	09	+	1
(1 2 1+2 1+1)	(ON/OFF)		(+/-)	(0 - 3)	(0 - 11)	(0 - 60)	(1 - 4)	(0 - 99)	(0 - 99)	(0 - 99)	(+/-)	(0 - 1)

LINE 1

DCO 1

WAVE FORM	
FIRST	SECOND
2	0
(1 - 8)	(0 - 8)

E N V (PITCH)									
STEP	1	2	3	4	5	6	7	8	
RATE	50								(0 - 99)
LEVEL	00								(0 - 99)
SUS/END	END								

DCW 1

KEY FOLLOW	
6	(0 - 9)

E N V (WAVE)									
STEP	1	2	3	4	5	6	7	8	
RATE	74	33	66	50					(0 - 99)
LEVEL	72	44	00	00					(0 - 99)
SUS/END		SUS		END					

DCA 1

KEY FOLLOW	
2	(0 - 9)

E N V (AMP)									
STEP	1	2	3	4	5	6	7	8	
RATE	71	53	59	62	60				(0 - 99)
LEVEL	99	88	94	83	00				(0 - 99)
SUS/END				SUS	END				

LINE 2

DCO 2

WAVE FORM	
FIRST	SECOND
2	0
(1 - 8)	(0 - 8)

E N V (PITCH)									
STEP	1	2	3	4	5	6	7	8	
RATE	50								(0 - 99)
LEVEL	00								(0 - 99)
SUS/END	END								

DCW 2

KEY FOLLOW	
2	(0 - 9)

E N V (WAVE)									
STEP	1	2	3	4	5	6	7	8	
RATE	83	30	50						(0 - 99)
LEVEL	40	64	00						(0 - 99)
SUS/END		SUS	END						

DCA 2

KEY FOLLOW	
2	(0 - 9)

E N V (AMP)									
STEP	1	2	3	4	5	6	7	8	
RATE	70	52							(0 - 99)
LEVEL	43	00							(0 - 99)
SUS/END		END							

This patch is another example of programming the two lines as separate components of a single instrument. This is pretty much the opposite approach that was used in the previous patch. Here, LINE 2 is used as a Noise source to provide the breath element to a flute sound.

There are a number of things to notice in this patch. The first and most obvious is that one of the dual-line modes is employed, in this case LINE 1 + LINE 2. This provides us with individual control over the two elements of the sound. LINE 1 is programmed as the pitch component of the sound. Some of the important elements of this line's programming include using WAVEFORM 2 to provide a "hollow" sound, using the DCA ENV to create a double "chiff" to the amplitude (characteristic of the flute sound), and finally using a DCW Envelope to provide some timbral change. There is also some Key Follow thrown in for good measure to keep the timbre mellow as you play up the keyboard. All of these elements contribute to the overall realism of the pitched element of the sound.

LINE 2, on the other hand, is used only as Noise, and for the most part does not add any pitched element to the sound. Noise, as we said, adds extra realism to the flute sound by recreating the "breath" element that is an important component of it. Using a separate line as the Noise source allows you to control the parameters of the Noise separately from the flute element. There are a few things to notice regarding the Noise. The DCA ENV is programmed to provide a short Noise "burst" at the beginning of each note, and the amplitude of the noise is set considerably lower than the amplitude of the flute portion of the sound. Also worth noticing is that there is a DCW envelope used which provides a slight timbre change in the Noise. The last thing that should be mentioned is that it is important to achieve the correct balance between the two elements of the sound, otherwise the Noise will be too obvious. Using the dual-line mode of LINE 1 + LINE 2 allows for this balance to be adjusted.

PATCH 11: "ELECTRIC DRUM"

INTENT: Using the DCO ENV with Noise to create electronic percussion

PARAMETER

LINE SELECT	MODULATION RING	MODULATION NOISE	DETUNE +/-	DETUNE OCTAVE	DETUNE NOTE	DETUNE FINE	VIBRATO WAVE	VIBRATO DELAY	VIBRATO RATE	VIBRATO DEPTH	OCTAVE +/-	OCTAVE RANGE
1+2	—	ON	+	3	05	00	—	—	—	—	−	1
(1·2·1+2·1+1')		(ON/OFF)	(+/−)	(0 ~ 3)	(0 ~ 11)	(0 ~ 60)	(1 ~ 4)	(0 ~ 99)	(0 ~ 99)	(0 ~ 99)	(+/−)	(0 ~ 1)

LINE 1

DCO 1

WAVE FORM FIRST	WAVE FORM SECOND
2	0
(1 ~ 8)	(0 ~ 8)

ENV (PITCH)

STEP	1	2	3	4	5	6	7	8	
RATE	99	50	54						(0 ~ 99)
LEVEL	69	61	00						(0 ~ 99)
SUS/END			END						

DCW 1

KEY FOLLOW: 0 (0 ~ 9)

ENV (WAVE)

STEP	1	2	3	4	5	6	7	8	
RATE	99	50							(0 ~ 99)
LEVEL	99	00							(0 ~ 99)
SUS/END		END							

DCA 1

KEY FOLLOW: 0 (0 ~ 9)

ENV (AMP)

STEP	1	2	3	4	5	6	7	8	
RATE	99	35	51						(0 ~ 99)
LEVEL	95	00	00						(0 ~ 99)
SUS/END			END						

LINE 2

DCO 2

WAVE FORM FIRST	WAVE FORM SECOND
1	4
(1 ~ 8)	(0 ~ 8)

ENV (PITCH)

STEP	1	2	3	4	5	6	7	8	
RATE	50								(0 ~ 99)
LEVEL	00								(0 ~ 99)
SUS/END	END								

DCW 2

KEY FOLLOW: 0 (0 ~ 9)

ENV (WAVE)

STEP	1	2	3	4	5	6	7	8	
RATE	99	32							(0 ~ 99)
LEVEL	99	00							(0 ~ 99)
SUS/END		END							

DCA 2

KEY FOLLOW: 0 (0 ~ 9)

ENV (AMP)

STEP	1	2	3	4	5	6	7	8	
RATE	99	58							(0 ~ 99)
LEVEL	99	00							(0 ~ 99)
SUS/END		END							

This patch is similar to the previous patch; the two lines are used as two elements of a composite sound. Another similarity is that LINE 2 is used as a Noise source.

This patch emulates the classic Simmons-type electronic tom sound. LINE 1 is used to create the "body" of the sound, and generates the typical dropping pitch sweep. There are two important aspects of this section of the sound. Notice that the DCO ENV consists of three steps. The first and second steps generate the main pitch envelope while the third step brings the pitch back to 00. This is to ensure that the pitch envelope will still be in motion as the amplitude dies away. If the pitch envelope were to complete its travel before the sound died away, the sound's effectiveness would be diminished. So the second thing to look at is the DCA ENV. This is also built with three steps. Only through trial and error were we able to determine the correct rates for the decay section so that the amplitude of the sound would end before the DCO Envelope.

LINE 2 is used to create the Noise element that is also very characteristic of this type of drum sound. Here, the Noise is transposed up three octaves to give it a very thin, wispy quality. The waveforms that have been chosen provide the most realistic type of Noise timbre; their effectiveness was also found only through trial and error. The Noise envelope is slightly shorter than the body of the sound, so it decays somewhat more quickly after the sound is triggered. When the two lines are added together and the Detune function is incorporated, the resultant sound is a pretty good approximation of the well-known electronic tom sound. This patch will sound good whether it played from the keyboard or triggered from a drum machine via MIDI.

PATCH 12: "DUAL ECHO"

INTENT: Creating repeated delay effects using the DCW and the DCA

PARAMETER

LINE SELECT	MODULATION: RING	MODULATION: NOISE	DETUNE: +/-	DETUNE: OCTAVE	DETUNE: NOTE	DETUNE: FINE	VIBRATO: WAVE	VIBRATO: DELAY	VIBRATO: RATE	VIBRATO: DEPTH	OCTAVE: +/-	OCTAVE: RANGE
1+1 OR 2	—	—	0	0	00	04	1	38	48	64	+	0
(1 2 1+2 1+1)	(ON/OFF)	(ON/OFF)	(+/-)	(0 - 3)	(0 - 11)	(0 - 60)	(1 - 4)	(0 - 99)	(0 - 99)	(0 - 99)	(+/-)	(0 - 1)

LINE 1

DCO 1

WAVE FORM: FIRST	WAVE FORM: SECOND
3	2
(1 - 8)	(0 - 8)

E N V (PITCH)

STEP	1	2	3	4	5	6	7	8	
RATE	50								(0 - 99)
LEVEL	00								(0 - 99)
SUS/END	END								

DCW 1

KEY FOLLOW	
0	(0 - 9)

E N V (WAVE)

STEP	1	2	3	4	5	6	7	8	
RATE	99	58	24						(0 - 99)
LEVEL	99	75	00						(0 - 99)
SUS/END		SUS	END						

DCA 1

KEY FOLLOW	
0	(0 - 9)

E N V (AMP)

STEP	1	2	3	4	5	6	7	8	
RATE	99	46	99	43	99	43	99	39	(0 - 99)
LEVEL	99	00	85	00	80	00	75	00	(0 - 99)
SUS/END	SUS							END	

LINE 2

DCO 2

WAVE FORM: FIRST	WAVE FORM: SECOND
1	0
(1 - 8)	(0 - 8)

E N V (PITCH)

STEP	1	2	3	4	5	6	7	8	
RATE	50								(0 - 99)
LEVEL	00								(0 - 99)
SUS/END	END								

DCW 2

KEY FOLLOW	
0	(0 - 9)

E N V (WAVE)

STEP	1	2	3	4	5	6	7	8	
RATE	99	45	99	43	99	41	99	40	(0 - 99)
LEVEL	99	00	99	00	80	00	75	00	(0 - 99)
SUS/END	SUS							END	

DCA 2

KEY FOLLOW	
	(0 - 9)

E N V (AMP)

STEP	1	2	3	4	5	6	7	8	
RATE	99	25							(0 - 99)
LEVEL	99	00							(0 - 99)
SUS/END	SUS	END							

This patch demonstrates two different methods of creating a repeating digital delay type of effect. The first example is LINE 1, in which the DCA ENV is programmed to provide three distinctly spaced repeats at successively diminishing amplitudes. As you can see, it is necessary to use all eight steps of the envelope for this effect. The first important point here is that STEP 1 be set as the Sustain Point, so that the sound will sustain for as long as the key is held down. Once the key is released, the envelope decays at STEP 2. Once STEP 2 is completed the envelope moves to STEP 3, which is the second attack, at a slightly lower DCA level. This results in this repeat sounding at a lower amplitude than the original, which emulates the repeat pattern of a digital delay. The other steps of the envelope follow a similar pattern of attack-decay. Only through trial and error and fine tuning can you program evenly spaced repeats. The envelope responds differently as the level decreases, so it is usually necessary to compensate with the Rate parameter.

The second example of this digital delay effect is created in LINE 2 using the DCW ENV. The pattern of multiple attack-decay is pretty much the same here. The important thing to remember when using the DCW ENV for this effect is that the DCA ENV must have a sufficient release time to allow for the sounding of all of the repeats. If the release time is too short, the amplitude will decay before the DCW ENV has had a chance to complete its travel through all of the steps. If you add both of these lines together by selecting the dual-line mode LINE 1 + LINE 2, you will end up with a very interesting multiple-repeat sound.

PATCH 13: "REVERBER"

INTENT: Creating a pseudo reverb effect using the DCA ENV

PARAMETER

LINE SELECT	MODULATION RING	MODULATION NOISE	DETUNE +/-	DETUNE OCTAVE	DETUNE NOTE	DETUNE FINE	VIBRATO WAVE	VIBRATO DELAY	VIBRATO RATE	VIBRATO DEPTH	OCTAVE +/-	OCTAVE RANGE
1+1	—	—	—	0	00	04	1	15	50	03		0
(1 2 1+2 1+1)	(ON/OFF)	(ON/OFF)	(+/-)	(0 - 3)	(0 - 11)	(0 - 60)	(1 - 4)	(0 - 99)	(0 - 99)	(0 - 99)	(+/-)	(0 - 1)

LINE 1

DCO 1

WAVE FORM FIRST	WAVE FORM SECOND
2	0
(1 - 8)	(0 - 8)

E N V (PITCH) STEP	1	2	3	4	5	6	7	8	
RATE	50								(0 - 99)
LEVEL	00								(0 - 99)
SUS/END	END								

DCW 1 KEY FOLLOW: 0 (0 - 9)

E N V (WAVE) STEP	1	2	3	4	5	6	7	8	
RATE	99	46	20						(0 - 99)
LEVEL	80	53	00						(0 - 99)
SUS/END		SUS	END						

DCA 1 KEY FOLLOW: 1 (0 - 9)

E N V (AMP) STEP	1	2	3	4	5	6	7	8	
RATE	99	73	35						(0 - 99)
LEVEL	99	61	00						(0 - 99)
SUS/END	SUS		END						

LINE 2

DCO 2

WAVE FORM FIRST	WAVE FORM SECOND
(1 - 8)	(0 - 8)

E N V (PITCH) STEP	1	2	3	4	5	6	7	8	
RATE									(0 - 99)
LEVEL									(0 - 99)
SUS/END									

DCW 2 KEY FOLLOW: (0 - 9)

E N V (WAVE) STEP	1	2	3	4	5	6	7	8	
RATE									(0 - 99)
LEVEL									(0 - 99)
SUS/END									

DCA 2 KEY FOLLOW: (0 - 9)

E N V (AMP) STEP	1	2	3	4	5	6	7	8	
RATE									(0 - 9
LEVEL									(0 - 9
SUS/END									

This patch is an example of how to generate reverb as part of a patch. The secret lies mostly in the programming of the DCA ENV. STEP 1 of the envelope is set as the Sustain Point, so the sound sustains for as long as the key is held down. As soon as the key is released, the DCA envelope immediately drops from the Sustain Level of 99 to a Level of 61 in STEP 2 and then moves to STEP 3 for a long release time. This quick drop to the lower level combined with the long decay time creates a pseudo-reverb at the end of the sound. The level that is programmed into STEP 2 determines the "reverb volume," and it is important that you set this level low enough to create the reverb effect. (If this level is too high, the decay will sound more like a regular decay and less like a reverb.)

The Rate setting in STEP 3 (the end point and release stage) determines the length of the reverb effect. Again, this parameter must be set to a long enough release for you to hear the effect as reverb: if it is set too short, the sound will decay too fast to hear the reverb effect; if it is set too long, the effect will not decay fast enough and the sound will get muddy. The last item to consider is the release of the DCW. The reverb is much more effective if the timbre's release is set fairly slow so that the high harmonics die away as the reverb is decaying. If the timbre's release is set too fast, the reverb will sound unnatural, as the high end will disappear too quickly. There should be some decay of the high harmonics, however, to simulate the high-end decay that occurs naturally in reverb.

PATCH 14: "SLOW-STRINGER"

INTENT: Creating a smooth, slow attack with the DCA ENV

PARAMETER

	MODULATION		DETUNE				VIBRATO				OCTAVE	
LINE SELECT	RING	NOISE	+/-	OCTAVE	NOTE	FINE	WAVE	DELAY	RATE	DEPTH	+/-	RANGE
1+1	—	—	+	0	00	06	1	24	47	07	+	1
[illegible]	(ON/OFF)		(+/-)	(0 - 3)	(0 - 11)	(0 - 60)	(1 - 4)	(0 - 99)	(0 - 99)	(0 - 99)	(+/-)	(0 - 1)

LINE 1

DCO 1

WAVE FORM	
FIRST	SECOND
1	0
(1 - 8)	(0 - 8)

E N V (PITCH)									
STEP	1	2	3	4	5	6	7	8	
RATE	50								(0 - 99)
LEVEL	00								(0 - 99)
SUS/END	END								

DCW 1

KEY FOLLOW	
0	(0 - 9)

E N V (WAVE)									
STEP	1	2	3	4	5	6	7	8	
RATE	99	28							(0 - 99)
LEVEL	99	00							(0 - 99)
SUS/END	SUS	END							

DCA 1

KEY FOLLOW	
0	(0 - 9)

E N V (AMP)									
STEP	1	2	3	4	5	6	7	8	
RATE	56	43	34	30					(0 - 99)
LEVEL	36	60	99	00					(0 - 99)
SUS/END			SUS	END					

LINE 2

DCO 2

WAVE FORM	
FIRST	SECOND
(1 - 8)	(0 - 8)

E N V (PITCH)									
STEP	1	2	3	4	5	6	7	8	
RATE									(0 - 99)
LEVEL									(0 - 99)
SUS/END									

DCW 2

KEY FOLLOW	
	(0 - 9)

E N V (WAVE)									
STEP	1	2	3	4	5	6	7	8	
RATE									(0 - 99)
LEVEL									(0 - 99)
SUS/END									

DCA 2

KEY FOLLOW	
	(0 - 9)

E N V (AMP)									
STEP	1	2	3	4	5	6	7	8	
RATE									(0 - 99)
LEVEL									(0 - 99)
SUS/END									

As we previously mentioned, the DCA ENV's response is logarithmic, making it difficult to program an even, slow amplitude attack with only one envelope step. This patch is a good example of using multiple envelope steps to provide a smooth attack. As you can see, the first three steps are used as individual portions of a single, complete attack. In STEP 1, the envelope travels quickly up to a Level setting of 36. In STEP 2, the attack continues with the Rate increased and the Level set to a value of 60. The third and last step of the attack is also set to a fairly quick rate, with the level here reaching its peak/sustain point. Thus, these three envelope steps are used in combination to provide a single, smooth attack.

PATCH 15: "VIDEO GAME"

INTENT: Creating special effects using the DCO ENV, Vibrato, and Detune

PARAMETER

LINE SELECT	MODULATION RING	MODULATION NOISE	DETUNE +/-	DETUNE OCTAVE	DETUNE NOTE	DETUNE FINE	VIBRATO WAVE	VIBRATO DELAY	VIBRATO RATE	VIBRATO DEPTH	OCTAVE +/-	OCTAVE RANGE
1+1	—	—	+	0	03	00	2	00	88	57	--	1
(1 2 1+2' 1+1')	(ON/OFF)	(ON/OFF)	(+/-)	(0 ~ 3)	(0 ~ 11)	(0 ~ 60)	(1 ~ 4)	(0 ~ 99)	(0 ~ 99)	(0 ~ 99)	(+/-)	(0 ~ 1)

LINE 1

DCO 1

WAVE FORM FIRST	WAVE FORM SECOND
7	0
(1 ~ 8)	(0 ~ 8)

E N V (PITCH)

STEP	1	2	3	4	5	6	7	8	
RATE	99	48	99	48	99	48	99	37	(0 ~ 99)
LEVEL	85	56	80	48	74	43	79	00	(0 ~ 99)
SUS/END								END	

DCW 1

KEY FOLLOW	
0	(0 ~ 9)

E N V (WAVE)

STEP	1	2	3	4	5	6	7	8	
RATE	99	26							(0 ~ 99)
LEVEL	99	00							(0 ~ 99)
SUS/END	SUS	END							

DCA 1

KEY FOLLOW	
0	(0 ~ 9)

E N V (AMP)

STEP	1	2	3	4	5	6	7	8	
RATE	99	01	01	01	01	06	99		(0 ~ 99)
LEVEL	99	98	99	98	99	98	00		(0 ~ 99)
SUS/END							END		

LINE 2

DCO 2

WAVE FORM FIRST	WAVE FORM SECOND
(1 ~ 8)	(0 ~ 8)

E N V (PITCH)

STEP	1	2	3	4	5	6	7	8	
RATE									(0 ~ 99)
LEVEL									(0 ~ 99)
SUS/END									

DCW 2

KEY FOLLOW	
	(0 ~ 9)

E N V (WAVE)

STEP	1	2	3	4	5	6	7	8	
RATE									(0 ~ 99)
LEVEL									(0 ~ 99)
SUS/END									

DCA 2

KEY FOLLOW	
	(0 ~ 9)

E N V (AMP)

STEP	1	2	3	4	5	6	7	8	
RATE									(0 ~ 9
LEVEL									(0 ~ 9
SUS/END									

This patch demonstrates a number of functions that have been discussed throughout this book. The main element of this sound is the rather crazy pitch envelope generated by the DCO ENV. The DCA ENV is programmed as a series of "delay" steps, so that the life of the sound exists for as long as the note is held down, and immediately terminates when the DCO ENV has completed its travel through all eight steps.

The dual-line mode of LINE 1 is used to effectively "double" the sound, and the second LINE 1 is detuned up a minor third. Interestingly enough, it is the vibrato that really puts it all together. The vibrato is set to a very high depth with a moderate rate. The important element is the Wave parameter, which is set to 2, a reverse sawtooth. Adding vibrato to this wave at a high depth and in conjunction with the crazy DCO envelope results in this "stepping" video game effect. Try turning off the vibrato to see how important it is to the final sound. This vibrato waveform (reverse sawtooth) is the best one to use for this type of effect, although the other waveforms will also provide some interesting results.

PATCH 16: "ANALOG FULL"

PARAMETER

LINE SELECT	MODULATION RING	MODULATION NOISE	DETUNE +/-	DETUNE OCTAVE	DETUNE NOTE	DETUNE FINE	VIBRATO WAVE	VIBRATO DELAY	VIBRATO RATE	VIBRATO DEPTH	OCTAVE +/-	OCTAVE RANGE
1+1	—	—	—	0	00	05	1	48	47	10		0
(1, 2, 1+1, 1+2)	(ON/OFF)		(+, -)	(0 - 3)	(0 - 11)	(0 - 60)	(1 - 4)	(0 - 99)	(0 - 99)	(0 - 99)	(+/-)	(0 - 1)

LINE 1

DCO 1

WAVE FORM FIRST	WAVE FORM SECOND
4	1
(1 - 8)	(0 - 8)

E N V (PITCH)

STEP	1	2	3	4	5	6	7	8	
RATE	50								(0 - 99)
LEVEL	00								(0 - 99)
SUS/END	END								

DCW 1 KEY FOLLOW: 1 (0 - 9)

E N V (WAVE)

STEP	1	2	3	4	5	6	7	8	
RATE	99	37	42						(0 - 99)
LEVEL	99	43	00						(0 - 99)
SUS/END		SUS	END						

DCA 1 KEY FOLLOW: 0 (0 - 9)

E N V (AMP)

STEP	1	2	3	4	5	6	7	8	
RATE	99	55	76						(0 - 99)
LEVEL	89	99	00						(0 - 99)
SUS/END		SUS	END						

LINE 2

DCO 2

WAVE FORM FIRST	WAVE FORM SECOND
(1 - 8)	(0 - 8)

E N V (PITCH)

STEP	1	2	3	4	5	6	7	8	
RATE									(0 - 99)
LEVEL									(0 - 99)
SUS/END									

DCW 2 KEY FOLLOW: (0 - 9)

E N V (WAVE)

STEP	1	2	3	4	5	6	7	8	
RATE									(0 - 99)
LEVEL									(0 - 99)
SUS/END									

DCA 2 KEY FOLLOW: (0 - 9)

E N V (AMP)

STEP	1	2	3	4	5	6	7	8	
RATE									(0 - 99)
LEVEL									(0 - 99)
SUS/END									

PATCH 17: "CRESCENDO BRASS"

PARAMETER

LINE SELECT	MODULATION RING	MODULATION NOISE	DETUNE +/-	DETUNE OCTAVE	DETUNE NOTE	DETUNE FINE	VIBRATO WAVE	VIBRATO DELAY	VIBRATO RATE	VIBRATO DEPTH	OCTAVE +/-	OCTAVE RANGE
1+2	—	—	—	00	00	07	1	72	53	08	—	1
(1, 2, 1+1, 1+2)	(ON/OFF)		(+/-)	(0 - 3)	(0 - 11)	(0 - 60)	(1 - 4)	(0 - 99)	(0 - 99)	(0 - 99)	(+/-)	(0 - 1)

LINE 1

DCO 1

WAVE FORM FIRST	WAVE FORM SECOND
1	0
(1 - 8)	(0 - 8)

E N V (PITCH)

STEP	1	2	3	4	5	6	7	8	
RATE	50								(0 - 99)
LEVEL	00								(0 - 99)
SUS/END	END								

DCW 1 KEY FOLLOW: 0 (0 - 9)

E N V (WAVE)

STEP	1	2	3	4	5	6	7	8	
RATE	70	55	35	41					(0 - 99)
LEVEL	99	21	91	00					(0 - 99)
SUS/END			SUS	END					

DCA 1 KEY FOLLOW: 0 (0 - 9)

E N V (AMP)

STEP	1	2	3	4	5	6	7	8	
RATE	93	60							(0 - 99)
LEVEL	99	00							(0 - 99)
SUS/END	SUS	END							

LINE 2

DCO 2

WAVE FORM FIRST	WAVE FORM SECOND
1	0
(1 - 8)	(0 - 8)

E N V (PITCH)

STEP	1	2	3	4	5	6	7	8	
RATE	54	50							(0 - 99)
LEVEL	20	00							(0 - 99)
SUS/END		END							

DCW 2 KEY FOLLOW: 0 (0 - 9)

E N V (WAVE)

STEP	1	2	3	4	5	6	7	8	
RATE	70	55	35	41					(0 - 99)
LEVEL	99	21	91	00					(0 - 99)
SUS/END			SUS	END					

DCA 2 KEY FOLLOW: 0 (0 - 9)

E N V (AMP)

STEP	1	2	3	4	5	6	7	8	
RATE	93	60							(0 - 99)
LEVEL	92	00							(0 - 99)
SUS/END	SUS	END							

PATCH 18: "HEAVY SYNCSWEEP"

PARAMETER

LINE SELECT	MODULATION RING	MODULATION NOISE	DETUNE +/-	DETUNE OCTAVE	DETUNE NOTE	DETUNE FINE	VIBRATO WAVE	VIBRATO DELAY	VIBRATO RATE	VIBRATO DEPTH	OCTAVE +/-	OCTAVE RANGE
1+2	ON	—	+	3	03	52	4	56	58	05		0
(1 · 2 · 1+2 · 1+1')	(ON/OFF)		(+/-)	(0 - 3)	(0 - 11)	(0 - 60)	(1 - 4)	(0 - 99)	(0 - 99)	(0 - 99)	(+/-)	(0 - 1)

LINE 1

DCO 1

WAVE FORM FIRST	WAVE FORM SECOND
8	2
(1 - 8)	(0 - 8)

E N V (PITCH)

STEP	1	2	3	4	5	6	7	8	
RATE	50								(0 - 99)
LEVEL	00								(0 - 99)
SUS/END	END								

DCW 1

KEY FOLLOW: 6 (0 - 9)

E N V (WAVE)

STEP	1	2	3	4	5	6	7	8	
RATE	99	33	52						(0 - 99)
LEVEL	97	31	00						(0 - 99)
SUS/END		SUS	END						

DCA 1

KEY FOLLOW: 2 (0 - 9)

E N V (AMP)

STEP	1	2	3	4	5	6	7	8	
RATE	99	99							(0 - 99)
LEVEL	99	00							(0 - 99)
SUS/END	SUS	END							

LINE 2

DCO 2

WAVE FORM FIRST	WAVE FORM SECOND
4	2
(1 - 8)	(0 - 8)

E N V (PITCH)

STEP	1	2	3	4	5	6	7	8	
RATE	50								(0 - 99)
LEVEL	00								(0 - 99)
SUS/END	END								

DCW 2

KEY FOLLOW: 6 (0 - 9)

E N V (WAVE)

STEP	1	2	3	4	5	6	7	8	
RATE	99	29							(0 - 99)
LEVEL	70	28							(0 - 99)
SUS/END		END							

DCA 2

KEY FOLLOW: 2 (0 - 9)

E N V (AMP)

STEP	1	2	3	4	5	6	7	8	
RATE	99	99							(0 - 99)
LEVEL	99	00							(0 - 99)
SUS/END	SUS	END							

PATCH 19: "COWBELL"

PARAMETER

LINE SELECT	MODULATION RING	MODULATION NOISE	DETUNE +/-	DETUNE OCTAVE	DETUNE NOTE	DETUNE FINE	VIBRATO WAVE	VIBRATO DELAY	VIBRATO RATE	VIBRATO DEPTH	OCTAVE +/-	OCTAVE RANGE
1+2	ON	—	+	1	09	00	—	—	—	—	+	1
(1 · 2 · 1+2 · 1+1')	(ON/OFF)		(+/-)	(0 - 3)	(0 - 11)	(0 - 60)	(1 - 4)	(0 - 99)	(0 - 99)	(0 - 99)	(+/-)	(0 - 1)

LINE 1

DCO 1

WAVE FORM FIRST	WAVE FORM SECOND
2	0
(1 - 8)	(0 - 8)

E N V (PITCH)

STEP	1	2	3	4	5	6	7	8	
RATE	50								(0 - 99)
LEVEL	00								(0 - 99)
SUS/END	END								

DCW 1

KEY FOLLOW: 1 (0 - 9)

E N V (WAVE)

STEP	1	2	3	4	5	6	7	8	
RATE	99	55							(0 - 99)
LEVEL	88	00							(0 - 99)
SUS/END		END							

DCA 1

KEY FOLLOW: 4 (0 - 9)

E N V (AMP)

STEP	1	2	3	4	5	6	7	8	
RATE	49	50	59						(0 - 99)
LEVEL	99	60	00						(0 - 99)
SUS/END			END						

LINE 2

DCO 2

WAVE FORM FIRST	WAVE FORM SECOND
2	0
(1 - 8)	(0 - 8)

E N V (PITCH)

STEP	1	2	3	4	5	6	7	8	
RATE	50								(0 - 99)
LEVEL	00								(0 - 99)
SUS/END	END								

DCW 2

KEY FOLLOW: 1 (0 - 9)

E N V (WAVE)

STEP	1	2	3	4	5	6	7	8	
RATE	79	04							(0 - 99)
LEVEL	65	00							(0 - 99)
SUS/END		END							

DCA 2

KEY FOLLOW: 3 (0 - 9)

E N V (AMP)

STEP	1	2	3	4	5	6	7	8	
RATE	91	59							(0 - 99)
LEVEL	99	00							(0 - 99)
SUS/END		END							

PATCH 20: "FROG PIANO"

PARAMETER

LINE SELECT	MODULATION RING	MODULATION NOISE	DETUNE +/-	DETUNE OCTAVE	DETUNE NOTE	DETUNE FINE	VIBRATO WAVE	VIBRATO DELAY	VIBRATO RATE	VIBRATO DEPTH	OCTAVE +/-	OCTAVE RANGE
1+2	ON	–	+	3	07	02	1	45	49	05	–	1
(1 2 1+2 1+1')	(ON/OFF)		(+/-)	(0 - 3)	(0 - 11)	(0 - 60)	(1 - 4)	(0 - 99)	(0 - 99)	(0 - 99)	(+/-)	(0 - 1)

LINE 1

DCO 1

WAVE FORM FIRST	WAVE FORM SECOND
5	0
(1 - 8)	(0 - 8)

E N V (PITCH)

STEP	1	2	3	4	5	6	7	8	
RATE	50								(0 - 99)
LEVEL	00								(0 - 99)
SUS/END	END								

DCW 1

KEY FOLLOW	
6	(0 - 9)

E N V (WAVE)

STEP	1	2	3	4	5	6	7	8	
RATE	99	33	50						(0 - 99)
LEVEL	87	80	00						(0 - 99)
SUS/END		SUS	END						

DCA 1

KEY FOLLOW	
0	(0 - 9)

E N V (AMP)

STEP	1	2	3	4	5	6	7	8	
RATE	99	50							(0 - 99)
LEVEL	99	00							(0 - 99)
SUS/END	SUS	END							

LINE 2

DCO 2

WAVE FORM FIRST	WAVE FORM SECOND
2	0
(1 - 8)	(0 - 8)

E N V (PITCH)

STEP	1	2	3	4	5	6	7	8	
RATE	50								(0 - 99)
LEVEL	00								(0 - 99)
SUS/END	END								

DCW 2

KEY FOLLOW	
4	(0 - 9)

E N V (WAVE)

STEP	1	2	3	4	5	6	7	8	
RATE	99	51	50						(0 - 99)
LEVEL	99	50	00						(0 - 99)
SUS/END		SUS	END						

DCA 2

KEY FOLLOW	
0	(0 - 9)

E N V (AMP)

STEP	1	2	3	4	5	6	7	8	
RATE	99	48	50						(0 - 9
LEVEL	99	82	00						(0 - 9
SUS/END		SUS	END						

Use the next page, which may be photocopied, as a form to log your own unique, creative patches.

PATCH FORM

(This form may be photocopied to log your own patches.)

PATCH NAME ____________________ CARTRIDGE NO. __________ TONE NO. __________

PARAMETER

LINE SELECT	MODULATION		DETUNE				VIBRATO				OCTAVE	
	RING	NOISE	+/−	OCTAVE	NOTE	FINE	WAVE	DELAY	RATE	DEPTH	+/−	RANGE
(1 2 1+2 1+1)	(ON/OFF)		(+/−)	(0 ~ 3)	(0 ~ 11)	(0 ~ 60)	(1 ~ 4)	(0 ~ 99)	(0 ~ 99)	(0 ~ 99)	(+/−)	(0 ~ 1)

LINE 1

DCO 1

WAVE FORM	
FIRST	SECOND
(1 ~ 8)	(0 ~ 8)

E N V (PITCH)									
STEP	1	2	3	4	5	6	7	8	
RATE									(0 ~ 99)
LEVEL									(0 ~ 99)
SUS/END									

DCW 1

KEY FOLLOW	
	(0 ~ 9)

E N V (WAVE)									
STEP	1	2	3	4	5	6	7	8	
RATE									(0 ~ 99)
LEVEL									(0 ~ 99)
SUS/END									

DCA 1

KEY FOLLOW	
	(0 ~ 9)

E N V (AMP)									
STEP	1	2	3	4	5	6	7	8	
RATE									(0 ~ 99)
LEVEL									(0 ~ 99)
SUS/END									

LINE 2

DCO 2

WAVE FORM	
FIRST	SECOND
(1 ~ 8)	(0 ~ 8)

E N V (PITCH)									
STEP	1	2	3	4	5	6	7	8	
RATE									(0 ~ 99)
LEVEL									(0 ~ 99)
SUS/END									

DCW 2

KEY FOLLOW	
	(0 ~ 9)

E N V (WAVE)									
STEP	1	2	3	4	5	6	7	8	
RATE									(0 ~ 99)
LEVEL									(0 ~ 99)
SUS/END									

DCA 2

KEY FOLLOW	
	(0 ~ 9)

E N V (AMP)									
STEP	1	2	3	4	5	6	7	8	
RATE									(0 ~ 99)
LEVEL									(0 ~ 99)
SUS/END									

NOTES: