

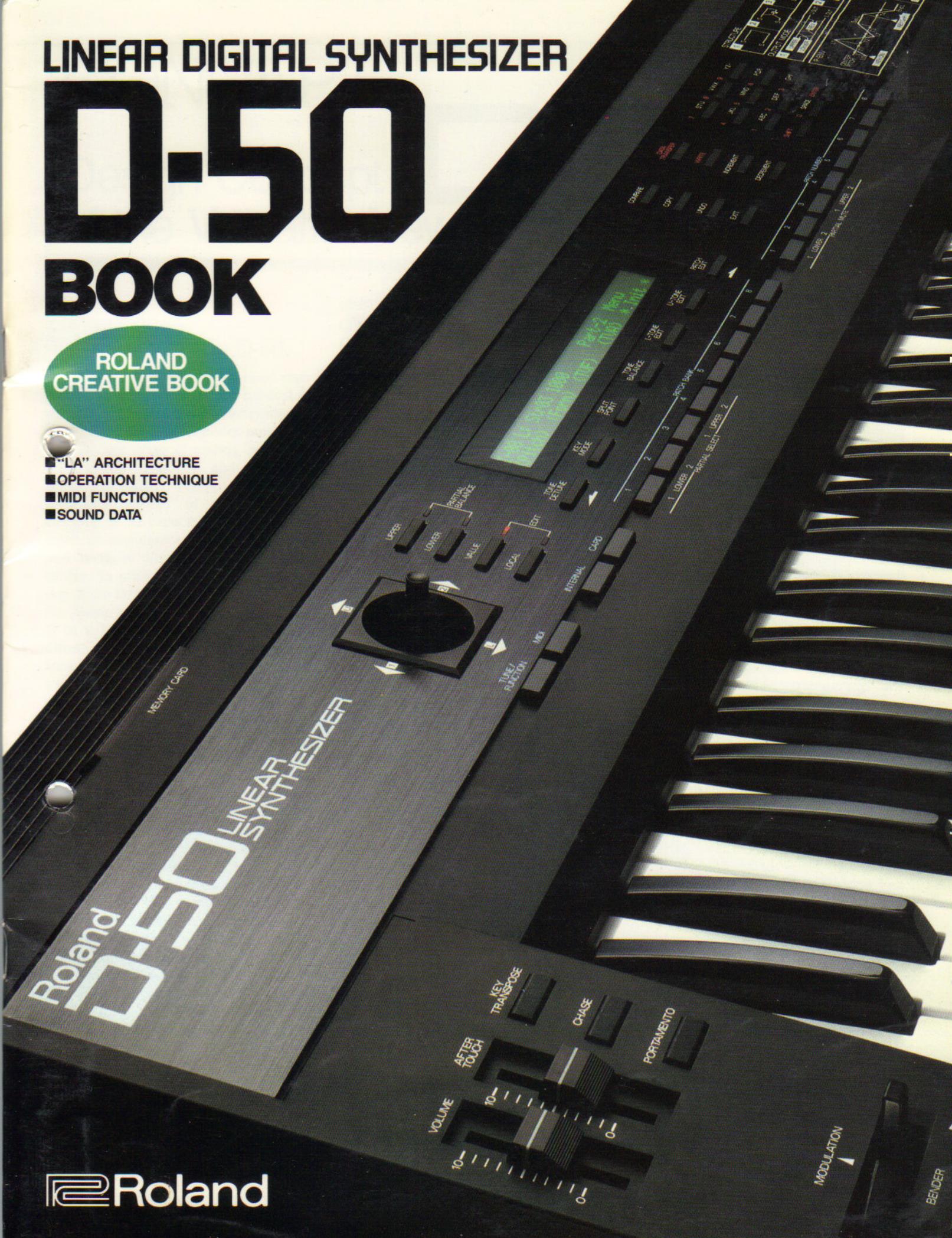
LINEAR DIGITAL SYNTHESIZER

D-50

BOOK

ROLAND
CREATIVE BOOK

- "LA" ARCHITECTURE
- OPERATION TECHNIQUE
- MIDI FUNCTIONS
- SOUND DATA



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ROLAND CREATIVE BOOK

D-50 BOOK

Just as musicians around the world are continuously striving to create new sounds and new music, Roland Corporation is constantly working to provide players with the latest music-making technology. Roland's new D-50 synthesizer is the culmination of years of research into a totally new sound-generating technology called LA synthesis. In one respect, LA synthesis places completely new sounds on the musicians' sonic palette. On the other hand, it is built on the conceptual foundations of more traditional methods of synthesis that are already familiar to many musicians. Another ingredient, microprocessor control, unites these attributes in one inexpensive, easy-to-use package—the Roland D-50. This book is designed to introduce and explain the elements of the D-50 and LA synthesis in plain English and provide insight into getting the most music from this exciting new technology.

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Adapted by Jeff Burger

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CONCEPT

Design Concept of the Versatile New D-50

Expression— The Heart Of The D-50

The D-50 uses an exciting new method of producing sounds called LA synthesis or Linear Arithmetic synthesis. This new technology provides musicians with a wide range of sounds, yet offers unparalleled simplicity and speed in producing them. Perhaps the most prominent feature of LA synthesis, however, is its capacity to allow musicians to communicate their expressions and nuances directly into the desired timbre. In other words, "playability" is one of the D-50's greatest attributes.

Being a true digital synthesizer, the D-50 is based on an all-digital process. Often, mention of the word "digital" is enough to send fear into the hearts of even the most accomplished synthesists. This is largely due to the myth that digital synthesizers are categorically difficult to program and incapable of producing the "fat" sounds that their analog counterparts are known for. Those fears can be set aside with the D-50 because LA synthesis unites the crystal-clear sound of digital with the warmth and programming ease of analog systems such as the Roland Juno and Super JX.

Until now, many musicians have had to rely on a variety of different synthesizers to create the wide range of timbres that are typical of today's music. The D-50, however, unites the best of all these musical worlds under one roof, providing players with a single instrument to fulfill their artistic dreams.

One of the most fascinating qualities of a synthesizer is its ability to create just about any sound that one can imagine. The D-50 is perfect for creating new sounds that have never been heard before in a world of "me too" synthesizer programs. On the other hand, the instrument is also capable of simulating the sounds of acoustic instruments with



incredible realism. While digital sampling devices such as the Roland S-10 and S-50 have some of this ability, the D-50 goes a step further in enhancing the performance control the player has over these sounds. In the brass family, for example, the timbre and pitch are controlled by many performance aspects during the course of a note such as wind pressure, lip movement, etc... The D-50 allows the player to control pitch and timbre parameters using a wide variety of performance controls such as after-touch, left-hand controllers and foot pedals. In this way the D-50 sets new standards in uniting performance control with great sound.

Quick Sounds

As a general rule, the more controls there are on a synthesizer, the wider its range of sounds becomes. With all of the diverse sound-generating potential found on the D-50, it is no surprise that there are a great number of parameters that need to be manipulated in the course of shaping a desired timbre. What is surprising is the ease with which the musician ac-

cesses and changes these parameters. Indeed, with its efficiently structured data entry system, the advanced user interface is another of the D-50's strongest attributes.

Changing sounds on the D-50 is easy—select a parameter, change its value, select another parameter, change its value, etc... The more you use it, the more like second nature it becomes. To simplify this interaction, the D-50 uses intuitively-structured levels of control displayed in a well-lit LCD window and parameters can be changed using the numeric keypad, increment/decrement buttons and/or the joystick. The joystick's design even lets you control two related parameters simultaneously.

As if three types of data entry weren't enough, the optional PG-1000 programmer can be added to the D-50 at any time. This device provides an independent slider for every parameter found on the instrument, eliminating some of the tedium experienced when using the same controls for various parameters. The combination of the D-50 and PG-1000 brings incredible speed to programming in the LA synthesis environment.

LA ARCHITECTURE

LINEAR ARITHMETIC SYNTHESIS

Sensitivity—Uniting the Player and the Instrument

Basics Of LA Synthesis

After hearing sound produced using LA synthesis, it is easy to assume that the LA method is radically different from more traditional techniques of sound synthesis. You'll be pleased to know, however, that LA synthesis derives many of its concepts from some older synthesizers that you may be familiar with. So, if you are comfortable with the average analog synthesizer, you'll be making new sounds with the D-50 immediately. Don't worry if this is your first experience with a synthesizer, though, because this book is specifically designed to cut down on your learning curve.

Before we get too far into the LA method, let's take a quick look at synthesis in general. The New Webster's Dictionary defines "synthesis" as "the combination of parts into a complex whole" (in this case, a sound). As we will shortly explain, LA synthesis certainly fits this description, as do the other types of synthesis that have preceded it. Since it is virtually impossible for

the performer to control this "combination of parts" manually in real time, the instrument must be programmed to create the desired sound.

Sound synthesis is a highly interactive process. The programmer must be able to conceptualize and analyze a sound by its various components and attributes. For example, most sounds can be categorized by pitch, timbre (or tone), volume and how those characteristics change over time. This analysis must then be applied to the synthesizer's various parameters.

Here we come to a problem—synthesizer designers must break the elements of sound down into parameters that are easily grouped, understood and manipulated. To have full and fast control over the timbre, the musician must be able to intuitively know how each control will effect the sound. This interaction lies at the heart of being able to create and tailor any sound the player desires. Put another way, while the synthesizer itself may be virtually limitless in the sounds it can produce, it is limited

by the musician's ability to sculpture sounds to the desired end given the particular user interface which has been designed into the instrument.

Unfortunately, this intuitive correlation of synthesizer parameters to aurally satisfying results has become more elusive as synthesizers have evolved in complexity—until LA synthesis. For example, the most widely used method of synthesis is the subtractive synthesis used by most analog synthesizers. Sounds are created by eliminating various harmonics from a basic waveform such as a sawtooth wave. This technology usually employs VCO's (or DCO's), VCF, VCA and envelope generators. These components correspond more or less directly to the key elements of pitch, timbre, volume and time. While subtractive synthesis is not the most flexible technology, it offers relatively intuitive operation.

Another representative technology is additive synthesis. Here sound is created by adding individual harmonics together. While this theoretically provides a great deal of flexibility, many complex parameters are required in order to reap the benefits of this technique. Unfortunately, many systems do not offer enough of these parameters for optimal results. In addition, many factors have to be taken into consideration when programming additive synthesizers, such as exact harmonic content and how each harmonic changes in time.

Other popular forms of digital synthesis include FM (frequency modulation) and PM (phase modulation). With these technologies a wide range of sounds can be created using a small number of parameters. Unfortunately, it is not always easy to create planned, integrated harmonics or predict the effect of a given parameter. The result is that sound creation is not very intuitive without investing a great deal of time.



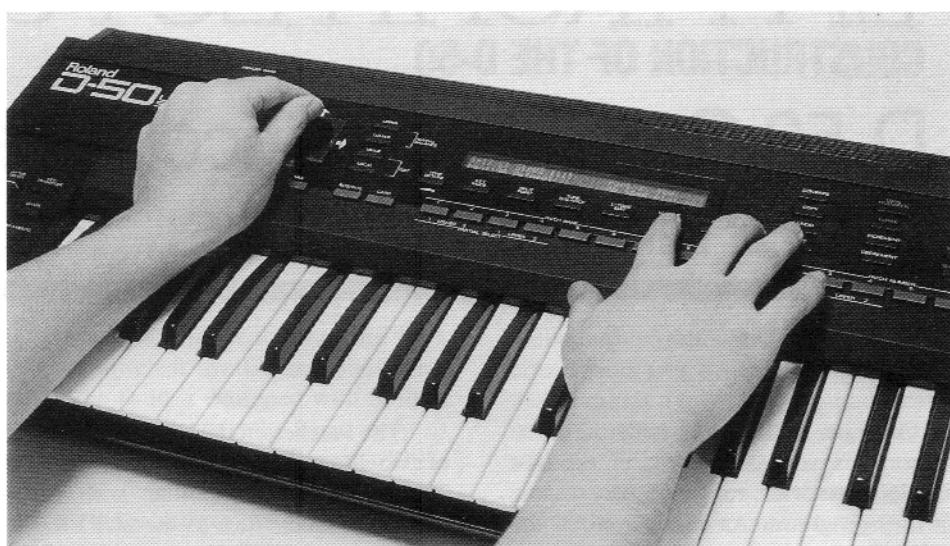
In recent years a new technology called digital sampling has evolved. This basically involves making digital recordings of real-world sounds and playing them back at the desired pitches. While this provides a great deal of realism, reshaping of those sounds is usually limited to variations on a theme. To further complicate matters, these sounds are often rather static and do not always accommodate performance nuances as effectively as might be desired.

Let's return now to our discussion of Linear Arithmetic synthesis. In a general sense subtractive synthesis and digital sampling are actually both forms of linear synthesis. LA synthesis is a hybrid of some of the concepts found in these technologies.

Earlier we said that the D-50 is a completely digital synthesizer. That means that the sound is totally created through a series of incredibly complex internal calculations. Fortunately all that number-crunching goes on inside the synthesizer and the user only has to worry about the overview! These calculations are primarily addition and subtraction, hence the name Linear Arithmetic. On the D-50, sounds are created by combining partials and tones (addition), removing unwanted harmonics (subtraction) and ring modulating (sum and difference).

Producing Sounds By Mixing Elements

If you think about it, most sounds can be broken down into smaller component sounds. Let's take a quick look at the characteristics of a piano, which has typically been one of the most difficult acoustic instruments to synthesize. First, we can break the piano sound into two different major elements—the initial attack and the decay that follows. The initial attack can be subdivided into additional components—the high transient of the hammer hitting the string and the many complex harmonics representing the string's vibration. After that initial



attack, on the other hand, the piano sound has a much longer decay and the harmonic emphasis is shifted to the resonance of the soundboard. To make matters more complicated, some of these characteristics differ from one point on the keyboard to another!

Traditional synthesizers, especially those using subtractive synthesis, have had a difficult time imitating the piano accurately for several reasons. For one thing, few envelopes have been able to produce the sharp initial transient followed by the appropriate decay. Secondly, the harmonic content is so complex that no amount of manipulating traditional waveforms can match the piano's harmonic spectrum. Finally, as soon as you get as close as possible to synthesizing a piano in one range of the keyboard, the timbre is typically nowhere close in other ranges.

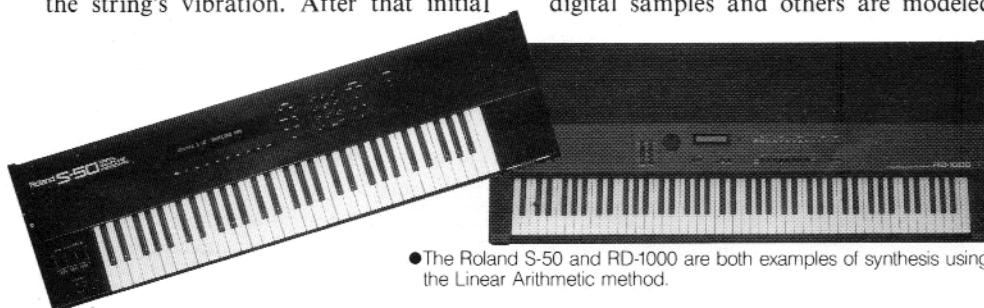
This kind of scenario is where the D-50 really shines. We mentioned earlier that synthesis is the process of combining parts into a complex whole. Linear arithmetic synthesis actually gives you control over the individual sonic elements and the D-50 produces sound by mixing these individual elements together.

Some of these elements are PCM digital samples and others are modeled

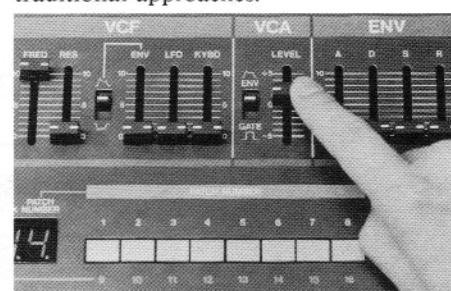
after traditional subtractive synthesis. In this way the appropriate sonic components can be selected and combined as needed. Going back to our piano sound, we might find that a PCM element is best for the overall harmonic structure and the initial attack of the hammers, while the decay of the string vibrations are best simulated using subtractive synthesis elements.

We're certainly not implying that the D-50 is limited to simulating acoustic instruments. However, that capacity is a clear indication of D-50's capabilities. You'll also find that the instrument offers the limitless possibilities associated with the finest of traditional synthesizers. The real point is that the D-50 provides a musical toolbox of sonic building blocks which the musician can combine and manipulate to any desired end.

If all this sounds a bit overwhelming, don't worry! It is not really necessary to deal with these concepts in great detail to get lots of sound from the instrument. We point out these concepts largely to illustrate the true potential of the D-50 and Linear Arithmetic synthesis in contrast to the problems inherent in more traditional approaches.



• The Roland S-50 and RD-1000 are both examples of synthesis using the Linear Arithmetic method.



• Knowledge of analog synthesis can easily be applied to learning the D-50.

LA ARCHITECTURE

CONSTRUCTION OF THE D-50

D-50 Construction Incorporates Four Individual Partials

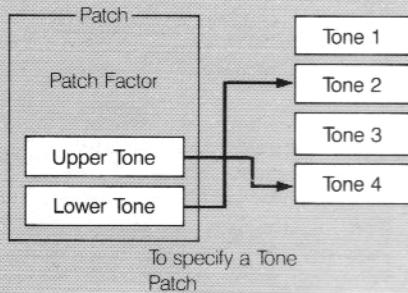
You can make music with the D-50 as soon as you take it out of the box thanks to a wide range of very usable factory programs. As with any tool, the more you know about its functions, architecture and inner workings, the more satisfying the results will be. The goal of this book is to provide you with the knowledge required to create sounds that are limited only by your imagination. In subsequent sections we will walk you through individual controls and parameters, however we recommend that you invest a little time in learning the overall architecture of the D-50 in this chapter first.

One D-50 Sound Is Composed Of Two Tones

Let's start with an overview. The D-50 contains 64 memory locations for synthesizer patches, with another 64 available when using a memory card. The word "patch" comes from the days of the original modular synthesizers when sounds were created by connecting various sound modules with patch cords. The term is now used to refer to a complete group of synthesizer settings which make up one total sound. "Fantasia" in location 1-1 is an example of a Patch on the D-50.

Figure 1

SUPER JX and S-50



The Patches on the D-50 are made up of two Tones—the Upper Tone and Lower Tone. If you are familiar with other Roland products such as the SUPER JX, S-50 and MKS-50 you are probably acquainted with this concept of Tones and Patches. Their relationship in the D-50 is probably most similar to that found in the MKS-50. While the SUPER JX and S-50 allows various Tone/Patch relationships, the D-50 is locked into having two Tones per Patch. Figure 1 is designed to clarify these differences.

Each of these two Tones is in turn made up of two Partials (Figure 2). In

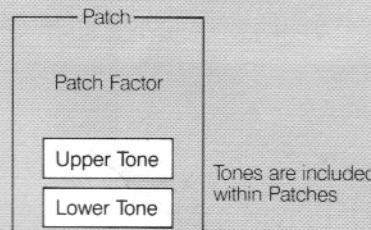
older terminology a partial is a harmonic component of a waveform. In the D-50, a Partial is basically equivalent to one complete traditional synthesizer using subtractive synthesis. So two Partials are combined to make a Tone and two Tones are combined to make a Patch. Another way to look at it is that one D-50 Patch is a combination of up to four complete synthesizer sounds!

This should illustrate that the variety of sound attainable with the D-50 is significantly greater than with older instruments which typically processed one or two oscillators through a single VCF and



● This in-depth study will help you take full advantage of the D-50's unique expressive potential.

D-50

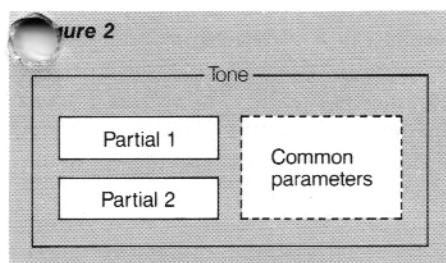


● Spectacular new tone colors can be generated by combining two different edited samples to form one tone.

VCA. In addition, any of the Partials can use PCM samples as well. The PCM sound generators allow the musician to create sounds with complex harmonics which can not be achieved with subtractive synthesis. In short, the D-50 gives you the best of both worlds!

We'll get into working with these Partials shortly, but right now we'll take a quick look at the polyphonic nature of the D-50. One reason why the instrument can perform effectively with four distinct sounds on each key depression can be attributed to the fact that the D-50 has 32 partials available at any one moment. Since each Tone uses two partials, and a patch is usually comprised of two Tones, the total polyphony is eight notes.

Different keyboard modes determine how these voices are allotted when the keyboard is played. For example, when the four Partials per voice are used, up to eight notes can be played simultaneously on the keyboard (32 divided by 4 is 8). Later on we'll cover other keyboard modes which provide for 16-voice polyphony, solo, keyboard splits, etc...



• Tones are basically divided into three areas: Common parameters, Partial 1 and Partial 2.



• In DUAL Mode, sounds are created using all four Partials for each note.

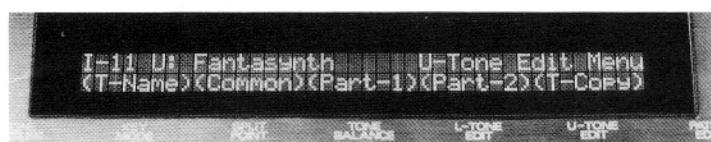
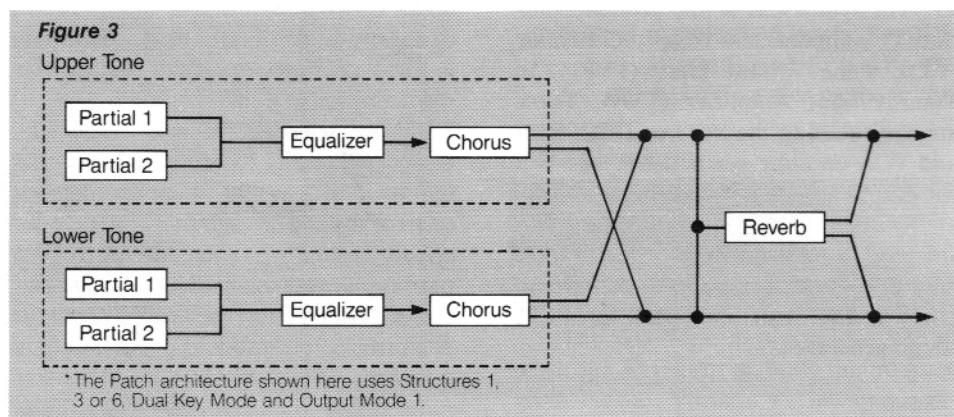
In addition to performing the work of four different synthesizers simultaneously, the D-50 is equipped with built-in effects that are typically found only as expensive output signal processors. These effects include a parametric equalizer, chorus, delay and various types of reverb. In summary, the D-50 incorporates all the sounds and effects that are required to create just about any sonic atmosphere. As we're about to demonstrate, the exact architecture can change somewhat, but Figure 3 shows the basic flow of these signals.

Flexible Architecture

While the D-50 is certainly a complete instrument, it may be beneficial for you to think of it as a series of individual components. Conceptualizing it as four

individual synthesizers, five different effects and two different outputs often makes things a lot simpler to understand in the process of creating and editing sounds.

Earlier we introduced the concepts of combining Partials to make up Tones and combining Tones to make up Patches. The way these signals are combined, processed and assigned to the keyboard and outputs is totally up to the user. The Key Mode can be set to assign voices to the keyboard as desired. The Upper and Lower Tones can each be assigned to individual outputs as needed. Reverb and other effects can be programmed according to the needs of the music at hand. Partials can be set to generate synthesized or PCM sounds. This programmable architecture ensures that the D-50 will conform to the individual musician's needs.



• The Output Mode determines how the Reverb is connected to the two Tones.



• In DUAL Mode, sounds are created using all four Partials for each note.



• The Structure determines how the two Partials of a Tone are combined.

LA ARCHITECTURE

FUNCTION BLOCKS AND PARAMETERS

Working with the Individual Parameters

An initial look at the D-50 might be a bit intimidating, but it all becomes clear when we look at it control by control. So now...the moment you've been waiting for! In this chapter we'll take a look at each section of the D-50, taking one parameter at a time.

Partial Parameter

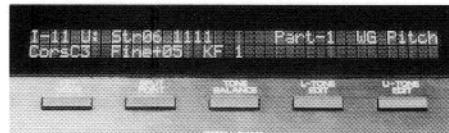
As we've touched on briefly, the smallest unit of sound on the D-50 is the Partial. Later we'll combine these Partials into the more complex Tones and Patches. Figure 1 illustrates the architecture of a Partial. Each of these Partials can draw from one of two types of sound generators—the synthesizer sound generator or the PCM sound generator. Which one you use is determined by the Structure, which will be covered shortly.

The synthesizer sound generator has three components—Wave Generator (WG), Time Variant Filter (TVF) and Time Variant Amplifier (TVA). These are equivalent to the VCO or DCO, VCF and VCA on older synthesizers. The WG generates the initial waveform, the TVF and TVA control the changes of tone and volume, respectively, over time. Please note that some of these controls have no effect if the Structure is set for PCM sound generation.

Wave Generator

Table 1 shows which parameters apply to the two types of sound generators. Valid parameters are marked with an "X" and parameters which do not apply are marked with an "0".

WG Pitch



The Coarse (Coarse) parameter controls the basic pitch of the Partial in half steps within the range of C1 to C7 (C4 being Middle C). This reference is to the key of C. For example, let's say that we're depressing Middle C on the keyboard with a Coarse setting of G5. In this case we would actually hear a note that is an octave and one fifth higher than the depressed key.

After selecting the basic pitch with Coarse, Fine sets the fine tuning within the range of ± 50 or approximately a quarter tone. This is handy for detuned effects or in fine tuning the pitch of a partial that is being used as a harmonic.

KF (Key Follow) determines how the pitch tracks the keyboard or MIDI input.

In most cases the setting is actually a ratio of aural octaves in contrast to physically playable octaves. The normal setting is 1—the intervals you hear match those that you play. Other settings provide microtonal and macrotonal scales, as shown in Figure 2. A setting of 7/8, for example means that a physical octave only yields 7/8 of an octave aurally. A setting of 2 produces a whole-step for every half-step played. Keyboard control is turned off completely with a setting of 0. Negative numbers indicate that the pitch moves in the opposite direction of the playing motion! Settings s1 and s2 stand for two different stretch tunings.

WG Modulation



LFO's (Low Frequency Oscillators) produce sub-audio frequencies which are traditionally used for modulation such as vibrato. The D-50 offers a total of three independent LFO's and their primary settings such as waveform and rate are found in the Common parameters. Other parameters such as routing and amounts are determined at the Partial level. LFO-1 is the only LFO source available for WG Modulation.

Figure 1

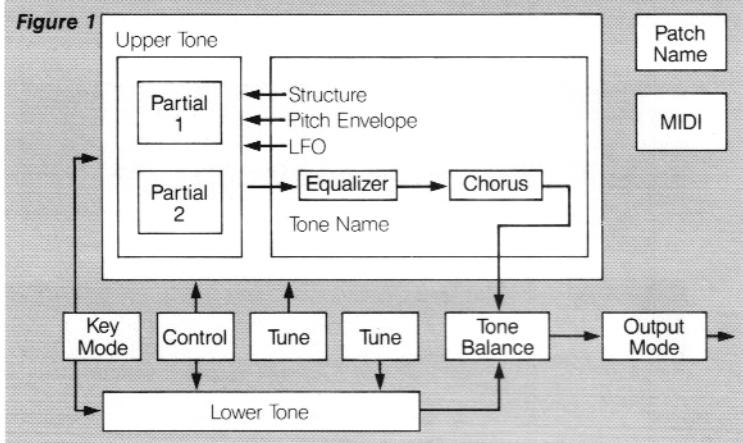


Table 1

	Synth	PCM
WG Pitch	○	○
WG Modulation	○	○
WG Waveform	○	×
PCM Wave No.	×	○
WG Pulse Width	○	×
Pulse Width	○	×
Velocity Range	○	×
After Touch Range	○	×
LFO Select	○	×
LFO Depth	○	×

In the Partial WG Mod display an LFO setting of (OFF) indicates no modulation. A setting of (+) represents normal modulation, while (-) stands for inverted modulation. Here's an example of inverted modulation: modulation with

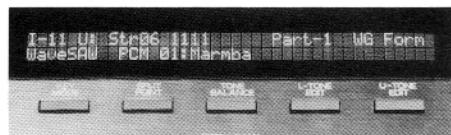
a square wave will normally result in a trill between the performed pitch and a higher one. On the other hand, modulating with an inverted square wave would trill down to a lower pitch from that played on the keyboard. Setting the LFO

parameter to (A & L) indicates that modulation will only have an effect when aftertouch or the Bender is activated. (Aftertouch refers to extra pressure exerted on the keyboard after the initial key depression.) Please note that the proper depth settings are required in the Pitch Mod Edit display from the Common level: LFOD must have a setting other than 0 in order to hear any effect when using (+) or (-). Lev and Aftr must also have positive settings in order for use of Aftertouch and Bender, respectively, to have an audible effect.

WG modulation can also be performed by P-ENV or pitch envelope. As with the LFO's, the major functions of P-ENV are set at the Common level. In a Partial's WG Mod display, an ENV setting of (+) represents positive or normal modulation by the P-ENV, while a setting of (-) indicates negative or inverted envelope modulation. If ENV is set to (OFF), P-ENV will have no effect on pitch of this Partial.

The final parameter, Bend, determines how the Bender affects the pitch. The actual Bender range is set at the Patch Factor level in the Control Edit display. In the WG Mod display, a Bend setting of (NOM) indicates that the range of the Bender will match the range set at the Patch Factor level. If Bend is set to (KEY) the range set at the Patch Factor level is multiplied by the Key Follow setting. If Bend is set to (OFF), the Bender will not effect the pitch of this Partial.

WG Waveform



The WG Wave display allows you to select the waveform or basic timbre for a given Partial. While a Partial can draw its sound source from either the synthesized waveform (determined by **WAVE**) or a PCM sample (determined by **PCM**), only one of the two can be in effect at any one time. The choice is made by setting the Structure parameter at the Common level, which we'll cover shortly.

If the Structure is set in the Common level in such a way that the Partial draws its sound from the PCM sound source, the PCM parameter determines which of the sampled sounds is active. Table 2 shows the PCM source numbers, display abbreviations and full names.

Figure 2

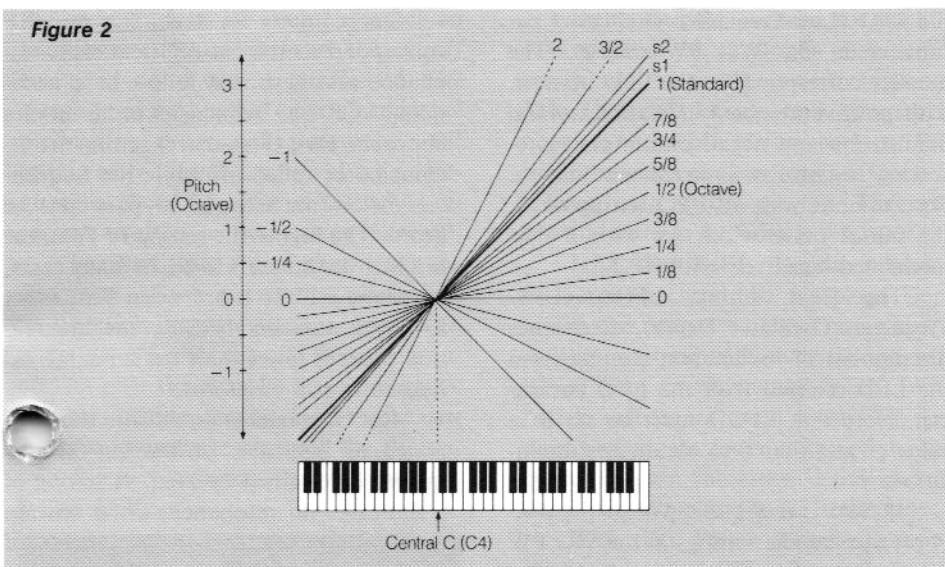
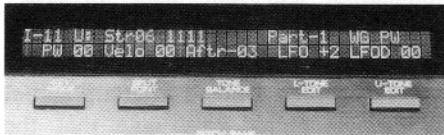


Table 2

Number	Display	PCM Name	Number	Display	PCM Name
1	Marmba	Marimba	51	EP_lp1	Electric Piano (Loop 1)
2	Vibes	Vibraphone	52	EP_lp2	Electric Piano (Loop 2)
3	Xylot	Xylophone 1	53	CLAVlp	Clavi (Loop)
4	Xyo 2	Xylophone 2	54	HC_lp	Harpsichord (Loop)
5	Log_Bs	Log Bass	55	EB_lp1	Electric Bass (Loop 1)
6	Hammer	Hammer	56	AB_lp	Acoustic Bass (Loop)
7	JpnDrm	Japanese Drum	57	EB_lp2	Electric Bass (Loop 2)
8	Kaimba	Kalimba	58	EB_lp3	Electric Bass (Loop 3)
9	Pluck1	Pluck 1	59	EG_lp	Electric Guitar (Loop)
10	Chink	Chink	60	CELLlp	Cello (Loop)
11	Agogo	Agogo	61	VIOlp	Violine (Loop)
12	3angle	Triangle	62	Reedlp	Leed (Loop)
13	Bells	Bell's	63	SAXlp1	Sax (Loop 1)
14	Nails	Nail File	64	SAXlp2	Sax (Loop 2)
15	Pick	Pick	65	Aah_lp	Aah (Loop)
16	Lpiano	Low Piano	66	Ooh_lp	Ooh (Loop)
17	Mpiano	Mid Piano	67	Manlp1	Male (Loop 1)
18	Hpiano	High Piano	68	Spect1	Spectrum 1 (Loop)
19	Harpsi	Harpsichord	69	Spect2	Spectrum 2 (Loop)
20	Harp	Harp	70	Spect3	Spectrum 3 (Loop)
21	Orgpcc	Organ Percussion	71	Spect4	Spectrum 4 (Loop)
22	Steel	Steel Strings	72	Spect5	Spectrum 5 (Loop)
23	Nylon	Nylon Strings	73	Spect6	Spectrum 6 (Loop)
24	Eguit1	Electric Guitar 1	74	Spect7	Spectrum 7 (Loop)
25	Eguit2	Electric Guitar 2	75	Manlp2	Male (Loop 2)
26	Dirt	Dirty Guitar	76	Noise	Noise (Loop)
27	P_Bass	Pick Bass	77	Loop01	Loop 1
28	Pop	Pop Bass	78	Loop02	Loop 2
29	Thump	Thump	79	Loop03	Loop 3
30	Uprite	Upright Bass	80	Loop04	Loop 4
31	Clarn	Clarinet	81	Loop05	Loop 5
32	Breath	Breath	82	Loop06	Loop 6
33	Steam	Steamer	83	Loop07	Loop 7
34	FluteH	High Flute	84	Loop08	Loop 8
35	FluteL	Low Flute	85	Loop09	Loop 9
36	Guiro	Guiro	86	Loop10	Loop 10
37	IndFlt	Indian Flute	87	Loop11	Loop 11
38	Harmon	Flute Harmonics	88	Loop12	Loop 12
39	Lips1	Lips 1	89	Loop13	Loop 13
40	Lips2	Lips 2	90	Loop14	Loop 14
41	Trumpt	Trumpet	91	Loop15	Loop 15
42	Bones	Trombones	92	Loop16	Loop 16
43	Contra	Contrabass	93	Loop17	Loop 17
44	Cello	Cello	94	Loop18	Loop 18
45	VioBow	Violin Bow	95	Loop19	Loop 19
46	Violns	Violins	96	Loop20	Loop 20
47	Pizz	Pizzicart	97	Loop21	Loop 21
48	Drawbr	Draw bars (Loop)	98	Loop22	Loop 22
49	Horgan	High Organ (Loop)	99	Loop23	Loop 23
50	Lorgan	Low Organ (Loop)	100	Loop24	Loop 24

●WG Pulse Width



If WAVE is active as a result of the proper Structure setting, SAW produces a sawtooth wave and SQU produces a rectangular wave. Actually, SQU is an abbreviation for square, however a square wave is just one form of rectangular wave. The pulse width of a rectangle wave is the ratio of positive width of the waveform to its negative width as illustrated in Figure 3. The actual pulse width of the rectangular wave is determined in the WG PW display. The **PW (Pulse Width)** parameter dictates the basic pulse width, with 0 being a square wave or 50% duty cycle (characterized as hollow sounding) and higher settings producing progressively thinner rectangular waves (characterized as a nasal sound). A setting of 100 represents a 97% duty cycle. The relationship between the value in the D-50's PW display to the actual pulse width can be seen in Figure 4.

Once the initial pulse width is set with PW, it can be modified by the other four parameters in the WG PW display. **Velo (Velocity)** allows the initial pulse width to be modified by keyboard velocity with possible settings ranging from -7 to +7. Applying increased velocity will force a higher duty cycle with a positive Velo setting and decreased duty cycle with a negative setting. Of course, this only has an effect if PW is not already set at its limit in the given direction.

Figure 3

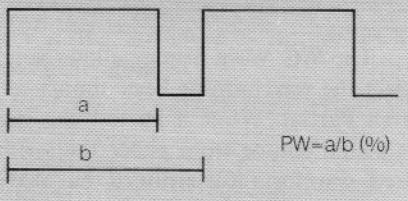
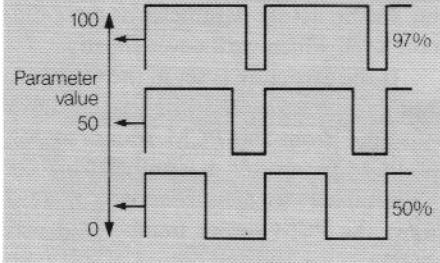


Figure 4



Aftertouch can be used to create the same effects as were just described under Velo by using the **Aftr (Aftertouch)** parameter. Its range is also -7 to +7.

The pulse width can also be modulated by any of the three LFO's by using the **LFO (Low-Frequency Oscillator)** parameter in the WG PW display. The number corresponds to the LFO number, with positive numbers indicating normal modulation and negative numbers representing negative or inverted modulation. For example, with an LFO setting of -2, the initial pulse width set with PW is modulated negatively with LFO-2.

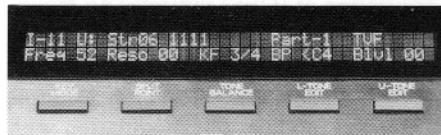
The final setting, **LFOD (Low-Frequency Oscillator Depth)**, determines the amount of modulation coming from the LFO selected with the LFO parameter. Note that LFOD must be set to a value greater than 0 to obtain any modulation.

If WAVE is set to SAW in the WG Form display, the settings in the WG PW display have no effect on pulse width. However, a PW setting of 0 has the effect of shifting the pitch of the sawtooth wave up one octave. This can produce interesting effects such as feedback when used in conjunction with the Velo and After parameters!

TVF

The Time Variant Filter digitally simulates the VCF on an analog synthesizer. Filters do exactly what they do—filter out unwanted sounds. In the case of the D-50, you might find it convenient to think of the TVF as a brilliance control. As illustrated in Table 3, the TVF is only active when using the synthesizer sound source of a Partial and has no effect on PCM samples.

●TVF Frequency



The controls for Freq, Res and KF correspond to the cut-off frequency, resonance and keyboard follow in a traditional VCF. The frequencies or harmonics above the **Freq (Frequency)** setting are attenuated or rolled off while the frequencies below are allowed to pass and be heard. The higher the setting of Freq, the brighter the timbre will be. In many cases, no sound will be heard when Freq is set to lower numbers because the attenuation point is lower than the fundamental harmonic of a waveform.

Res (Resonance) establishes the resonance or emphasis of the cut-off frequency determined by Freq. A setting of 0 indicates no resonance, while settings approaching 30 create the perception of an actual pitch at the TVF Frequency and a more electronic effect.

KF (Key Follow) allows the keyboard to influence the cut-off frequency. This control works the same way as the KF parameter in the WG Pitch display. Once again the possibilities represent the ratio of how many octaves the cut-off frequency is actually changed compared to the physical scale of a 12 key octave. Disregarding a few other influences, setting this parameter to match that of the WG Pitch KF insures that the brilliance aspect of the timbre remains constant regardless of what area of the keyboard is played. Of course, other settings may be used purposely for opposite effects. Refer to the section on WG Pitch for further explanation of these other ratios.

The two Bias work together to add

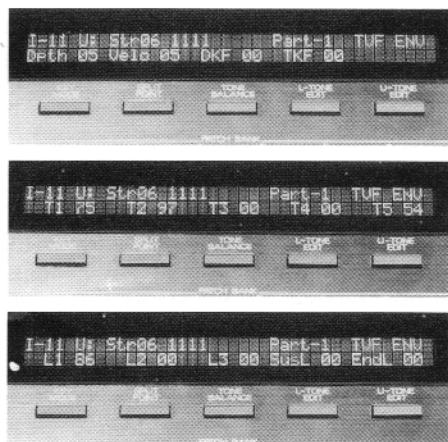
Table 3

	Synth	PCM
TVF	Cutoff Frequency	○ ×
	Resonance	○ ×
	Key Follow	○ ×
	Bias Point	○ ×
	Bias Direction	○ ×
	Bias Level	○ ×
TVF ENV	Depth	○ ×
	Velocity Range	○ ×
	Key Follow(Depth)	○ ×
	Key Follow(Time)	○ ×
	T1/T2/T3/T4/T5	○ ×
TVF Modulation	L1/L2/L3/SusL/EndL	○ ×
	LFO Level	○ ×
	LFO Depth	○ ×
	After Touch Range	○ ×

additional flexibility to keyboard control of the cut-off frequency. To effectively understand Bias, it may be beneficial to envision a filter-response curve established by the setting of KF. **BP (Bias Point/Direction)** determines a point on the keyboard (and KF curve) at which an additional effect or angle on the cut-off frequency curve can be established. The direction of the angle is determined by the accompanying arrow. For example, a BP setting of > C4 indicates an effect on frequencies above C4 while < G3 would represent an effect on frequencies below G3.

The **Bvl (Bias Level)** determines the sharpness of the attenuation angle and its direction. Positive settings indicate an angle where the cut-off frequency increases past the Bias Point and negative numbers represent an angle where the cut-off frequency decreases past the BP setting. Figure 5 illustrates this relationship.

●TVF ENV



Envelopes provide the synthesist with a way of determining how effects change

Figure 5

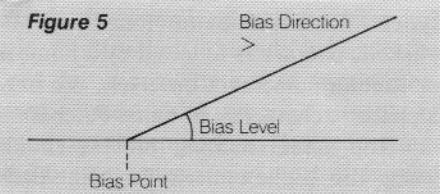
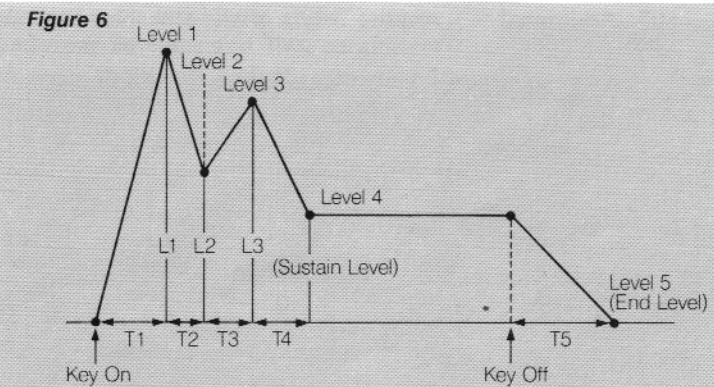


Figure 6



with respect to time, in this case the cut-off frequency or brilliance. Shortly we'll cover the actual parameters of the envelope, but for now we'll look at the parameters that determine how the envelope is applied.

Dpth (Depth) is used to establish how much of the envelope's effect is normally applied to the cut-off frequency. **Velo (Velocity)** effects how velocity influences the depth of the envelope. With higher settings, the envelope's effect is increased with harder playing. The range of valid settings for both is 0 to 100.

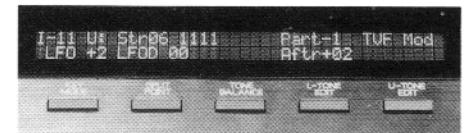
DKF (Key Follow-Depth) is used to influence the way TVF Envelope Depth tracks the keyboard. Valid range is 0 to 4. With a setting of 0, the envelope depth is uniform across the keyboard. When higher values are used, a curve is produced where the lower range of the keyboard is given increased depth and the depth in the upper range is decreased.

TKF (Key Follow-Time) works in a similar way to DKF, except that the keyboard curve affects envelope time rather than depth. At higher settings the times are increased in the lower range and decreased in the upper range. This is particularly useful in simulating acoustic instrument families.

The next two TVF ENV pages determine the shape of the envelope itself. While similar in concept, the D-50's envelopes provide greater flexibility than the traditional ADSR's found on earlier synths. D-50 envelopes work on the basic idea of setting a series of five different levels and the times that it takes to go from one level to the next. For example, **T1** is the time it takes to change from 0 level to the level established by **L1**, **T2** is time it takes to go from **L1** to **L2**, and so on. You may have noticed that the **L4** parameter is labeled **SusL (Sustain Level)**. This is due to that fact that this level is sustained as long as the key remains de-

pressed (after the first three envelope stages are completed). Put another way, after the envelope reaches the Sustain Level, **T5** is not activated until the key is released. **EndL (End Level)** represents the level which the envelope finally rests at after key release and the time determined by **T5**. Figure 6 shows these relationships graphically. All envelope parameters may also be entered via the 10-key pad.

●TVF Modulation



The parameters in the TVF Mod display provide additional sources of modulation of the Time Variant Filter and they work the same way as their sister settings we covered under Pulse Width. The **LFO (Low-Frequency Oscillator)** parameter determines which of the three LFO's is the modulation source, with (+) and (-) dictating positive or inverted modulation.

LFOD (Low-Frequency Oscillator Depth) indicates the depth of TVF modulation by the selected LFO and, once again, a value greater than 0 is required in order for modulation to have an effect.

Aftr (Aftertouch) is used to select the amount of influence keyboard aftertouch has on the TVF.

TVA

The TVA or Time Variant Amplifier is a digital simulation of the traditional VCA in analog synthesizers. TVA's are used to influence the output level or volume of a Partial. Unlike the TVF, the TVA can be used to affect the output of a Partial regardless of whether a synthesized or PCM sound source is being used. Certain parameters are still unavailable, as shown in Table 4.

Table 4

	Synth	PCM
TVA	○	○
Level	○	○
Velocity Range	○	○
Bias Point	○	○
Bias Direction	○	○
Bias Level	○	○
T1/T2/T3/T4/T5	○	○
L1/L2/L3/SusL/EndL	○	○
TVA ENV	○	○
Velocity Range(T1)	○	○
Key Follow(Time)	○	○
TVA Modulation	○	×
LFO Select	○	×
LFO Depth	○	×
After Touch Range	○	×

●TVA

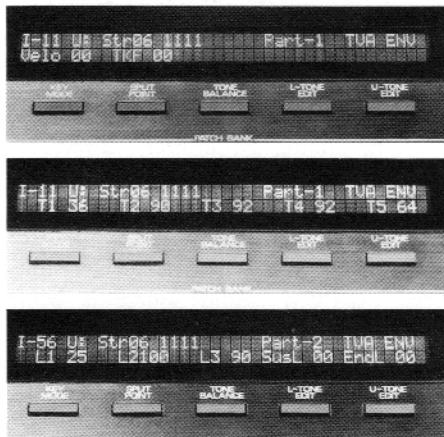


The **Levl** (Level) parameter determines the basic output volume of the Partial. Given the total range of 0 to 100, the highest settings are capable of inducing some distortion—an effect which is often unwanted yet useful in some cases. Also note a setting of 0 does not always mean that no sound will be output due to the settings of the modulation sources that we're about to cover. Levl is also a key element in determining timbre when the Partial is used in conjunction with a Structure which uses ring modulation.

Velo (Velocity) allows performance velocity to be routed to the TVA. The valid range is -50 to +50, with harder playing resulting in increased TVA output (louder volume) with positive settings and decreased output with negative settings.

BP (Bias Point/Direction) and **Blvl** (Bias Level) operate the same way as the analogous settings we covered under TVF. Here, they alter the keyboard response curve which influences the volume output.

●TVA ENV



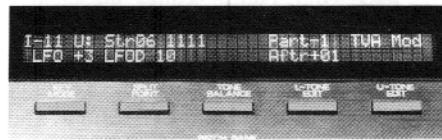
The TVA Envelope works in exactly the same way as the TVF envelope, except that the effect is routed to the Partial's output volume instead of the filter frequency.

Velo (Velocity) determines the amount of performance velocity which is routed to the envelope depth. Valid settings range from 0 to 4. Note the distinction between this parameter and the Velo control we just covered on the TVA dis-

play. TVA Velo is sent directly to the TVA while TVA ENV Velo is routed to the TVA Envelope which is in turn controlling the TVA itself.

TKF (Key Follow Time) sets up a keyboard curve which affects overall envelope times. At higher settings the envelope times are increased in the lower range and decreased in the upper range. Like its counterpart in the TVF ENV display, this is often useful in simulating acoustic instrument families. In the brass family, for example, it takes much longer to get the air moving through the body of a tuba than a trumpet—which translates to how long it takes these instruments to reach full brilliance and volume. This relationship of times to performance ranges is what the TKF settings are all about.

●TVA Mod



This display provides for modulation of the TVA by any of the D-50's four Partial's LFO's and/or keyboard aftertouch. The parameters should by now look familiar, as they operate in the same way as those we've covered in earlier sections. Note that TVA Modulation has no effect when PCM sound sources are selected. This is reflected in Figure 4.

The **LFO** (Low-Frequency Oscillator) parameter selects which of the four Partial's LFO's is being used for modulation and whether its polarity is normal (+) or inverted (-). The depth or amount of that modulation is determined by **LFO Depth** (Low-Frequency Oscillator Depth) within a range of 0 to 100.

Aftertouch can be routed to the TVA via the **Aftr** (Aftertouch) parameter with its range of -07 to +07. Additional

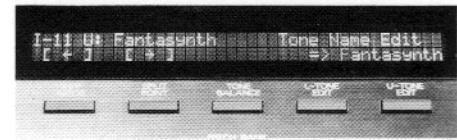
pressure on the keyboard results in greater volume given positive settings and a reduction in volume using negative settings.

The preceding parameters encompass all the controls that are available to a Partial and are identical for each of the four Partials. Remember, however, that not all parameters apply depending on the choice of synthesized or PCM sound sources.

COMMON PARAMETERS

Common parameters are used to determine the things which are common to both Partials within an Upper or Lower Tone such as Structure, LFO's, pitch envelope and effects.

●Tone Name



The **T-Name** (Tone Name) parameter is used to name the combined settings of the two Partials and Common parameters that make up an Upper or Lower Tone. What's in a name? A lot! Given the vast possibilities of sounds that the D-50 is capable of making, we recommend that you give a little extra thought when naming Tones—great timbres deserve great names! For one thing, it should be easy to distinguish a Tone Name from a Patch Name. We therefore advise establishing a system where you name Tones with alphabetic characters followed by a number or Roman numeral. Conversely, use only alphabetic characters to name Patches.

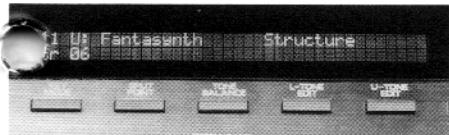
The actual naming process entails using the alphanumeric keypad. Each number key also represents three consecutive letters of the alphabet. You can

Table 5

Structure Number	Partial 1	Partial 2	Partial Combinations
1	S	S	Mix of Partial 1 and Partial 2
2	S	S	Mix of Partial 1 and Ring Modulation
3	P	S	Mix of Partial 1 and Partial 2
4	P	S	Mix of Partial 1 and Ring Modulation
5	S	P	Mix of Partial 1 and Ring Modulation
6	P	P	Mix of Partial 1 and Partial 2
7	P	P	Mix of Partial 1 and Ring Modulation

cycle through these by pressing the given key repeatedly. For instance, press the 1 button on the keypad and you get a 1 in the display. Push it again and you get a capital A, press it again and you get a capital B, etc... If you want lower case letters, hold the SHIFT key down while making the entry (backwards from a typewriter). When the character is correct, left and right movement through the name is done using the (you guessed it) SELECT buttons with the matching arrows! When everything is just the way you want it, simply press EXIT and your Tone has a new name.

●Structure



As we mentioned earlier, the **Structure** is used to determine the relationship of the two Partials found within a Tone. The variations entail whether the sound source of each of the two Partials is synthesized or PCM and whether they are used in parallel or ring modulated. Table 5 shows the seven possible relationships.

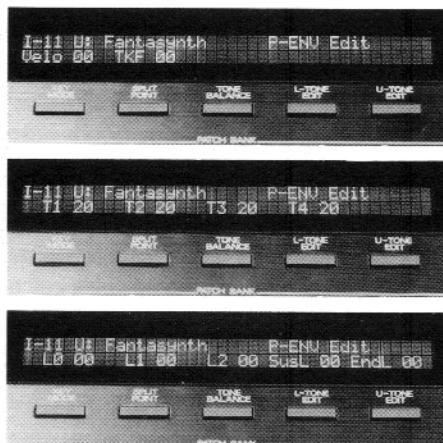
Since the Structure sets up the most fundamental aspects of a sound, it is recommended that it be the first thing that you deal with when beginning to conceptualize and program a sound. Probably the best way to think of the D-50 is as two complex Tones, each consisting of two separate synthesizers operating in parallel with their own sound chains, as exemplified by Structures 1, 3 and 6. Structure 1 would typically be used for a combination of two synthesized sounds which are each capable of standing alone, such as layered strings and brass. Structure 6 is most often used to reproduce the sound of acoustic instruments by combining PCM samples and using envelope and TVA parameters to shape the events properly. Structure 3 is popular for combining elements of realism of PCM sounds (such as the crisp attack of the vibraphone) with the flexibility of the synthesizer.

The ring modulation found in the remaining Structures, on the other hand, is used to create percussive and metallic sounds as well as special effects. While the other Structures create composite sound by adding Partials together, ring

modulated sounds are created by calculating the sums and differences of two sounds and creating sidebands or non-integrated harmonics. For this reason it is somewhat more difficult to create ring modulated sounds that match your imagination because the individual components bear little similarity to the effect of the combined partials.

In later sections, we'll cover other approaches to selecting Structures and using ring modulation.

●Pitch Envelope



The P-ENV or Pitch Envelope provides a way to control the pitch of the two Partials over time. Earlier, we saw that the WG Mod display for each Partial provides an ENV control to determine if modulation is received from the P-ENV and its polarity. The actual envelope parameters are determined in the P-ENV Edit display.

Velo (Velocity) determines how much performance velocity will influence the depth of P-ENV. The valid range is 0 to 2. Playing harder on the keyboard while using higher settings forces an increase in the range of the P-ENV.

TKF (Key Follow-Time) determines the keyboard response curve which is ap-

plied to the overall timings of the P-ENV. Valid settings range from 0 to 4, with 0 being flat or equal response across the entire keyboard and higher numbers progressively shortening the timings in higher performance octaves and lengthening them in lower octaves.

The actual P-ENV works basically the same way that the TVF and TVA envelopes work, except for the fact that negative settings are also available. The level range of -50 to +50 corresponds to an octave in either direction from the basic pitch, which is represented by 0. If the Velo setting is greater than 0 this range is increased slightly.

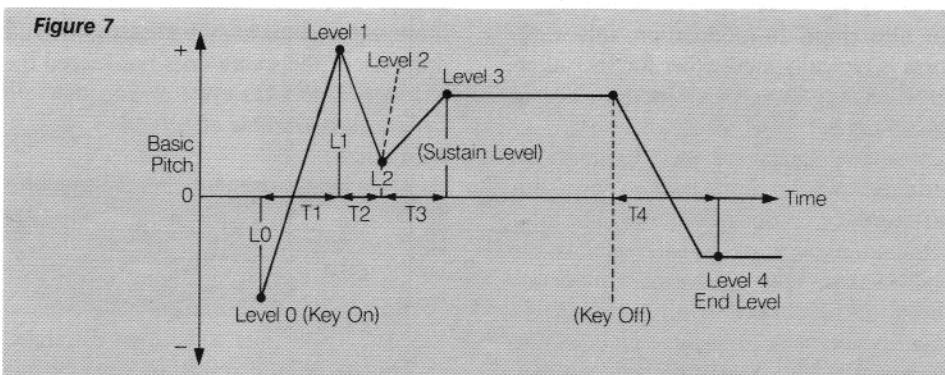
●Pitch Modulation



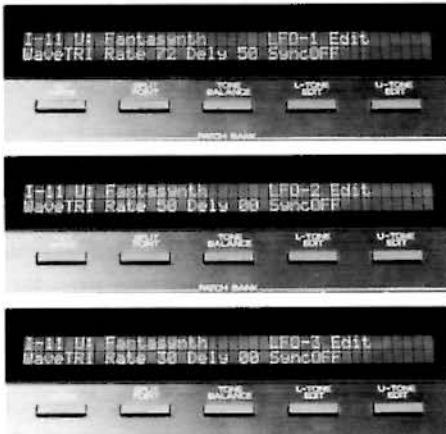
Earlier we saw that the WG Mod display provides the ability for LFO-1 to modulate a Partial's pitch. The Pitch Mod Edit display is used to select the amounts of that modulation. **LFOD (Low-Frequency Oscillator Depth)** selects the amount of permanent modulation from LFO-1 which is being routed to pitch within the range of 0 to 100. **Lev (Lever)** selects the amount of modulation induced by using the Bender Lever, while **Aftr (Aftertouch)** specifies the degree of modulation accepted from keyboard aftertouch.

Table 6

Velocity Range	Level Setting	Pitch Change
0	+50	+1 Octave
	-50	-1 Octave
	+50	+1.5 Octaves
	-50	-1.5 Octaves
1	+50	+2 Octaves
	-50	-2 Octaves



•LFO



The two Partials of each tone share four Partial LFO's. In covering various sections so far we've seen how to apply modulation from these LFO's with individual amounts to WG Pitch, PW, TVF and TVA. In this section, we'll examine the LFO's themselves. The operation and parameters of all four Partial LFO's are identical.

The type of modulation is determined by the **WAVE** parameter. The possible settings are TRI (Triangle), SAW (Sawtooth), SQU (Square or rectangular) and RND (Random). Each has a distinctly different effect and application from the others and can readily be envisioned according to its name.

Triangle waves are characterized by a smooth up-and-down motion. The most popular application is vibrato, which uses a moderate speed and small amount of depth. A greater depth and slower speed results in a siren-like effect. Modulating the TVF with a triangle wave can result in wah-wah type effects, and applying it to the TVA can create tremolo.

Sawtooth waves, on the other hand, feature a gradual downward slope followed by an immediate rise to the top of the next slope. In modulation, this waveform is typically used either for special effects, or, at slower speed in the place of an envelope.

Square waves are used to make an instant transition from high to low—on-off-on-off or up-down-up-down. The most common application is to modulate the pitch with a square wave at a moderate speed to produce a trill. Applying the square wave to the TVA can result in a shimmering or pulsing pseudo-sequenced effect.

A random waveform is just what it sounds like—random! It offers no real predictability or pattern and as a result is typically used for sample-and-hold type special effects.

Rate determines the rate or speed of the modulation, while **Delay** (Delay) allows the user to specify a delay time before modulation begins. This is useful in creating effects such as delayed vibrato.

When LFO's are used for special effects that involve timing, it is often desirable to make sure that the effect restarts at a predictable point each time a key is pressed. The **Sync** parameter is used to synchronize the LFO's phase with key depressions. Let's say that a sawtooth wave is being used to create a special effect with a verbal equivalent of "down-down-down-down". With Sync set to OFF, depressing a key repeatedly has unpredictable effects because you don't know where you'll catch the modulating waveform in its cycle. You might get "own-down-down-d" or "n-down-down-dow". A Sync setting of ON resets the phase of the modulating wave with a key depression only after all keys have been released. On the other hand, setting Sync to KEY resets the phase each time a new key is played regardless of whether other keys are engaged. For those familiar with older instruments, the ON and KEY settings are similar to single trigger and multiple triggers, respectively, on traditional instruments, but here the effect is applied to LFO phase.

Here are a few extra pointers on using Sync. Resetting the LFO phase can be used in certain situations like an envelope generator. For instance, the D-50 offers no envelope for use in conjunction with the PW parameter. Modulating the pulse width with a slow sawtooth wave can simulate this effect, provided Sync is engaged. You may want to use caution, however, and make sure that the overall duration of the sound does not exceed the length of one LFO cycle or you may experience undesirable effects.

•Equalizer



The D-50 puts a built-in equalizer, chorus, delay, and reverb at your finger-

tips with several advantages over outboard processing gear. First, the effects are completely part of the digital calculations that the D-50 makes in synthesizing a sound before it is converted to the analog audio domain, providing a clean sound and impossibility of mismatched levels. Secondly, they are programmable aspects of each Patch and do not need to be set independently when going from sound to sound. The Common parameters contain two of these effects—equalizer and chorus.

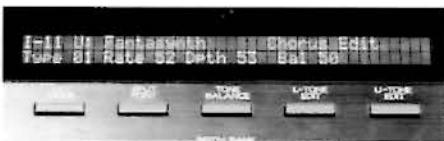
Equalizers are used to alter specific frequency ranges of an instrument's sound—sort of a deluxe version of the treble and bass tone controls found on stereos. This type of EQ is probably best described as semi-parametric. The functions are divided into two areas—low frequency and high frequency.

Lf (Low Frequency) determines the EQ frequency for the low end of the audio spectrum. All frequencies below this Lf point will be affected. The frequencies are specified in Hertz with 16 available points ranging from 63Hz to 840Hz. **Lg (Low Gain)** specifies how much gain is given to the frequencies below the Lf point and is specified in decibels within the range of -12dB to +12dB. Positive numbers boost the frequencies in the specified range while negative numbers decrease the frequencies in that range.

The high EQ works a little differently than the low EQ. **Hf (High Frequency)** is used to set a center frequency for the high EQ with 22 available points ranging from 250Hz to 9.5Hz. **HQ (High Q)** then determines the width of the EQ effect surrounding the Hf center frequency. Finally, **Hg (High Gain)** works similarly to Lg by setting the gain of the specified range from -12dB to +12dB.

Note that the effect of the two EQ attenuations is smooth rather than abrupt due to the roll-off technique shown in Figures 8 and 9. We recommend using the following technique to set the EQ to your needs. First, boost or attenuate the range in question with Lg or Hg so that the effect is very pronounced. Then set the proper frequency with Lf or Hf (along with HQ if you're working with the high EQ). Once the proper frequency is established, then go back and adjust the gain for the desired amount of equalization.

●Chorus



The D-50's built-in chorus provides each Tone with a variety of effects which increase the apparent dimensions of the sound. For example, traditional chorus effects lend the appearance of multiple instruments where there is only one.

Type is used to specify one of eight chorus-like effects by number. They are 1) Chorus 1, 2) Chorus 2, 3) Flanger 1, 4) Flanger 2, 5) Feedback Chorus, 6) Tremolo, 7) Chorus Tremolo and 8) Dimension. Since one sound is worth a thousand words, experimentation is the best way to understand the difference in these effects.

Rate determines the speed of the chorus effect. Settings around 50 will yield an effect common to most chorus applications. Working hand in hand with Rate is **Dpth (Depth)**, which sets the amount of chorus modulation. Once again a moderate amount will be appropriate in most cases. Both these parameters have a range of 0 to 100.

Bal (Balance) establishes the balance or ratio of normal sound to the chorused effect with a range of 0 to 100. A setting of 0 provides only the dry (normal) sound while 100 yields only the wet sound effect.

Patch Factor

As we mentioned earlier, a D-50 Patch consists of two Tones. Patch Factor is the control level used to establish the master aspects of a Patch. These include the tuning, Patch name, outputs, controllers and MIDI.

●Key Mode



The D-50's keyboard can be used to control the two Tones in a variety of ways and these options are established using **Key Mode** from the master display. Earlier, we discussed the fact that the D-50 has a total of 32 simultaneous voices at the Partial level. In **WHOLE** mode, the D-50 features 16-voice polyphony (you can play 16 keys at once), with each note playing the two Partial of the Upper Tone. This offers the greatest polyphony for synthesizing voice-critical instruments such as pianos. As a trade-off, you can only use two D-50 Partial.

The D-50 can also be configured to produce today's popular layered sounds (which traditionally requires using MIDI and several synthesizers). **DUAL** mode "stacks" the Upper and Lower Tones together, allowing you to play them from the keyboard simultaneously with 8-voice polyphony. In this way, each key depression plays four Partial. (SP has no effect in **WHOLE** or **DUAL** modes). **Bal (Balance)** determines the volume ratio of the two sounds with 0 representing all Lower Tone and 100 being all Upper Tone.

SPLIT mode lets you divide the D-50's keyboard into two 8-voice synthesizers. As you might suspect, the bottom section plays the Lower Tone and the higher range controls the Upper Tone with 8-voices available for each sound. The **SP (Split Point)** parameter sets the actual split point, Middle C being C4. Here **Bal** determines the volume ratio between the two parts of the keyboards.

WHOL-S (Whole Solo) sets up the D-50 to play the Upper Tone monophonically (one note at a time). The keyboard has last-note priority, meaning that it responds to the last key played even if others are still being held down. SP and Bal have no effect.

In **DUAL-S** (Dual Solo) mode, you still get monophonic response with last-note priority, however the Upper and Lower Tones are stacked or layered. SP has no effect and Bal operates the same way as in **DUAL** mode.

SPL-US (Split—Upper Solo) mode splits the keyboard at the point set with SP with monophonic response for the Upper Tone and 8-voice polyphony for the Lower Tone. Bal sets the volume balance between the two sections.

SPL-LS (Split—Lower Solo) works the same as **SPL-US** except that the Lower Tone is monophonic and the Upper Tone has 8-voice response.

SEP (Separate) mode is designed specifically for use in a MIDI system where at least one Tone on the D-50 is being played from another MIDI device. Simply put, the Lower Tone responds only to MIDI messages being received on the D-50's Basic Channel and keyboard control is disabled. The Upper Tone can be controlled by the keyboard or another external MIDI device which is sending on the D-50's Separate Channel. We'll be spending a lot more time on MIDI in just a bit.

SEP-S (Separate—Solo) works the same way with the exception that the Upper Tone only responds monophonically to each controller. In other words, one note of the Upper Tone can be played by the external MIDI device via the Separate Channel and another single note from the Upper Tone can be played by the keyboard. The Lower Tone is still disconnected from the keyboard and receives polyphonically on the Basic Channel only.

Figure 8

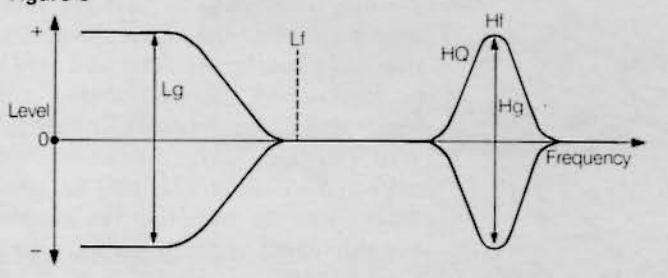
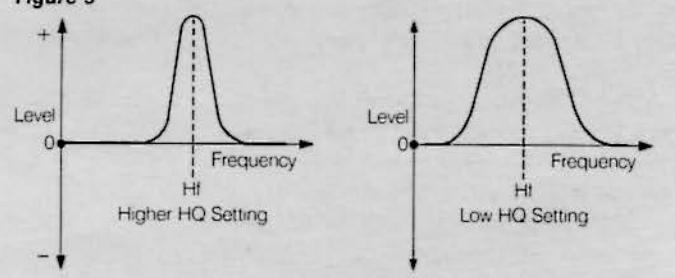


Figure 9



● Tone Tune



Earlier we covered how the pitch of each Partial is determined in the WG Pitch display. The Tone Tune display provides the ability to adjust the tuning of each Tone without having to make matching adjustments to the pitch of each Partial. This display is accessed by pressing the TONE DETUNE switch while in the master display.

LKey (Lower Key) determines the coarse tuning of the Lower Tone in half-steps and **UKey (Upper Key)** performs the same function for the Upper Tone. Both parameters have a range of -24 to +24.

LTun (Lower Tune) controls the fine tuning of the Lower Tone while **UTun (Upper Tune)** sets the fine tuning of the Upper Tone. These parameters have a valid range of -50 to +50 cents.

● Patch Name



The **P-Name (Patch Name)** parameter is used to name the complete Patch. Patch Names can be up to 18 characters long. Remember to give your Patches meaningful names. If you work on multiple revisions of a Patch, give them names and numbers like "MyPatch-2". The actual procedure of naming a Patch is the same as that for naming a Tone and is covered later under the section on Operation Technique.

● Control



The Control Edit display is used to set the response of the D-50's controllers such as Bender, aftertouch, portamento and damper pedal.

Bend (Bender) sets the maximum pitch bend range of the left-hand Bender. The value is displayed in half-steps with range of 0 (no bend) to 12 (one octave).

AfPB (Aftertouch Pitch Bend) establishes the maximum range of the pitch bend effect incurred by aftertouch (press-

ing a key harder). The range is -12 to +12 in half steps. Positive numbers bend the pitch up while negative numbers bend the pitch down. Note that aftertouch can be used to control many effects such as modulation and brilliance and that the AfPB control determines only the amount of pitch bend. Various aftertouch routing options are shown in Table 7.

Portamento is the term used to describe how long it takes the sound to slide from one pitch to another when a key is depressed. **Port (Portamento)** allows the user to select the time or speed of this effect. A setting of 0 is immediate and increasingly higher numbers supply progressively longer glide times. In order to hear the effect of this setting, the left-hand PORTAMENTO switch must be engaged.

The second **Port** parameter determines how portamento is applied to the two D-50 Tones. U assigns portamento only to the Upper Tone, L only to the Lower and UL to both Upper and Lower. Note that portamento has been engaged and have a value greater than 0 in order to work, regardless of which mode is set here.

Hold determines whether the Pedal Hold function is applied only to the Upper Tone (U), the Lower Tone (L) or both (UL). This choice is especially handy when one Tone is being controlled from an external source.

● Output



The Output Mode Edit display is used to set the way the two Tones are processed by ambient effects and ultimately routed to the Upper and Lower audio output jacks of the D-50. Just as each Tone has the benefit of chorus and delay effects, an entire Patch can be processed through the on-board digital reverb.

Table 7
Patch Factor

Control	After Touch (Pitch Bender)
Common Parameter	
Pitch Modulation	Pitch After Touch Modulation
Partial Parameters	
WG Pulse Width	After Touch Range
TVF Modulation	After Touch Range
TVA Modulation	After Touch Range

Mode selects one of four output configurations. Mode 01 mixes the two Tones together before sending them to the reverb. The "wet" signal is then sent to both audio outputs. In Mode 2, each output jack gets the "dry" signal from its matching tone in addition to the "wet" mix of the two reverberated signals. Mode 03 sends the Upper Tone through the reverb and on out to the Upper output while passing the "dry" Lower Tone directly to the Lower jack. The final option, Mode 04 instead processes the Lower Tone with reverb and sends the Upper Tone straight out.

The **Rev (Reverb)** parameter selects one of the 32 reverb settings by number. While you will find the list of reverbs later under Effects, the best way to get acquainted with these varied effects is to experiment and let your ear be your guide.

Rbal (Reverb Balance) determines the ratio of "dry" sound to "wet" effect. A setting of 0 represents all source and no effect while 100 indicates no source and all effect.

Vol (Volume) is used to program the overall volume level of each Patch. This is especially useful in determining the relative loudness of each patch to be used in a performance without having to adjust the output of each Partial. Unlike the **Levl** control for each Partial, Vol is not designed to distort at higher levels. The relationship of these settings should be considered in the same way a guitarist considers pre-amp volume vs. master volume to obtain a properly "clean" or "dirty" signal at the desired volume.

● Chase



This function allows the D-50 to create a variety of delayed effects by having the Lower Tone "chase" the Upper Tone. The effect of these settings is also determined by the Key Mode. In DUAL mode, a **Mode** setting of UL plays the Lower Tone once after the Upper Tone, ULL first plays the Upper Tone and repeats the Lower Tone and ULU alternates the Upper and Lower Tones. If Key Mode is WHOLE, UL plays the Upper Tone twice and ULL and ULU play the Upper Tone repeatedly. Note that the left-hand CHASE switch must be on in order to hear this effect.

Figure 10

---> Program change information only

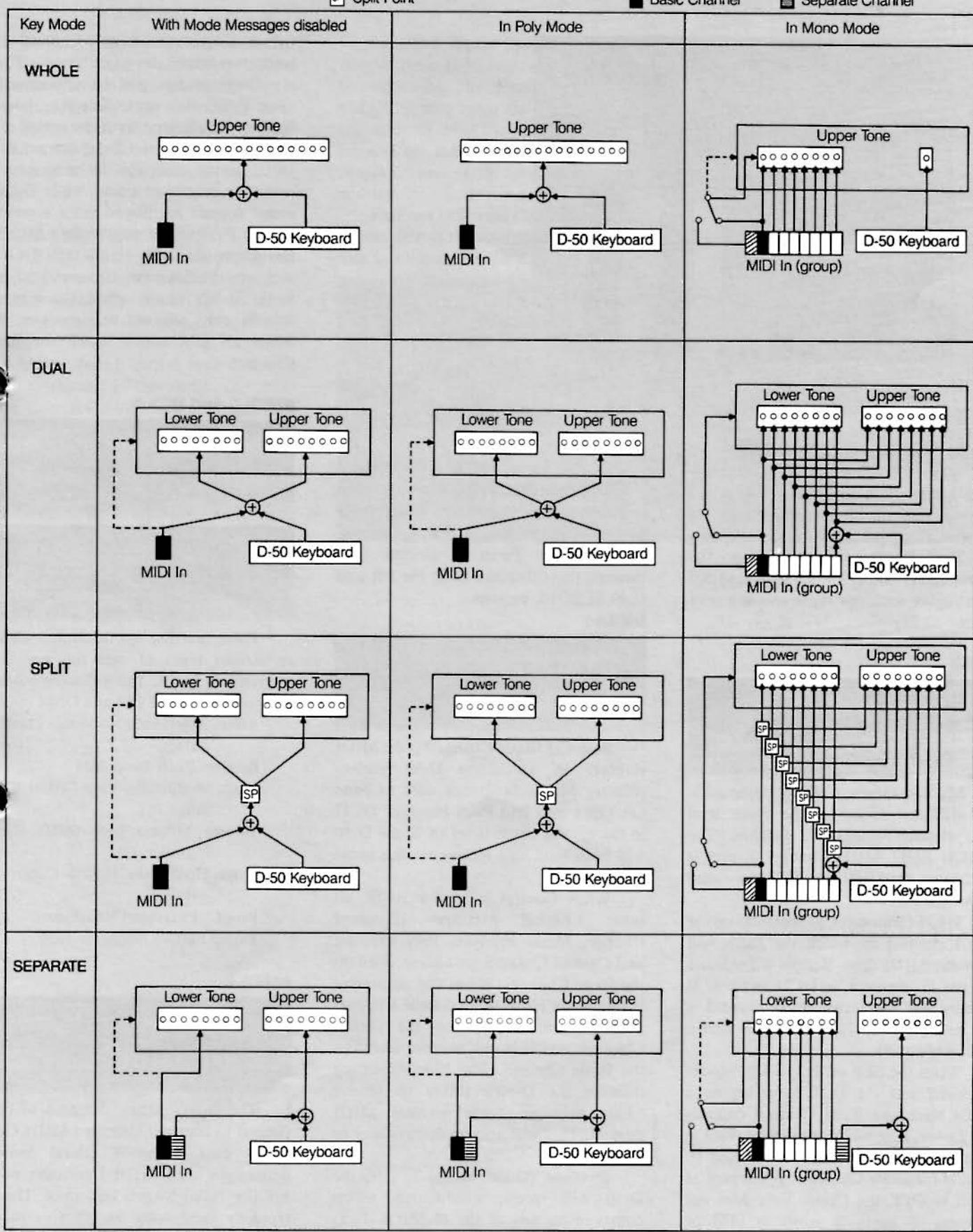
SP Split Point

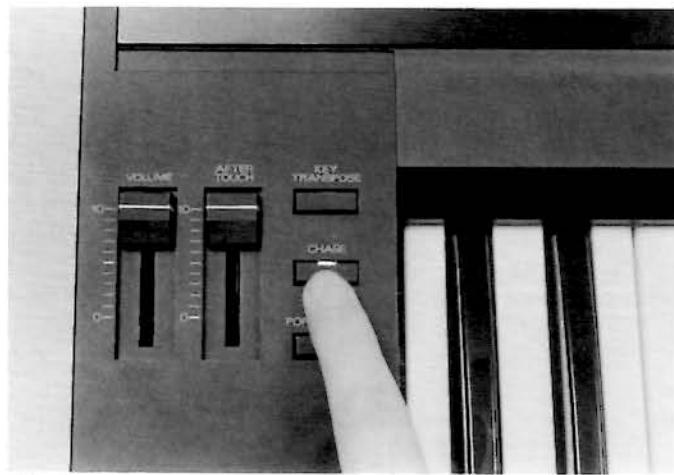
ooooo Number of voices

Global Channel

Basic Channel

Separate Channel





•The Chase function is available only in the Dual and Whole key modes.

Level (Level) in the Chase Edit display determines the volume of the delayed signals in relation to the original. At a setting of 100, the delayed signal is not reduced in volume at all.

Time determines how far apart the Chase delays occur. The range is 0 to 100 with higher numbers representing longer times.

•MIDI



MIDI parameters are programmed in two different areas—at the Patch level and globally across all Patches. The PATCH EDIT MIDI Channel display is used to set the MIDI functions associated with each Patch.

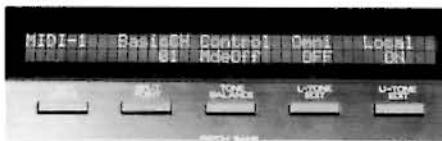
TxCH (Transmit Channel) sets up the MIDI channel on which the Patch will transmit MIDI data. Besides the settings for the 16 channels, a TxCH value of B assures that the transmitting channel is the same as the Basic Channel (main receive channel).

When the SEP or SEP-S Key Modes are used and the D-50 is acting as a MIDI slave, the Basic Channel controls the Lower Tone while the Upper Tone is controlled by the channel determined by **SepCH (Separate Channel)**. When SepCH is set to OFF, the Upper Tone does not respond to anything when in SEP or SEP-S mode.

MIDI

The dedicated MIDI button is used to access four displays which establish the way the D-50 responds to MIDI regardless of which Patch is selected. Step through these displays using the left and right SCROLL buttons.

•MIDI-1



BasicCH (Basic Channel) is the MIDI channel on which the D-50 receives primary MIDI commands such as Note On/Off events and Pitch Bend. If TxCH in the current patch is set to B, the D-50 will both send and receive on this same channel.

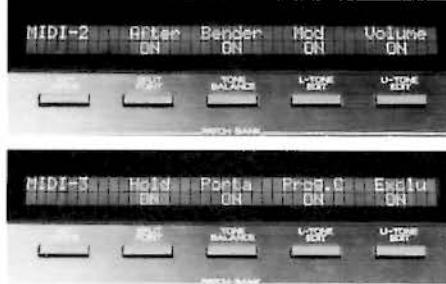
When **Control** is set for BCH, all other Channel Messages (Program Change, Mono Pressure, Poly Pressure and Control Change) are also received on the Basic Channel. When this parameter is set for G.CH, these additional Channel Messages are received on the Global Channel, which is one number less than the Basic Channel. The MdeOff setting disables the D-50's ability to receive Mode messages from external MIDI devices. This will also be discussed later in greater detail.

If **Omni (Omni Mode)** is ON, the D-50 will receive information which comes in on any of the 16 MIDI channels. With OMNI set to OFF, only sig-

nals coming in on the Basic Channel will be acknowledged.

Local allows you to conceptually sever the D-50's controllers (key board, Bender, pedals, etc.) from the actual synthesizer. This way the D-50 can act as a MIDI master controller for other instruments or sequencer tracks while the internal sounds are played from a remote source. Put another way, performance information goes only to the MIDI OUT jack via the Transmit Channel and not to the D-50's voices, while the on-board sounds only respond to signals at the MIDI IN jack which match the Basic Channel.

•MIDI-2 And MIDI-3



These two displays determine whether various types of data are sent and received via MIDI. The following parameters can be turned ON and OFF:

After: Aftertouch or Mono Pressure data

Bender: Pitch Bend data

Mod: Modulation data (MIDI Controller 01)

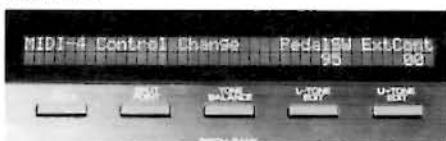
Volume: Volume data (MIDI Controller 07)

Hold: Hold data (MIDI Controller 64)

ProgC: Program Change data

Exclu: System Exclusive data

•MIDI-4



The D-50's pedals can also be configured to transmit specified MIDI Controller data. **PedalSW (Pedal Switch)** determines what MIDI Controller number the Pedal Switch transmits. This is typically used with on/off Controllers (64 to 95).

ExtCont (External Control Pedal) sets the MIDI Controller number that the External Control Pedal transmits. This is best used for variable Controllers (0 to 31). These MIDI Controllers are defined in the MIDI Implementation Chart which is packed with your owner's documentation.

•TUNE/FUNCTION

All of the settings in this display are special in that they are global settings—in other words, they are set for the entire instrument and do not change with Patches

Master Tune is used to tune the entire D-50 to the rest of the world. The reference is to A—440Hz (concert standard for the A above Middle C) and valid values span 427Hz to 452Hz.

Protect establishes whether the write-protect on the instrument is ON or OFF. This must be set to OFF in order to write anything to memory.

PedalSW (Pedal Switch) determines what internal D-50 function is controlled by depressing the Pedal Switch. The CHASE setting turns the Chase function on, and off PORTA turns Portamento on, and off P-SFT advances to the next program and OFF makes it affect nothing.

ExtCont (External Controller) in this display selects the internal D-50 function that is assigned to the External Control

Pedal. The BAL setting effects Balance between the two Tones, MOD assigns the Control Pedal to Modulation (like pushing forward on the Bender) and AFTER has the pedal controlling whatever parameters aftertouch is routed to. The pedal has no effect when this parameter is OFF. Note that AFTER and MOD settings disable the normal controls for these effects.

Table 8

PEDAL SWITCH

CONTROL FUNCTION	FUNCTION
P-SFT (Patch Shift)	Advances to next Patch
PORTA (Portamento)	Turns Portamento on and off
CHASE (Chase)	Turns Chase on and off
OFF	D-50 does not respond to pedal—MIDI slave does

EXTERNAL CONTROL

CONTROL FUNCTION	FUNCTION
BAL (Tone Balance)	Controls Balance between Upper and Lower Tones
AFTER (Aftertouch)	Controls functions usually affected by aftertouch
MOD (Modulation)	Controls functions usually affected by Modulation
OFF	D-50 does not respond to pedal—MIDI slave does

OPERATION TECHNIQUE

PARAMETER MAP

Operating System Efficiency

Structured Parameter Programming For Improved Operability

Compared to most synthesizers, each D-50 Patch features a wide range of parameters. In contrast, the front panel of the instrument has only a few controls. This is due to the unique way that the SELECT buttons work in conjunction with the LCD (liquid crystal display). Each display page places the command parameters in the LCD directly above the row of SELECT buttons which then take on those functions. Together, the LCD and SELECT buttons offer an economic and elegant solution to programming.

The D-50's various parameters are organized in a tree structure—most displays "branch" into further sub-displays.

These displays are also referred to as menus and there are often menus within menus. While this terminology will be familiar to those with computer experience, don't panic if this is your first exposure. Nested menus provide a very easy and effective way of accessing and changing the desired parameters.

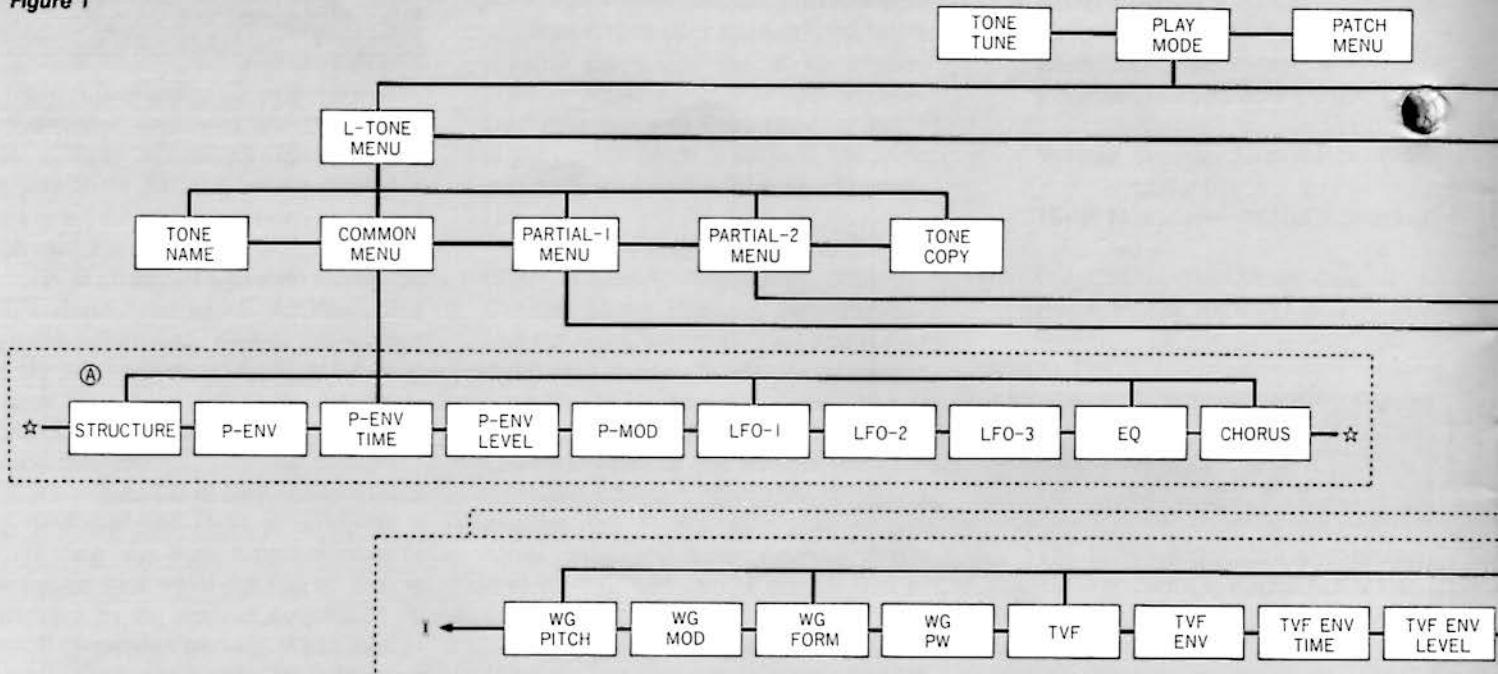
In the previous section on LA Architecture, we described each display in detail. Figure 1 shows how these displays are nested together, with each box indicating a display. To progress to the next level of the tree, simply select the desired sub-menu from a display by pressing the matching SELECT button under the LCD. Note that the parameters for the top level display are actually written above the buttons on the front panel. The final display in each "branch" shows the edit parameters themselves directly above the SELECT buttons. A

given parameter is then accessed by pressing its matching SELECT button.

Once a parameter itself is selected, its current value will flash. That value can be edited by moving the joystick left to right for coarse changes and fine adjustments can be made using the INCREMENT and DECREMENT controls. Note that these switches repeat their function when they are held down. Some parameters can also be entered directly from the D-50's 10-key pad. Simply enter the appropriate value and press ENTER. If you accidentally enter the wrong number, enter a 0 and the correct number before pressing ENTER. Pressing the UNDO button will allow you to revert to a parameter's original setting after it has been edited.

Displays which are at the same tree level can be viewed successively by scrolling using the forward and backward

Figure 1

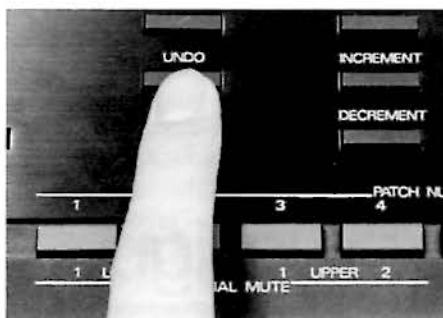


SCROLL buttons. For example, to change the pulse width value for the wave generator in Partial 1 of the Lower Tone, follow these steps:

- 1) Press the L-TONE EDIT button to get to the L-Tone Edit Menu.
- 2) Select (Part-1) to display the Part-1 Menu.
- 3) Select (Form) to display the WG Form page.
- 4) Press the right SCROLL button to move forward to the next display, WG PW.
- 5) Select PW, which is the actual pulse width parameter and the current value will begin to blink.
- 6) Correct the value using the joystick, 10-key pad or INCREMENT and DECREMENT buttons.

This scrolling process can be used to less all of the displays at the same level and the last display will wrap around to the first. Note that some of these displays, such as TVF, TVA and Pitch can also be accessed directly from the next higher level. After working with the D-50 for a short period of time, you should quickly gain a feeling for where each parameter is and how to get to it.

You can easily go back to the next highest level using the EXIT button. To get to the display which allows you to access Common parameters, for example, press EXIT twice from the WG PG display in the previous example. To



•The D-50 is designed for efficient editing.



•To leave a parameter and return to its menu display, simply press the Exit button.

return directly to the main display of a Patch from any level, press EXIT while holding down the SHIFT button.

While you're in any of the Partial displays, the first four PATCH BANK switches act as PARTIAL SELECT switches. The Partial these buttons access is inscribed on the front panel in white letters below these switches. These allow the user to select the same display in the other Partial without having to move through the tree structure manually. This is just one of the many time-saving programming conveniences designed into the D-50.

Another feature that is available while you are in any of the Partial displays is PARTIAL MUTE. The first four PATCH BANK switches mute the Partial which match the white letters below these switches. This is a very handy fea-

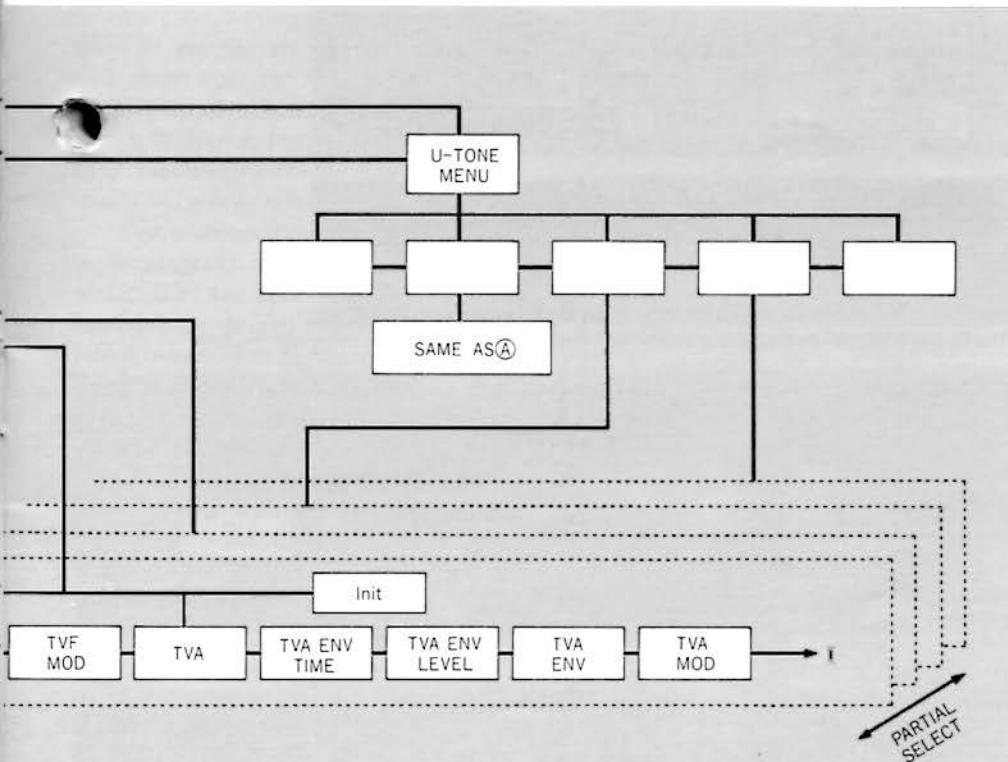
ture since it is often desirable to work on the sound of one Partial at a time without hearing the others. The mute status of the four Partial is displayed in the upper-left corner of the LCD, immediately to the right of the Structure number. The number 1 indicates that the Partial is audible, while a 0 means that the partial is muted.

In the chart below there are two commands which do not represent actual sound parameters, but which represent additional editing functions—tone copying and Partial initialization.

The **T-Copy (Tone Copy)** command allows you to copy any complete Tone from any Patch to the currently selected Patch Tone. The fourth SELECT button toggles between Internal and Card memory and the fifth one determines the Patch and Upper or Lower source that the Tone will be copied from. Once the source Tone is selected, moving to any other display will lock that Tone into the current Patch Tone.

The **Init (Partial Init)** function at the Partial level is used to reset all the parameters of the currently selected Partial to standard default settings. This is useful when starting to program a Partial from scratch or entering a series of complex settings. Initialized settings include a basic square wave or PCM 01, depending on the Structure. Note that the Structure and other Common parameters are not initialized because they are not part of the Partial settings.

Even having described each parameter and explaining their architectural relationship with the chart, don't be surprised if it takes a little time to get around quickly on the D-50. Since there's a lot to memorize, we recommend keeping a chart handy which you can refer to when programming your first sounds. After that, you should have no problem getting around on the instrument.



OPERATION TECHNIQUE

STRUCTURE

Using Structured Design

The D-50 contains many parameters and combinations not commonly found on previous instruments which greatly increase the sound-generating possibilities of the synthesizer. This section describes how to use the D-50's parameters to best advantage to create the most innovative sounds.

Structures Determine The Combination Of Partial

We've already covered the basic architecture of the LA Synthesis used in the D-50. By way of review, each Patch consists of two Tones which are each made up of two Partial. Each Partial is equivalent to one traditional synthesizer. The real key to creating innovative sounds with the D-50 lies in combining the four Partial effectively. The heart of this combination process lies in the Structures. Figure 1 shows the relationship of PCM sound generators (P) to synthesizer sound generators (S) in each of the seven available Structures.

Figure 2 represents the architecture of the basic sound chain of a single Partial. Even though the D-50's sounds are generated completely through digital processes, the experienced synthesist can treat these components in much the same way as traditional analog synthesizers. Conversely, those learning electronic music for the first time using the D-50 will be able to apply many of the same concepts and techniques to other simpler products.

Analog synthesizers traditionally include a VCO (Voltage Controlled Oscillator) or DCO (Digitally Controlled Oscillator) that generates pitched and non-pitched waveforms which act as sound sources. The timbre is further shaped using a VCF (Voltage Controlled Filter) and the amplitude or audio level is controlled by a VCA (Voltage Controlled Amplifier). EG's (Envelope

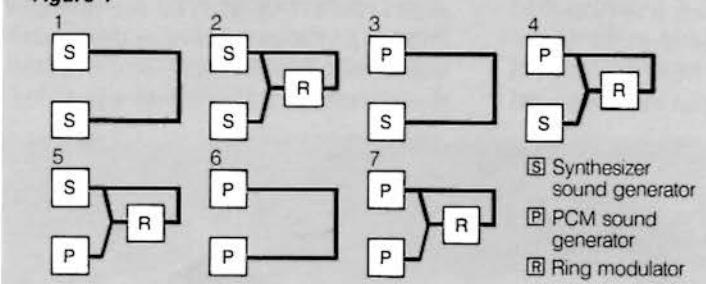
Generators) are included to shape how those parameters change over time when each event occurs, while LFO's (Low-Frequency Oscillators) provide repetitive changes such as vibrato, tremolo and buzz.

The role of the traditional VCO or DCO is fulfilled by the WG (Wave Generator) on the D-50. This component is the starting point of the sound, producing either square, sawtooth or pulse waves. The width of the pulse waves can be modulated so that the timbre changes with time and becomes more animated sounding. Synthesized string sounds, for example, often employ

pulse width modulation to simulate the movement of the bows on strings. The WG's pitch can be affected by a variety of controls such as EG's and LFO's. Subtle pitch enveloping can simulate the slight bends typical of blowing into wind instruments, while wider ranges are usually reserved for special effects. Using LFO's for pitch modulation, moderate speeds produce vibrato, fast speeds create a buzzy aspect and slow modulation lends the effect of a siren.

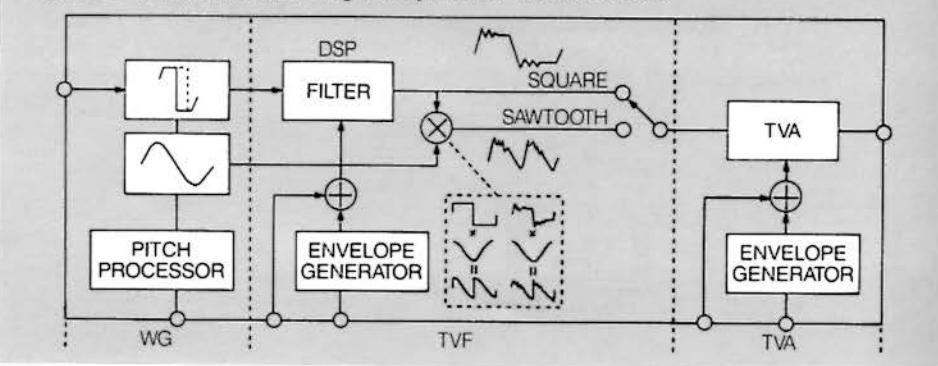
Analog synthesis is usually a subtractive synthesis process. The oscillators produce waveforms which are fairly rich in harmonic content and the unwanted

Figure 1



• The Structure display is used to choose from the seven possible combinations of Partial in a Tone.

Figure 2 Partial Parameters Using The Synthesizer Sound Generator



harmonics are removed using a filter. On the D-50 the traditional VCF is replaced with the TVF (Time-Variant Filter). As implied by the name, the cut-off frequency of the TVF can be changed over time. EG's are often employed to simulate the way brilliance and timbre change over time in acoustic instruments. Using the brass family as an example, it takes a certain amount of time to get the air moving when you blow into, say, a tuba. The greater the air pressure, the brighter the sound gets. EG's would be applied to the TVF to shape this timbre change. LFO modulation of the TVF, on the other hand, provides regular timbre changes to create wah-wah, buzz and other special effects.

The final major Partial component, the TVA (Time-Variant Amplifier), replaces the common VCA to control the amplitude of volume over time. This component alone would simply act as a programmable volume control, however modulation from an LFO and especially the EG make the instrument's sound come alive. It is said that the most distinguishing aspect of a sound is its transient characteristics and creating these changes over time is the job of the Envelope Generator. Just as the TVF's EG changes the timbre over time, the TVA's EG affects volume over time. Returning to our tuba analogy, the time that it takes to get the air moving, sustain it and then stop the air moving using breath control not only affects the instrument's brilliance, but its volume as well. LFO modulation of the TVA typically results in tremolo effects.

One problem that plagues many analog synthesizers is that sounds which are perfected in one area of the keyboard do not have the desired effect in other keyboard ranges. The D-50 overcomes these situations with a new feature called Bias. This control is used to increase or decrease the response of the TVF and TVA in a certain keyboard area. While this is useful with a single Partial, its real power becomes evident when using different Bias settings on several Partials simultaneously. For instance, one Partial may be set for a great cello in the bottom octaves and a second Partial could be set for a great violin in the upper octaves, but neither may work effectively outside of their respective ranges. Bias can be

employed to taper off the volume of the cello's upper octaves and the violin's lower octaves to create a more realistic string section across the entire keyboard.

Another example of Bias is found in factory Patch 13 (Jazz Guitar Duo). Notice that while the keyboard appears to be split, the Key Mode is actually set for DUAL. Bias is used to taper off the sound of AccBass in the upper octaves and volume of Jazz Guitar in the lower octaves and the results are quite satisfactory. This technique provides a gradual transition rather than the hard split point resulting from using SPLIT. Using Bias in this way may take a bit of time to master, however the results are well worth it.

PCM—Acoustic Sounds At Your Fingertips

PCM sound generation deserves at least as much consideration as traditional synthesis since it brings a tremendous degree of realism to the D-50's sounds. PCM refers to digital samples of real-world sounds which are stored in memory using Pulse Code Modulation and the high quality of this technique has already been proven in several rhythm machines.

The D-50 incorporates 100 of these PCM sounds, giving the musician the benefit of digital samples without the hassle of perfecting them. These PCM options include "one-shot" sounds (the

sound occurs with each key depression and dies out), looped sounds (repeated front-to-back, front-to-back to create sustain) and loop variations (several PCM sounds looped together). Used alone or in conjunction with synthesizer sound sources from other Partials, these PCM samples open a whole new world of possibilities for the synthesist.

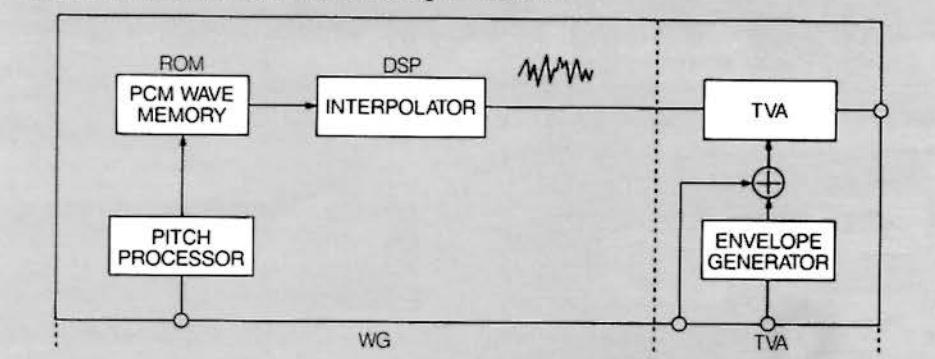
Observe in Figure 3 that the sound chain is much simpler when using PCM sounds rather than synthesized sounds. The applicable controls were covered earlier in detail, however the simplified explanation is that PCM sounds cannot be processed by the TVF, nor can they take advantage of TVA modulation via the LFO. The primary reason for this is that digital samples typically need to be output as is and, by nature, provide for little control other than pitch and amplitude. The timbre itself is inherent in the sample. Taking a few minutes to establish which parameters are valid in conjunction with the PCM sound generators may save a great deal of time and frustration.

The PCM sound generator in one Partial is most often more effective when used in conjunction with synthesizer sound sources in other Partials. As an example, earlier we mentioned that sounds are primarily identified by their initial transients. In the D-50, PCM sound sources are often used for this characteristic of realism while the body of the sound is created by the more flexible synthesizer section.



• The WG Form display allows the musician to choose from 100 PCM sounds.

Figure 3 Partial Parameters Available Using PCM Sounds



Ring Modulator

Structures 2, 4, 5 and 7 all use ring modulation to generate complex sounds. While ring modulation can take some time to master, making the effort to do so is again well worth the investment.

Until several years ago, ring modulators were used solely for creating special effects. After almost disappearing from the controls of most synths, ring modulation returns in the D-50 with more musically useful applications.

The ring modulators accept input from two different sound sources (the two Partials of a tone in this case) and these signals are manipulated mathematically to produce harmonics which are not found in the input sound sources. As shown in Figure 4, when sound sources A and B are ring modulated, the resulting frequencies are $A+B$ and $A-B$. Ring modulation has conventionally been used musically to create the metallic kinds of sounds whose complex harmonics are not found in the simpler sawtooth and rectangular oscillator waveforms. In more technical terms, VCO's and DCO's produce harmonics with only integer values, while ring modulation creates non-integer harmonics which produce harsher effects.

On the D-50, metallic sounds are easily created by using some of the PCM sounds without employing ring modulation. However, when ring modulation is used in conjunction with PCM sound sources the otherwise static nature of the PCM timbres can be changed because of the additional harmonics created by this process. This is especially useful since the TVF cannot be applied to PCM sound sources. Changes in timbre over time can be created by a variety of

Figure 4

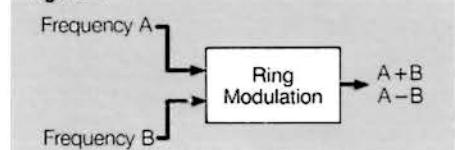
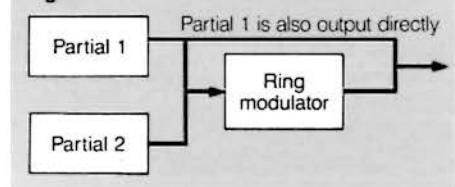


Figure 5



methods, including manipulating the TVA envelope of the second ring modulated Partial.

As seen in Figure 5, the output of Partial 1 goes directly to the Tone's audio output as well as to the ring modulator. Partial 2, on the other hand, is routed only to the ring modulator. The resulting sound of that Tone, therefore, is a mix of the true harmonics from Partial 1 and the sideband harmonics produced by ring modulating Partial 1 with Partial 2. When balancing these sound components, settings below 50 favor Partial 1 and settings above 50 favor the ring modulation effect.

A side effect of using a Structure which incorporates ring modulation is that Partial 2 loses independent control of LFO selection, depth and aftertouch. Instead these parameters are dictated by the analogous settings in Partial 1. Again, this is only true in ring modulated Structures.

Mastering The Structure

More often than not, the type of sound source you choose for Partial 1 will have a major influence on the overall sound. This is true largely due to the scenario we just discussed with ring

modulation, where Partial 1 provides a direct sound and Partial 2 is primarily used for the added effect of ring modulation. Put another way, Partial 1 provides the fundamental harmonics in these situations. Let's take a closer look at each of the Structures now.

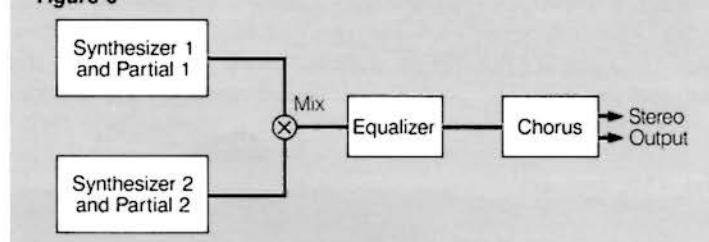
Structure 1

In Structure 1, each Partial uses a synthesizer sound source and these signals are simply mixed together. In this Structure, you can think of each Tone as consisting of two traditional synthesizers. Figure 6 illustrates this arrangement.

When both Partials employ synthesizer sound sources, a great deal of flexibility is available because all of the Partial's WG, TVF, TVA, LFO and EN parameters are accessible. For instance, all three of the Tone's LFO's can be used to add character to the sound—one for vibrato, another for buzz or growl and a third for tremolo. Another important consideration is that the pulse width can be modulated, an effect traditionally used to bring life to otherwise static waveforms. Other effects such as complete use of aftertouch contribute to the pure synthesizing power of this Structure.

Factory Patch 46 makes use of pulse width modulation as well as aftertouch

Figure 6



When selecting a structure for the Ring Modulator, take extra care in setting the LFO, Aftertouch Depth. Partial 2 has the same setting as Partial 1.



A variety of timbre and pitch changes can be obtained by applying aftertouch to PW.

in a very unique way to produce the effect of guitar feedback when greater pressure is applied to the keyboard. The WG is producing a sawtooth wave rather than a square wave, so technically the pulse width is not being employed. As discussed previously, however, the pulse width control has no effect on a sawtooth wave with one exception—when pulse width is set to zero, the pitch jumps up an octave. In Patch 46, the Aftr parameter is set for -07 and PW is set at 24 for both Partials of the Upper Tone. When pressure is applied to a key, the pulse width is driven down to 0, which in turn drives the pitch up to the next octave. Playing this patch in the style of an electric guitar lead will yield best results, using normal playing technique for the basic notes and applying added pressure while sustaining the note to create the feedback effect. Factory Patch 26 employs a similar method and provides an interesting starting point for a variety of edits. The sound's initial attack is created using Structure 6 in the Upper Tone, while the Lower Tone uses Structure 1 to synthesize the sustaining portion and generate the feedback effect when aftertouch is used. Note that only Structure 1 is affected by aftertouch.

Structure 2

This Structure utilizes two synthesized sound sources and ring modulation, producing a different effect than that of the Partial waveforms alone. Ones in factory Patches 13 (Jazz Guitar) and 28 (Elec Piano) are examples of Structure 2 in action.

Looking at just the guitar portion of Patch 13, we see that Structure 2 is employed as an integral part of the sound. While Partial 1 creates the main body of the sound, the initial picking of the string and subsequent release is generated through ring modulation. This can be verified in two ways: first, listen to the two Partial of the Upper Tone individually. Second, change the Structure to Structure 1, and notice the difference that ring modulation makes. Notice that the TVA EG settings for the two Partial aid in creating the composite effect because they are set for opposite effects. Partial 1 has a high sustain level when a key is held, while Partial 2 (the finger noise) has mostly only release where Partial 1 has none. This leads to the conclu-

sion that the amplitude of Partial 2 determines how much ring modulated signal is present. In general this rule can be applied when determining the balance of straight sounds to ring modulated sounds, but if either Partial's amplitude (volume) reaches 0 level, no output comes from the ring modulator. When using a Structure that incorporates ring modulation, programming can be more difficult and less intuitive. It is suggested that the rough aspects of the sound be created with Partial 1, followed by introducing partial 2 for timbre control. Experiment with various parameters for Partial 2. Pitch, waveform, filter settings, envelopes, etc. can all have dramatic effects on a ring modulated sound. Remember that these same controls in Partial 1 influence ring modulation also.

Structure 3

In the remaining Structures, some or all of the timbre is generated using PCM sounds. In Structure 3, Partial 1 uses PCM sounds while Partial 2 features the synthesizer sound generator. Mastering the use of its 100 PCM sounds is a big step toward mastering the D-50 itself. We'll cover these sounds in two basic divisions—one-shot sounds and continuous loop sounds.

One-shot sounds are mainly used to create the attack portion when synthesizing an acoustic instrument. Let's take a closer look at how important this capability is in a synthesizer. Synthesizing a flute, for example, isn't too much of a problem because a traditional synth has little difficulty reproducing the few sparse harmonics found in the sustain portion of the woodwind. The attack portion, however, is a much more significant challenge because it incorporates

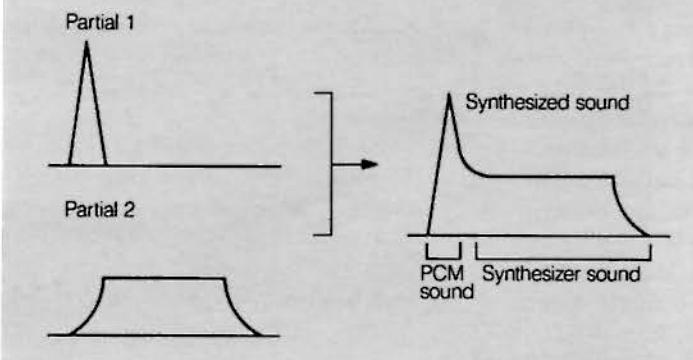
breathing and pitch bend which generates much more complex harmonic changes that are difficult to duplicate synthetically.

This dilemma is true of most acoustic sounds—the attack portion is what truly distinguishes the sound, yet it's often the most difficult to reproduce. The trade-off is also true—synthesis provides greater flexibility than digital samples in creating the body of sound. Roland's solution is to incorporate the best of both worlds so that each portion of the sound is created by a specialized component. Because the psychological impact created in those first few milliseconds of a sound, you'll find many diverse one-shot PCM timbres to choose from in PCM sounds 1 through 47.

Back to our flute, select factory Patch 23 and press the PARTIAL BALANCE button marked UPPER. Now move the joystick to the 10:00 position (upper-left corner) to hear the initial PCM sound and to the 1:00 position (upper-right) to hear the synthesized sustain portion. While working with and listening to only Upper Partial 1, select the PCM: parameter in Partial 1's WG Form display. Now try changing the initial setting of 38: Harmo to all the different one-shot PCM sounds from PCM 1 up through PCM 47 and notice how distinct the differences are.

The optimum method, then, of synthesizing an acoustic instrument is to have the sound begin with an appropriate one-shot PCM sound on at least one Partial, blending out almost immediately into at least one other Partial with a synthesizer sound source (Figure 7). Envelope settings come in very handy in making a smooth transition between these two different aural components.

Figure 7



Looped sounds are created by replaying a short portion of a digital sound over and over so smoothly that it sustains. As a matter of fact, just as the one-shot sounds were best at creating the initial transient, the D-50's looped sounds are used mostly for the body of a sound due to its sustaining nature. By their very nature, these short little snippets of the real world must be smooth and devoid of transients. Combined with the lack of a TVF, the only major control over these sounds is pitch and the TVA's EG. Assuming that you're still where we left you with your D-50, now listen to the looped sounds from PCM 48 to PCM 76 (most names include "lp" for loop). You'll notice that they don't sustain. Why? Because the TVA EG settings are set to taper off the volume. Turn up all the EG levels except End L and you'll get a steady tone to help familiarize you with these looped sounds.

Finally, audition the remaining PCM sounds up through PCM 100. These are generated by looping single or multiple PCM sounds in odd ways to create electronic effects. As with all looped samples, pressing a given key determines how fast that sound is played back. It is very noticeable as such when using these remaining PCM choices.

As you can see, breaking sounds down conceptually into their constituent parts is not only a very important aspect of taking a sound from visualization to final programming, but an integral part of the D-50 as well. Not only are Partials combined as we've just seen to create more realistic sounds, two Tones can be combined for incredible results. This theme will continue to recur in showing you how to get the most from your instrument.

●Structure 4

This Structure also has a PCM sound on Partial 1 and a synthesizer sound source on Partial 2 with the addition of the ring modulator. Remember that you won't hear much with the one-shot PCM voices even if Partial 2 has a long sustain. That's because the amplitude of Partial 1 falls rapidly to 0 without a sustain loop. When using looped sounds, Tones can be created in a similar way as with Structure 2. Again, it is usually a good idea to shape the basic sound with

Partial 1 and modify it by bringing in Partial 2 and subsequent ring modulation.

●Structure 5

Here the roles are reversed from Structure 4. The synthesizer section is acting as the fundamental sound component on Partial 1 while a PCM sound is used for ring modulation on Partial 2. The same caution holds true when using one-shot PCM sounds—you will only get a short ring modulation effect unless you use looped sounds. As with other Structures employing ring modulation, the direct signal from Partial 1 is available, while the combined settings of Partial 1 and 2 determine the character of the ring modulation which is then balanced in the mix as Partial 2. Again, the recommended approach is to establish the basic sounds with Partial 1 and embellish it with the ring modulation effect.

●Structure 6

This Structure uses PCM sounds for both Partial 1 and 2. As a result, all TVF parameters have no effect and the timbre is completely in the hands of the straight PCM sounds and the Common EQ settings. A common use of Structure 6 is to set Key Mode to DUAL while using one Partial for a one-shot PCM sound to generate the attack transient and the other Partial for a looped PCM sound for the remainder of the sound.

When PCM sounds are used, quite often they are most effective in given ranges of the keyboard. This is complicated by the lack of TVF Key Follow. It is therefore recommended that TVA Bias be used to scale the volume down in the inappropriate-sounding areas. In many cases, the other Tone can then be used in those same areas and scaled down via TVA Bias in the range where the other Tone is more appropriate.

●Structure 7

Like Structure 6, both Partials utilize PCM sounds, however the ring modula-

tor is introduced as well. While this combination provides great versatility, it is also the most difficult to manage and predict. As usual, it is probably most effective to create a rough sound with Partial 1 and round it out with Partial 2. Effective use of this Structure may require a great deal of experimentation due to the variety of possible combinations (100 PCM sounds \times 100 PCM sounds = 10,000 choices)!

Using Structures And Factory Presets

To make it easier to understand Structures, let's take a look at how the factory Patches utilize the seven Structure types. Keep in mind that each Tone in a Patch has its own separate Structure. Table 1 shows all 64 factory Patches and their incorporated Structures. Listen to these Patches while referring to Table 1 to establish how Structures have been used. Unfortunately, Structures 5 and 7 are not employed in any of these patches, but this exercise should familiarize you more with the others.

Structures 6 and 1 are used for Patch 11 (Fantasia) and is typical of layered sounds. Structure 6 creates the bell portion while Structure 1 is responsible for the synthesized string element.

Patch 13 (Jazz Guitar Duo) consists of an upright bass on the Lower Tone using Structure 3 and a jazz guitar on the Upper Tone using Structure 2. The main portion of the bass sound is created with the synthesizer sound of Partial 2, with the attack being added by the PCM sound generator on Partial 1. This is an excellent example of combining PCM and synthesizer sound sources to create a realistic yet flexible performance sound. We've already looked at the jazz guitar sound on the Upper Tone when we covered Structure 2. To review, Partial 1 creates the basic effect with finger noise being created with ring modulation of the two Partial 1s. This method is often employed when creating instruments similar to the guitar.



•The TVF does not work with PCM sounds. Equalization must be used to change the timbre.

Patch 14 (Arco Strings) owes its realism to the combination of Structures 6 and 1. Lower Partial 1 uses the PCM sound for the initial effect of the bow and the violin string, with little contribution to the overall sound from Partial 2. This is balanced with a synthesized sustaining string sound on the Upper Tone which is a combination of Partial 1 and 2. While these same Structure combinations are used in Fantasia, the effect is completely different. Fantasia uses them to create two different types of sounds concurrently, while Arco Strings employs them to create two portions of the sound which happen more end-on-end than on top of each other.

Patch 15 (Horn Section) also utilizes Structures and Tones in the same way that Arco Strings does. The initial lip buzz of the trumpet is obtained by using Structure 6 on the Lower Tone. This is then mixed with a synthesized trumpet created with Structure 1 on the Upper Tone. This method of combining PCM attacks and synthesized sustain is a very popular approach to creating sounds on the D-50, not only for simulating acoustic instruments, but also in lending a lifelike effect to new electronic sounds.

Patch 17 (D-50 Voices) and Patch 18 (Slow Rotor) both use nothing but Structure 6, resulting in sounds that are completely PCM generated. Notice the correlation of this with the rather static nature of these Patches. In D-50 Voices, the bass and treble ranges are created with the Lower and Upper Tones, respectively, and are cross-faded using TVA Bias settings to create the most realistic effect in any given keyboard range. Once again, this is an important technique to master.

Patch 68 (Picked Duo Guitar) is a combination of Structures 2 and 4. The Upper Tone uses Structure 4 to create the basic guitar sound using the PCM generator, while the finger noise comes from ring modulation of that PCM sound and the synthesized sound of Partial 2. This model might also be used in simulating other effects such as harpsichord. The same concept is applied to the Lower Tone, except that Structure 2 employs synthesizer sounds for both Partial 1s.

In addition to constructing realistic acoustic instruments by combining PCM and synthesized sound sources, the D-50

can certainly hold its own when creating lush analog synthesizer simulations. Patch 47 (Spacious Sweep) and Patch 65 (JX Horns-Strings) serve as examples of these types of sounds and both use Structure 1. In this way, the D-50 is directly equivalent to having four analog synthesizers with a single VCO or DCO on each, such as the Alpha-Juno. By using Structure 2 and its ring modulator, SUPER JX cross-modulated sounds can be generated and the D-50 takes on the guise of two dual-oscillator analog synthesizers.

Go through the remaining D-50 factory Patches at your own leisure while observing the Structures they each use.

Editing And Structure Selection

Now that we've discussed the influence that the different Structures have

on the overall sound of a D-50 Patch, it should be quite evident that the most important step in programming a new sound is to select the proper Structure.

The first step is to envision the sound and hear it in your head. The next thing to do is to take that sound apart mentally and conceptualize it in as many components and characteristics as you can. Based on this breakdown, determine if synthesized or PCM sounds or both are required. Next, determine the role of these components—will they be used to create different sections of the sound over time or will their harmonics be layered together to create a composite effect? Once all this is established, the final consideration is whether or not ring modulation is required in a given configuration to accomplish the end goal. Envisioning a sound as individual components and taking these steps will take the user a long way in creating the sounds he or she desires.

Table 1 Tone Structures For Factory Presets

PATCH#	LOWER	UPPER	PATCH#	LOWER	UPPER
11	06	01	51	03	03
12	06	01	52	01	06
13	03	02	53	03	03
14	06	01	54	03	03
15	06	01	55	01	01
16	06	01	56	06	06
17	06	06	57	—	06
18	06	06	58	06	06
21	06	06	61	03	06
22	01	03	62	03	03
23	02	03	63	06	02
24	01	03	64	06	01
25	01	06	65	01	01
26	01	06	66	03	03
27	06	01	67	06	06
28	02	02	68	02	04
31	06	01	71	06	06
32	06	06	72	01	06
33	03	01	73	03	01
34	01	01	74	06	01
35	01	01	75	—	01
36	06	01	76	06	02
37	01	01	77	01	06
38	06	06	78	02	02
41	06	06	81	06	01
42	03	03	82	06	02
43	03	02	83	01	03
44	01	06	84	02	02
45	06	01	85	06	01
46	—	01	86	06	01
47	—	01	87	06	06
48	02	06	88	06	06

OPERATION TECHNIQUE

PATCH FACTOR

Patch Factor Determines the Tone Combinations and Output

As you've no doubt seen by now, the D-50 has a wide variety of parameters which can lead to an almost limitless number of musical possibilities. Once the Partials are programmed and assembled into Tones, the Patch Factor determines how the Tones are used together, how they respond to the keyboard and how they are processed and output. In this section we'll take a closer look at this aspect of D-50 programming.

Patch Factor Determines The Tone Combinations And Outputs

For starters, let's review how the Patch Factor determines how the Upper



•Patch Factor is used to control parameters governing both Upper and Lower Tones.



•You can confirm the key mode, split point, and tone balance while you perform.

and Lower Tones are used in conjunction. Earlier we touched on the various Key Modes and how they affect performance considerations. In general, Tone combinations can be broken down into three main categories: WHOLE, DUAL and SPLIT. WHOLE mode uses only the Upper Tone and provides 16-note polyphony, so you trade sound complexity for added polyphony. In DUAL mode the Upper and Lower Tones are combined as one more complex sound, but polyphony is reduced to 8-voices. SPLIT modes allow the two Tones to be treated as two separate instruments in two different playing ranges of the keyboard. The remaining modes are variations on these themes, as can be seen in Figure 1.

WHOLE-S (Whole-Solo) and DUAL-S (Dual-S) modes are monophonic (one note at a time) modes which are very useful when playing solo parts. Of course, solo lines can be played when the keyboard is in a polyphonic mode, however

these mono modes offer several subtle advantages. The first is that some lead styles incorporate a technique that guitar players call "hammer-on" where a note is held while a second note is played and released, played and released. As a result, the pitch trills between the two notes. This effect is only possible with monophonic response because a polyphonic keyboard simply plays both notes at once. The second advantage is evident when using portamento. With a monophonic keyboard, the pitch where the note slides from is obvious—the last note. With polyphonic response, the pitch could start sliding from a variety of points since voices are assigned in a cyclic manner.

SPL-US (Split Upper Solo) and SPL-LS (Split Lower Solo) modes are used when you want to play chords with one sound on one section of the keyboard and a solo with another sound on the other part. For example, SPL-US would be used to chord in the left hand using the Lower Tone and solo with the Upper Tone in the right hand. Conversely, SPL-LS would allow a bass or other solo line in the left hand with the Lower Tone and right hand chords with the Upper Tone. Also note that if portamento is engaged in these modes, the portamento effect is only assigned to the solo portion and not to the chords.

The various Split modes are not only very useful when playing the keyboard, but equally as powerful when the D-50 is used as part of a MIDI set-up. When one of the Separate modes is selected, different MIDI receive channels can be set for each Tone or keyboard range. In SEP mode, the Lower Tone responds only to

Figure 1

Key Mode	Number of simultaneous voices	Sound Generating Method
WHOLE	16	Upper Tone only
DUAL	8	Upper and Lower Tone
SPLIT	8 each	Keyboard is divided at the Split Point and Upper and Lower Tones respond to different keyboard ranges.
SEP	8 each	Lower Tone is controlled only by MIDI, Upper Tone responds to both D-50 keyboard and MIDI.
WHOLE-S	1	Upper Tone plays monophonically.
DUAL-S	1	Upper and Lower Tones are layered with monophonic response.
SPL-US	Upper 1 Lower 8	Keyboard is divided at the Split Point. Lower Tone is polyphonic, while Upper Tone is monophonic.
SPL-LS	Upper 8 Lower 8	Keyboard is divided at the Split Point. Lower Tone is monophonic, while Upper Tone is polyphonic.
SEP-S	Upper 1 Lower 8	Lower Tone responds monophonically to Basic Channel. Upper Tone responds to D-50 keyboard and Separate Channel monophonically.

MIDI Messages coming in on the D-50's Basic Channel, while the Upper Tone is controlled by the SepCH. In this mode, the D-50's internal keyboard can only control the Upper Tone. SEP-S (Separate-Solo) works in the same manner except that both Tones have only monophonic response. Both Separate modes are very handy when using the D-50 from a MIDI sequencer since it can perform the work of two different conventional synthesizers.

Output Mode

We've seen how the D-50's two Tones can be combined and controlled in a variety of ways and that these configurations can be saved with each Patch. The Output Mode is used to determine how these Tones are internally processed and ultimately routed to the two audio outputs. Basically think of the D-50 as having stereo outputs. Typically the Upper and Lower audio outputs are routed to two separate channels of a mixer with the Lower channel panned hard left and the Upper channel panned hard right. A key concept in understanding the various Output Modes is that while the internal reverb can accept stereo inputs, the signals are mixed together inside the reverb and are not output discretely.

Mode 1 is used to create large sounds by mixing the Upper and Lower signals together, processing them through the reverb and sending identical post-processed signals to each output.

Mode 2, on the other hand, sends the two Tones directly to their respective outputs. In addition, the two signals are also fed into the reverb and the composite reverbed effect is sent to each output. This is especially useful when panning an instrument like a piano in a stereo field. Let's say a piano is created by using the Lower Tone to create the sound of the bottom octaves and the Upper Tone to generate the higher range. Using DUAL mode and TVA/TVF Bias, the two sounds can be cross-faded to create one smooth response across the whole keyboard. Using Mode 2 for output and given the aforementioned panning, the lower notes would come from the left speaker while the higher notes would come from the right.

Using Modes 3 and 4, the two Tones are kept completely separate and routed discretely to their own outputs. With

Figure 2

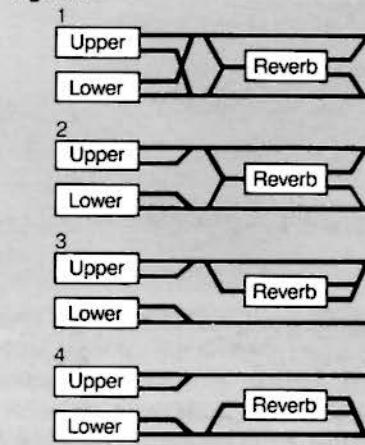


Figure 3

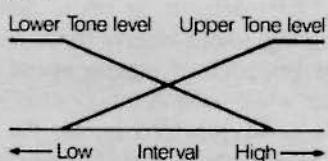
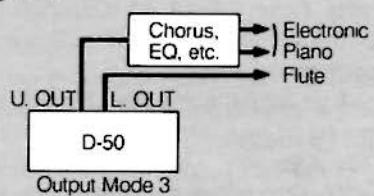


Figure 4



Mode 3, only the Upper Tone is given reverb along the way while Mode 4 offers reverb on only the Lower Tone. An example application might be a SPLIT keyboard mode with the Lower Tone playing piano and the Upper Tone playing flute. Mode 3 would process only the flute with reverb and Mode 4 would process only the piano.

Output is an important part of programming a D-50 sound. The bottom line is the same as with other D-50 considerations—conceptualize the overall sound, the two Tones, reverb and output together to realize the most satisfactory results.

Expression Controls

Patch Factor also determines how your use of the various performance controls on the D-50 influences the sound. We've already covered the controls themselves, but there are a few points worth mentioning with regard to application.

Aftertouch has become an important influence in recent years because of the added control it brings to electronic music performance. This term is sometimes confused with velocity. Velocity refers to how hard a note is struck, while aftertouch refers to the extra pressure exerted after the note has sounded. Also note that aftertouch is monophonic in response—that is, you could be playing a chord but the sound section does not receive an aftertouch signal for each key, just the one that is depressed the furthest. Polyphonic aftertouch is called poly pressure and is implemented on only a handful of instruments.

Aftertouch can be routed to a variety of synthesizer effects—pitch, pulse width, modulation, brilliance and volume. Regardless of which are in effect, there are two places that aftertouch amounts are controlled—the amount of the aftertouch signal that is allowed at the local parameter and the total aftertouch sensitivity of the entire instrument regardless of which Patch is active. The Aftr control in each local section (like TVF Mod and TVA Mod) sets the amount of the aftertouch signal that comes into that section. This information of course, is stored with each Patch. The AFTERTOUCH slider in the left-hand controller section of the D-50's scales the total aftertouch sensitivity across all Patches. This slider is used to adjust the overall aftertouch response to an individual's playing style.

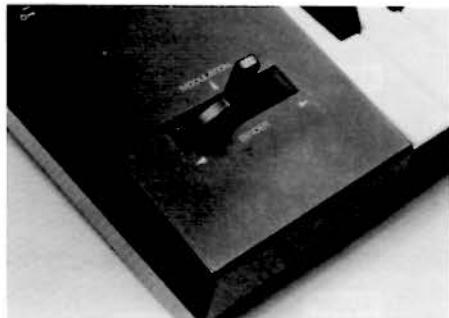
Let's take a look at routing aftertouch in such a way that it bends the pitch of the D-50's wave generator. This effect could be used to simulate the bends of a guitar, for example. The Aftr parameter at the Patch Factor level determines the amount of pitch bend obtained when a key is fully depressed. Patch 43 (Basin Strat Blues) bends down a full octave when maximum pressure is applied because this parameter is set for -12. This creates the effect of having a tremolo bar on a guitar. Changing the setting to +3, for example, would provide bends typical of the blues guitar style. A setting of -1 might be used in brass and reed instruments, as they sometimes bend slightly flat. Of course, the wider the bend range, the more difficult it becomes to control smaller intervals.

Special effects can also benefit from pitch aftertouch. It is often desirable when using sound effects to be able to change the pitch of certain sound components while leaving others unaffected. This is easily provided for on the D-50 since each Partial has the ability to switch aftertouch pitch control on or off via the Bend parameter in the WG Mod display. Factory Patch 32 (Gamelan Bell) uses this technique to bend only selected aspects of the sound.

True to its name, the Bender itself can also be programmed to control pitch in the same way. The Patch Factor Bend control determines the maximum bend range the Bender has. Using positive values, pitches bend up when the Bender is pulled to the right and bend down when the Bender is pulled to the left. Setting negative values has the opposite effect—pulling to the right lowers the pitch, etc.

Once again the effect of the Bender can be individually selected for each Partial just as in our last example. This could come in handy, say, for detuning effects. Guitarists often play the same pitch with two strings, bending one against the other. Synthesists began simulating that effect by detuning one oscillator against another. This effect can be accomplished on the D-50 by bending one Partial against another. Both Partials of a Tone are set for identical sounds and Bend is only turned on in one of them.

To round out the concept of our lead guitar, we can use the Patch Factor Bend and Aftr parameters in conjunction to access both of these effects. We'll put pitch bending a minor third on aftertouch and detune on the Bender. First,



•The Bender is indispensable for adding performance nuances.

identical sounds will be programmed on both Tones. Both will then have Bend set to +3 in the Patch Factor, while only one will have an Aftr setting of -1.

MIDI And Patches

In most synthesizers, MIDI parameters are set completely separate from the patches or presets. As you've no doubt figured out, the D-50 is not your average synthesizer. Each Patch can store the MIDI channel on which it transmits MIDI data to outboard gear. While the usefulness of this feature may seem elusive at first, closer inspection reveals it to be quite powerful when using the D-50 as a MIDI controller in performance. If another synthesizer was connected as shown in Figure 5, it would act as a slave to the D-50. Provided that the D-50 was transmitting on the slave's receive channel, it's easy to create popular layered effects. Being able to program the D-50's Transmit Channel with each Patch allows you to determine whether the slave's layer of sound is active or not when a given Patch is selected. Silent Patches can even be programmed when only the slave's sound is desired.

Several slaves could be hooked up as shown in Figure 6 each receiving on different channels. Patch changes on the D-50 could include instructions to transmit on a given channel to match that of the desired slave. Entire sets of these combinations can be pre-programmed and stepped through during a performance. (Remember that the Pedal Switch can be set to P-SFT to advance through all the programs in a PATCH BANK.) This process can make performances infinitely more elegant, so that you can concentrate on the music rather than the technology.

The other important consideration is that the D-50 can certainly receive MIDI data in addition to transmitting it. Using SEP and SEP-S modes, the Lower Tone responds only to incoming signals on the D-50's Basic Channel while the Upper Tone responds to the Separate Channel and the D-50's keyboard. This is very useful in today's electronic music environments because sequencers and other controllers can share the D-50's great sounds.

Figure 5

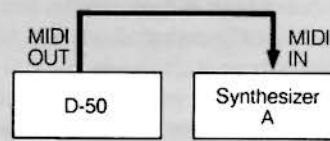
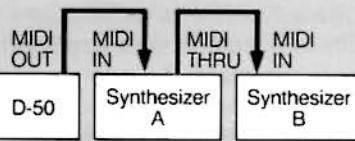


Figure 6



OPERATION TECHNIQUE

TONE PARAMETERS

Combining Partials into Tones

By now it is probably plain that the power of the D-50 lies in a variety of areas. Just as Partials themselves are the building blocks to each D-50 sound, the way they are combined as a Tone is equally as important. In this section we'll take a closer look at using these parameters to the greatest benefit.

Common Parameters Affect Both Partials In A Tone

Common parameters determine how two Partials are combined into a Tone, including Structure, Pitch Envelope, LFO, EQ and Chorus. The Structure is probably the single most important control on the D-50 because it determines which sound sources the Partials use and how they are combined. Since we've already covered Structures rather extensively in the previous section, let's take a closer look at the remaining parameters.

The LFO section of the D-50 is certainly one of its strong point. Many synthesizers have only a single LFO which can be routed to several sections. The D-50 has a total of three separate LFO's, each with its own settings for speed, waveform and more. These LFO's can then be routed separately to just about any parameter the synthesist may require — pitch, pulse width, filter and amplifier.

Modulating the pitch is the most common form of modulation as it is

used for vibrato. Remember that, unlike other sections, the WG Pitch can only be modulated by LFO-1. TVF modulation provides growl at faster speeds and automated timbre changes at slower speeds, while TVA modulation is primarily used for creating tremolo effects. Employing vibrato, growl and tremolo simultaneously is not found very often. The real power becomes clear when putting three LFO's in perspective with two Partials. A common technique, for example, entails routing LFO-1 to the WG Pitch of both Partials, one with positive modulation and the other with negative modulation. The effect this has is to make the sound more animated because when one Partial's pitch is going sharp, the other is going flat instead of their pitch moving as one. Of course, there are situations in which modulating the pitch of the two Partials with the same polarity is preferred. A second LFO might be applied to a given parameter of only one Partial, while the third LFO could be applied to a yet another aspect of the other Partial. Uniform effects can be created by purposefully applying the same LFO modulation to both Partials.

Another powerful effect made possible by LFO's is pulse-width modulation. Sawtooth and square waves produce a fairly static basic timbre. By changing the pulse width of the rectangular waveform (called Square in the D-50), the timbre itself changes. Automating this

process produces a very lively, animated effect. This technique has been used for many years in analog synthesis to simulate the complex interaction of an orchestral string section. The challenge is to not only recreate the sound of a violin string being bowed, but to produce the illusion of many string players at once. The D-50 can tackle this task with great results, again because of multiple LFO's. First start with similar sounds on each Partial using a rectangular wave. Each Partial's WG PW parameter can be modulated by separate LFO's with triangle waves at slightly different speeds and optional opposite polarities. The mixture of these independent movements results in a very rich tone that fulfills the simulated string section's needs. Slower modulation speeds imply fewer string players, while faster speeds suggest a larger section.

Many synthesizers only provide for pulse width to be modulated by triangle waves. Using different LFO waveforms can produce other interesting effects and the D-50 provides for this. Also, keep in mind that the pulse width of a D-50 Partial can also be influenced by other sources such as velocity and aftertouch.

Programming Partials

In previous sections, we've likened each of the D-50's four Partials to a complete conventional synthesizer. As such, learning each of the Partial's available functions is very important in creating and editing the optimum sound for your needs. For example, review the LA Architecture section to reinforce in your mind which parameters are unavailable when using PCM sound sources. This allows you to focus on only the valid parameters and can help avoid frustrating hours wondering why nothing seems to happen when you change certain settings.



• Set the LFO Common parameter for effects such as vibrato, growl and tremolo.



• The PW controls can have a dramatic effect on timbre when using synthesizer sound sources.

Another important thing to have a firm grip on is the relationship of Common parameters to Partial parameters. The controls over the actual LFO's and P-ENV is determined at the Common level because they are just that—common to both Partials in a Tone. The ultimate routing, amount and polarity of the sources that get sent to certain Partial parameters are determined by the appropriate controls in the various Partial sections. Creating modulation, then, is a several stage process. First, go to the LFO you wish to use in the Common level and set its master qualities. Second, go to the Partial section you wish to influence and use the local control to determine the proper effect. Third, go to the other Partial sections which can also potentially be influenced by the LFO and make sure that the local controls prevent unwanted modulation.

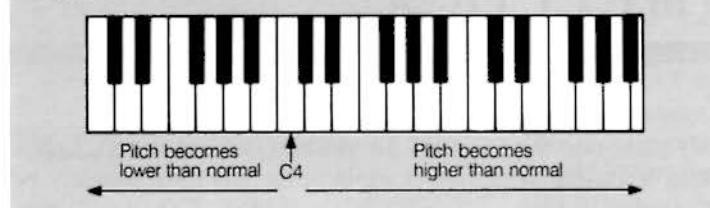
With so many modulation possibilities, a bit of housekeeping goes a long way when using multiple LFO's. When programming complex Patches, you might find it handy to take notes as to which LFO's are routed to which parameters. Remember that changing the settings of a given LFO will have an effect on all sections of the Tone which are being used by that LFO.

Now it's time to take closer look at how pitches relate to the keyboard. Acoustic instruments quite often exhibit a fixed relationship of notes played versus pitches sounded. If you play the A4 (the A above Middle C) of a perfectly tuned piano, you will always get a pitch with a frequency of 440Hz. The D-50, however, is extremely flexible in this regard. The Coarse control of the WG Pitch display is equivalent to the octave setting usually described in footage on organs and conventional synthesizers (4', 8', 16'). The nomenclature here describes ranges in octave numbers, so if Middle C is C4, the next note up is C#4, the next C is C5, etc.. The range of the actual keyboard on the D-50 is C2 to C7. The Coarse control also incorporates the setting of the chromatic interval. A common practice would be to set two Partials at intervals such as a fifth or an octave in order to create added harmonics. This control can also be used with all of the audible Partials as a way to transpose the entire instrument to a different key. For instance, you might have perfected playing a composition in



•The WG Key Follow can provide a wide variety of scales and tunings.

Figure 1



one key, yet a vocalist might require it to be performed in a different key.

The Fine control is very useful when it comes to creating a sound with more than one Partial that needs to be full and thick sounding. If two or more Partials are slightly detuned from one another, the resulting beating of frequencies adds an element of life and movement which is not usually found with perfect tuning. Fine tuning is also handy when using ring modulation to change the harmonic content. Make sure that you distinguish between the uses of Partial fine tuning and Master Tuning. The latter is used to set the overall tuning of all the Patches on the instrument, while fine tuning allows each Partial to be slightly detuned from that reference.

Key follow is a feature which is found on some other synthesizers, but typically with limited applications and options. Filters are often made to track the keyboard to provide some control over uniform brilliance across a wide playing range. The D-50 not only allows keyboard follow to influence a variety of parameters, but also offers many preset scale options. When key follow is applied to WG Pitch, the KF setting is the ratio of keyboard position to Pitch. The Western scale is standard to most synthesizers and this would be represented as a KF setting of 1. There are many exotic tuning possibilities which are available on the D-50 that both simulate existing ethnic tunings and provide new musical possibilities. In particular, negative settings invert the synth's response so that the pitch goes in the opposite of the actual performance. This is virtually never found in the acoustic world, yet provides for interesting solos, for example. Fractions with various values less than one offer microtonal scales with

more than 12 notes to the performance octave, while numbers greater than 1 produce macrotonal scales with fewer than 12 tones per performance octave. Experiment with the various numeric settings for this parameter if you are interested in creating ethnic or folk music as well.

Some instruments actually sound better when they are not tuned perfectly, that is, when octaves are not mathematically perfect (A-220, A-440, A-880). Pianos are often "stretch tuned" to create a warmer feeling. The lower octaves get progressively flat and the upper octaves go increasingly sharp, both with relation to Middle C. The D-50 can also be set to accommodate this kind of tuning. This is useful in creating Patches that are performed across a wide keyboard range and/or are to be played in conjunction with other stretch tuned instruments. A KF setting of s1 specifies that each octave above Middle C will be sharp by an additional 1 cent, while each octave below Middle C will be an additional 1 cent flat. A setting of s2 represents a 5-cent change for each octave.

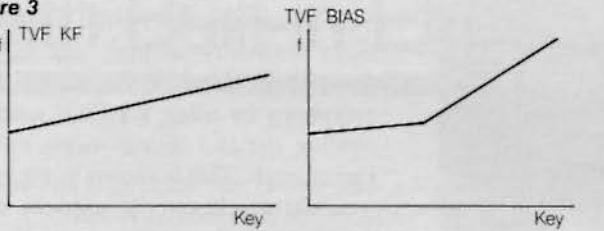
The effect of stretch tuning may seem a bit elusive at first, however it should become more clear using the following method. First, setup a Tone with Structure 1 or 6 with identical sounds on each Partial. Second, keep one Partial at a normal keyboard follow setting of 1, but change the other Partial's KF setting to s1. Now play out in either direction from Middle C and you should notice an increasing detuning effect. Try the same thing with a setting of s2 and the effect should be more pronounced.

Creating a stretch-tuned instrument would typically involve setting all Partials for the same type of key follow. Interesting effects can be created by setting



- TVF Bias allows a kind of tone change that cannot be obtained using the Key Follow function alone.

Figure 3



different Partials for different scales, however. This is especially effective when creating instruments that use the various D-50 Partials for different portions of sound. In a sound where one Partial is creating the initial attack and another is responsible for the body of the sound, setting the key follow of the attack portion for a lesser scale than the other can increase realism.

Factory Patches 31 (Breathy Chiffer) and 36 (Pipe Solo) both employ this combined scaling technique. In both Patches, Lower Partial 1 creates the initial attack to simulate the breath effect and is set for a fractional scale compared to the traditional scalings of the other Partials. These Partials could even be set to 0 so that they don't change at all across the keyboard, but this is often dull sounding. Conversely, a KF setting of 1 can be equally unrealistic. These compromise settings of 1/2 and 1/4 force a portion of the sound to change very little over a wide range and help create more realistic wind instruments (see Figure 2). Other factory Patches such as Patch 54 (Jet Strings) and 57 (Tine Wave) were programmed using similar techniques. As a final note, the realism of synthesized bell sounds can be enhanced by setting each Partial for a different key follow scale!

Let's also be certain of the distinction between Key Follow and Bias, as both can be routed simultaneously to effects such as the frequency of the TVF. As already stated, Key Follow is a basic ratio between physical keys and pitches that is established for the entire keyboard. This is a linear proposition—the ratio remains constant regardless of keyboard range. On the other hand, Bias provides additional custom tailoring of effects to specific keyboard ranges. As



- Set the TVA Levels cautiously when using ring modulation.

Figure 5

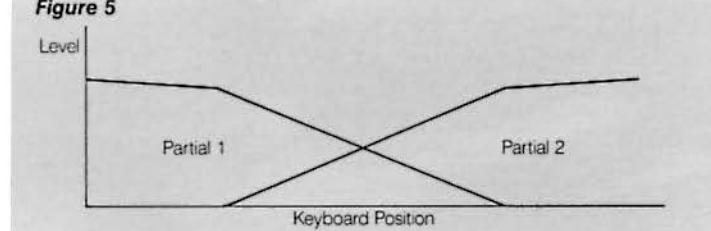
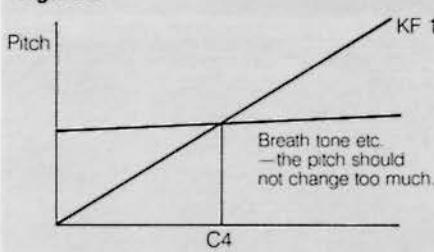


Figure 2



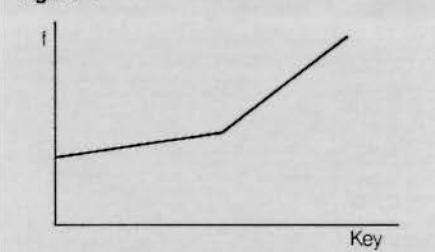
we saw earlier, Bias Point/Direction selects the range to be affected, while Bias Level determines how steep the effect is when playing further in that range. It is important to realize that both Key Follow and Bias can be used in conjunction to create the desired response.

Applying these concepts to the TVF, first set the basic TVF Frequency while playing the middle of the keyboard. The basic response of the TVF frequency to key position is set with KF, while a specific keyboard area can be additionally tailored using the Bias controls. Figure 3 shows the individual effects of Key Follow and Bias, while Figure 4 depicts their combined effects.

Creating Realistic Patches Using TVA Bias And Envelopes

Using the Bias controls in the TVA section, various ranges of the keyboard can change the volume of each Partial. When many Partials are used together, this effect can be used to control the balance between them. Figure 6 illustrates a Tone where Partial 1 is producing a low-range sound and Partial 2 is tailored for a high-range sound. Both

Figure 4



sounds' volume can be determined by Key position by using TVA Bias on each Partial, in this case for opposite effects. Sounds often work best in one keyboard range and the D-50's Bias options for each Partial can provide a realistic sound across the entire keyboard. A typical approach would be to use all four Partials to create a complete Patch, each specializing in a given range. Using DUAL mode and appropriate TVA Bias settings, extremely convincing instruments can be realized.

Earlier we talked about how important the initial attack is to a sound. Actually, psycho-acoustic specialists tell us the overall envelope characteristics (including the attack) act as an aural signature to the human ear. For this reason, extra emphasis should be placed on working with the ENV settings. The added features of the D-50's envelopes merit a little more consideration. Besides the addition of several more stages, the D-50's envelopes offer other significant improvements over traditional ADSR's. The latter's attack, decay and release stages simply change the time it takes to get from one overall level to another and their directions (rising or falling) are predetermined. On the other hand, the D-50's envelopes provide complete control over not only time, but individual level (and direction as a result).



Figure 6

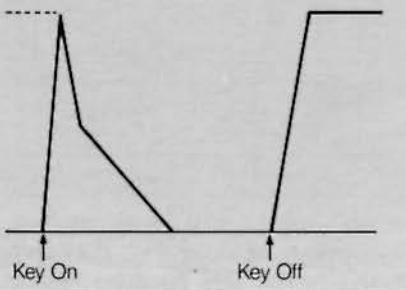
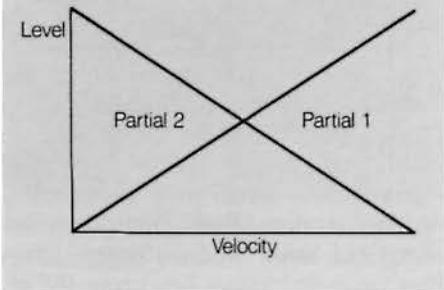


Figure 7



Taking a closer look at how this might be used, the release stage of a traditional envelope only determines the time from the sustain level to the zero amplitude and/or brilliance. The D-50's End Levels can instead be set to any value, even one higher than the sustain level! Previously we observed how his effect is used on the Jazz Guitar Tone in Patch 13 (Jazz Guitar Duo), where Partial 1 creates the body of the tone and ring modulation of the two Partialis is set via Partial 2 creates the effect of fingers being removed from the guitar strings. Figure 6 shows a similar envelope which creates the initial attack, dies away while the note is held and then leaps to an End Level of 100 on release.

More On Velocity And Aftertouch

Once a sound is programmed properly with respect to basic timbre and envelopes, it is important to make the Patch as playable as possible. Acoustic instruments typically offer a wide range of dynamics and effects when they are struck,

blown, plucked, etc.. One of the biggest challenges in synthesis has been to bring that level of performance to electronic instruments through keyboards, benders and other controllers. The D-50 offers a wide range of controls over nuance, and two of the most important are velocity and aftertouch.

Velocity is usually routed to the filter and amplifier of a synthesizer so that the sound gets brighter and louder as the keys are struck harder. One of the new features you'll find on the D-50 is the ability to set negative velocity amounts. At first glance this means you could set these same parameters so that they got mellow and softer when the keyboard is played with greater force. Big deal, you say! The real power of this becomes evident when programming in such a way that one or more Partialis respond to velocity with a positive setting and the remaining ones have negative velocity attributes. In this way you can crossfade between the two sounds depending on the velocity.

Let's say we want a Patch that normally has a nice mellow electric piano, but that takes on a brighter, metallic quality when the keyboard is played with

greater force. Using DUAL mode, program one Tone for the mellow piano with TVF and TVA Velocity settings of -50 on both Partialis. Set the other Tone for the metallic sound with the corresponding Velocity controls at +50. Voila...just what the doctor ordered! Note that since each Partial has these velocity sensitivity settings, this technique could be accomplished with 16-voice polyphony by using WHOLE mode and creating the two sounds using only one Partial each. This is shown in Figure 7.

Aftertouch can be used in similar ways because there are so many places on each Partial that it can be routed to with similar positive and negative effects. Not only can aftertouch be programmed separately for each Partial, but the left-hand AFTERTOUCH slider gives fingertip control over aftertouch as a whole. As we've discussed, this works as a master control affecting how much aftertouch signal is available for the local sections. With the slider in the 0 position, all aftertouch effects are disabled.

The first benefit of this master slider is the one we've previously stated—each player can adjust the instrument's overall sensitivity to their individual style. In this way, sounds like the factory Patches work equally well despite individual playing habits. The other bonus is that aftertouch is often required in only certain parts of songs. Having the overall aftertouch amount at your fingertips allows this type of flexibility and prevents having to write separate patches with different aftertouch settings.

The AFTERTOUCH slider also determines how much aftertouch signal is transmitted to other devices via MIDI. So setting the slider to 0 once again will eliminate aftertouch data, not only internally, but at the MIDI OUT port as well. This is very useful when working with a sequencer because aftertouch data can take up tons of memory even though it is not required in many applications. While you have to go through a lot to defeat aftertouch on most other instruments, the D-50's AFTERTOUCH slider makes life easy in this kind of situation.

The D-50 has a tremendous ability to accept nuances from the performer and apply them to a variety of synthesizer parameters. Taking the time to master this in your programming can often make the difference between an acceptable Patch and a great one!

OPERATION TECHNIQUE

EFFECTS

Creating the Total Sound with Built-in Effects

Just working with the D-50's Partials, LA Synthesis provides the ability to create completely new sounds. Creative expression is not limited to ordinary synthesis by any means. While other instruments rely on external signal processing to complete the final sound, the D-50 has plenty of on-board processing built right into every Patch!

Built-In Effects

The D-50's on-board effects include EQ, chorus, delay and reverb, yet the entire signal is digital! Never fear...the controls are easy to use and work like their analog counterparts.

We can see from Figure 1 that the equalizer and chorus are found in each Tone, while the reverb and chase are part of the Patch Factor. Having these effects available for each Tone really comes in handy when using them as different instruments (maybe bass and piano), each

with its own processing. Conversely, being able to use reverb and chase in conjunction with assignable Output Modes provides a great deal of overall power when the D-50 is used in stereo. Figure 3 shows which parameters are available from the Tone level and from the Patch Factor level.

Reverb

Reverb has become an indispensable accessory for synthesizers and many other instruments. Reverb is used to create a "space" around a sound and specify characteristics such as size. Are you in a tiled bathroom or the Grand Canyon? This is especially important to synthesizers because the signal is generated electronically right up through the point where it comes out of the speakers, so there's little chance of attaining the ambience that acoustic instruments have in a given sized room. The D-50 has a wide

range of these effects built right into each Patch for instant recall.

Another major trend has been to record instruments "dry" in a controlled environment and process them later to control the ambient properties of the sound. As a result, newer, less natural effects have been spawned electronically and have become popular. A number of these "multi-effects" are also included in the instrument. Figure 3 shows the 32 available effects. These effects are preset and the delay times and reverb times cannot be altered.



•Many unique effects can be created using the Chase function.

Figure 1

Tone Parameter	Equalizer	Lf Lg Hf HQ Hg
Patch Factor	Reverb and Output	Output Mode Reverb Type Reverb Balance
	Chase	Chase Mode Chase Level Chase Time

Figure 2

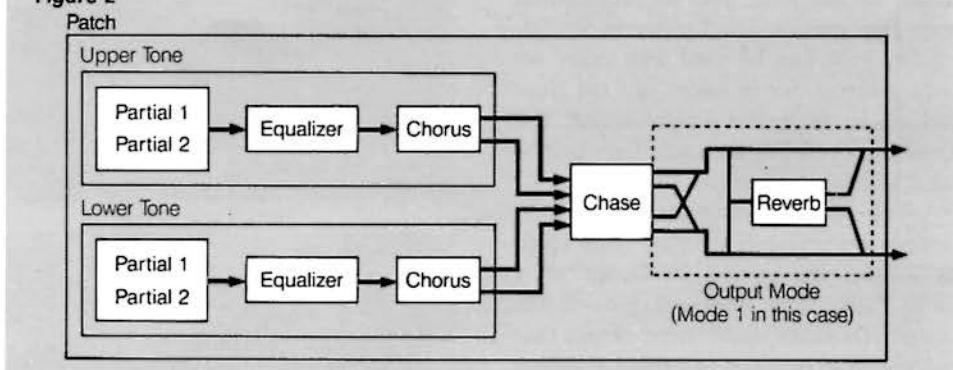


Figure 3 REVERB TYPE

1	Small Hall	9	Medium Large Room	17	Bright Hall	25	Gate Reverb (320ms)
2	Medium Hall	10	Large Room	18	Large Cave	26	Reverse Gate (360ms)
3	Large Hall	11	Single Delay (112ms)	19	Steel Pan	27	Reverse Gate (480ms)
4	Chapel	12	Cross Delay (180ms)	20	Delay (248ms)	28	Slap Back
5	Box	13	Cross Delay (224ms)	21	Delay (338ms)	29	Slap Back
6	Small Metal Room	14	Cross Delay (148—296ms)	22	Cross Delay (157ms)	30	Slap Back
7	Small Room	15	Short Gate (200ms)	23	Cross Delay (252ms)	31	Twisted Space
8	Medium Room	16	Long Gate (480ms)	24	Cross Delay (274—137ms)	32	Space



•Chorus can be programmed for each Tone.



•The Equalizer can be used to help shape timbres, either in the final editing process or as an integral part of the harmonic spectrum.

Chorus And Equalization

Chorus is available separately for each Tone and is used largely to make an instrument sound like several instruments playing at once. When used with two separate sounds each can be set for the best individual effect. When two Tones in DUAL mode sound similar, the two different chorus effects set at slightly different speeds will create a sound which has a life all its own. You can choose from the eight different chorus effects shown in Figure 4 for each Tone.

Chorus can be a wonderful effect, but it can become overused. If you want to program a sound that has no chorus effects, be sure that either the Chorus Depth or Chorus Balance parameter is set to 0. If you desire to put a Chorus effect on a sound, first set Chorus Rate, Depth and Balance to medium amounts so you can hear the effects. Then choose the appropriate Chorus Type and fine tune the other controls.

Equalizers are typically used to compensate for a room or speaker's deficiencies. They are found in car stereos, home stereos and, yes, in professional recording studios. Used properly, studio-quality EQ's can be used with razor accuracy to cut out or boost just the right frequencies to perfect a final sound. The D-50's built-in EQ for each Tone can be used in these same ways.

The choice of waveform and the TVF settings are certainly the first place to go to control the overall brilliance of a D-50 Patch. This does not provide the added flexibility in different ranges that is sometimes required to perfect a sound.

Figure 4 CHORUS TYPE

- | | |
|---|------------------|
| 1 | Chorus 1 |
| 2 | Chorus 2 |
| 3 | Flanger 1 |
| 4 | Flanger 2 |
| 5 | Feed Back Chorus |
| 6 | Tremolo |
| 7 | Chorus Tremolo |
| 8 | Dimension |

Also, since the TVF doesn't work with PCM sound sources, the EQ is extremely important in shaping the final timbre. Unlike the filter, however, EQ is inanimate once it's set. When using a Structure that incorporates both a PCM sound and a synthesized sound, try setting the PCM sound first with the EQ, followed by adding the synthesized sound and adjusting the TVF settings.

The TVF's Frequency can be changed via keyboard, envelope, velocity, after-touch, etc. for some very exciting possibilities. The static qualities of the EQ and the non-static qualities of the filter can be combined for excellent results. Certain aspects of sounds, such as the picking of a guitar or the striking of a piano hammer on its string, do not change as drastically as their fundamental pitches do when a scale is played.

We've already looked at a technique where the Partials which create these effects can be given a fractional Key Follow setting in the WG Pitch display so that they only change marginally. EQ provides an alternate solution since its real power comes into play when using it as an extension of the synthesizer. Each acoustic instrument has its own "fingerprint" in the form of its harmonic spectrum. An instrument's resonant frequencies don't change with regard to frequency. An oboe, for example, has very few lower harmonics and is characteristically bright in higher frequency ranges. Emphasizing or de-emphasizing certain frequencies with the D-50's EQ can go a long way toward realistic acoustic simulations by duplicating the instrument's natural resonance.

Figure 5

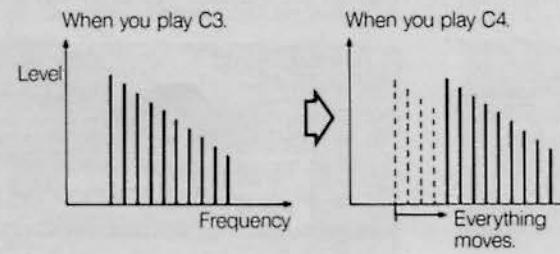
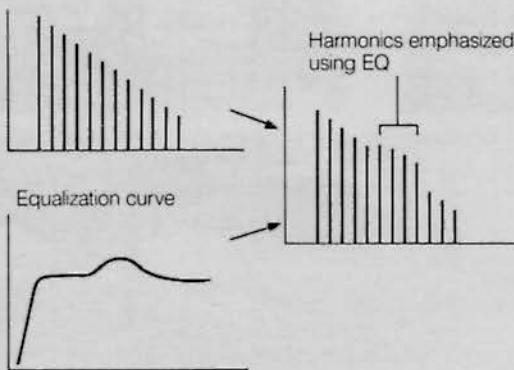


Figure 6





By carefully selecting Tones, the Chase Mode can create colorful delay effects.

Creating Delays Using Chase

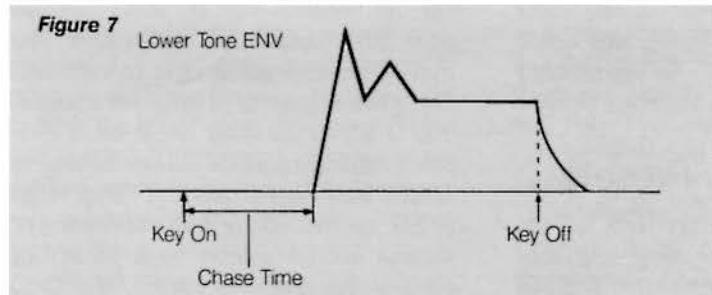
The D-50's Chase function can be used to simulate a traditional digital delay with several extra benefits. First, the two Tones can be used alternately to create echoes with different timbres from the original signal. Secondly, since Chase literally replays notes there is no signal degradation normally associated with conventional delay lines.

When programming a Patch using Chase, first select the sound to be used for the Upper Tone since this is the main sound. When using WHOLE mode, this timbre is simply repeated according to the Chase Mode. If DUAL is in use, select the timbre for Lower Tone next and this will be used for the first repeat. The Tone(s) used for subsequent repeats are determined by the Chase Mode. Then select the appropriate Chase Time to specify the time between repeats and Chase Level to determine the volume of the repeats. Note that if TVA Velocity is

set to 0, the sound will not decay but will repeat at the same volume. Also be aware that in DUAL mode, the Tone Balance also influences the volume of the delayed Tones in relation to one another. Finally select the appropriate Output Mode to take advantage of Tone separation.

There are pros and cons when using Chase versus Reverb for delays. Chase offers control over delay time and volume, while Reverb does not. Chase

provides more unique special effects by alternating Tones, but Reverb allows both Tones in a DUAL mode Patch to be echoed. Finally, Chase mode does not retain performance nuances such as pitch bender and vibrato, while Reverb does. These concepts should be taken into consideration when choosing between these two effects. As a last thought, there is nothing preventing you from using Reverb and Chase simultaneously for additional special effects.



OPERATION TECHNIQUE

EDITING PROCEDURE

Efficient Editing

By now it should be obvious that the D-50 owes its tremendous sound-generating capabilities to a wide range of control parameters. These parameters are found at various command levels—MIDI, Tune/Function, Patch Factor, Tone, Common and Partial. The best way to learn how all of these functions work is to get down to the task of programming. The D-50 offers many short cuts and programming aids which make editing very easy. We recommend spending a few minutes to review them.

Editing Factory Presets

A good place to start is by editing the factory Patches that come with your D-50. One reason for this is that these 64 Patches contain a wide variety of sounds, especially given two Tones each. Often it is easier to select a similar Patch to the one you wish to create and modify it to your needs rather than starting from

scratch. The other advantage to this approach is that it lets you learn a smaller number of parameters at time, rather than facing being overwhelmed by all controls at once.

Conventional instruments usually have been designed with a fixed architecture such as that shown in Figure 1. The parameters in each section may change, but the relationship of those sections does not change. For this reason, you may be used to going right to each section when beginning to program a sound. The D-50, on the other hand, has a variable architecture which allows the user to specify how the Partial and Tones relate to one another, along with the routing of various control sources to a variety of destinations. For this reason, the D-50 programmer must address these concepts before editing the individual parameters.

As an example, Key Mode specifies how the Tones are assigned to the keyboard. Structures determine the architec-

ture of a Tone and the basic type of waveform, LFO settings determine the type of modulation available to individual sections and Output Mode determines how all of this is processed and made available to the outside world. Many of these aspects are taken for granted on other synthesizers because they are predetermined by the manufacturer.

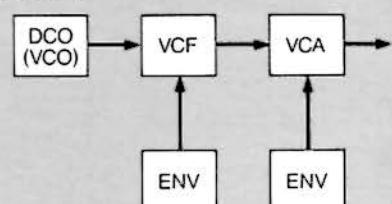
The very first thing you should do is conceptualize the entire sound and determine which components will be created by which Partial. Even with the simplest sounds, going through this planning stage will alleviate wasted time involved in the trial and error process. Let's break this overview level down into several key steps:

1) Key Mode Confirmation. Since Key Mode determines the highest level of the D-50's configuration—how the two Tones relate to each other and the keyboard—this is the most important step. This setting will determine whether the sound is created with the Upper Tone only (WHOLE), if both Tones are combined together as one sound (DUAL) or if the two Tones are configured as separate instruments in different keyboard ranges (SPLIT). Besides determining the role of each Tone, we can assume that if WHOLE mode is active we can ignore editing the Lower Tone altogether. DUAL mode especially brings with it special considerations since the



●Planning is required in order to use the extensive parameters of the D-50 to the fullest.

Figure 1



role of all four Partials in making the final sound must be determined.

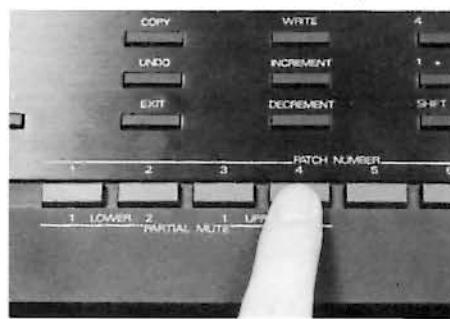
If the final Patch is designed to work in SEPARATE mode, the Lower Tone would normally only be heard when controlled from an external MIDI device. To make editing easier, we recommend selecting DUAL mode and using Tone Balance to listen to each Tone as it is being programmed. This provides the convenience of playing both Tones from the D-50 keyboard while programming. When editing is completed, switch back to SEPARATE mode before writing the final Patch to memory.

2) Confirming Each Partial. Once Key Mode is established, the next order of business is to confirm the role that each Partial plays in the final sound. In cases where WHOLE or SPLIT mode is used, only the two Partials of a given Tone need to be auditioned at a time since one Tone equals one timbre. When DUAL mode is in use, the function of all four Partials has to be taken into consideration since the final sound is created by combining two Tones.

When working at the Partial level, it is often desirable to hear the output of only certain Partials without the others. When you are editing any of the four Partials, the first four PATCH NUMBER buttons function as PARTIAL MUTE buttons which serve the function of disabling selected Partials. The upper-left portion of each Partial display shows the current Patch number Structure and Partial status. The latter consists of four numbers that represent the on-off status



•The on/off status of each Partial is displayed in all Partial edit displays.



•The sound of each Partial can be auditioned separately using PARTIAL MUTE.

of the Partials. From left to right, the numbers represent Lower Partial 1, Lower Partial 2, Upper Partial 1 and Upper Partial 2. A value of 1 indicates that the analogous Partial is audible, while a value of 0 shows that the Partial is muted. For example, 0011 indicates that only the two Partials of the Upper Tone are heard. The four PARTIAL MUTE buttons have a one-to-one correlation to these four numbers. The buttons act as toggles—push a PARTIAL MUTE button once to mute the Partial and again to hear it.

Employing this muting technique it becomes fairly simple to analyze a sound with respect to its various Partial components. Keep in mind that these different building blocks of a D-50 sound have different relationships and effects depending upon which Structure is in use. Remember to work as often as possible with one of the fundamental concepts of LA Synthesis—each Partial is often an individual portion of the sound such as the attack quality versus the sustain quality. This process becomes more difficult when using Structures involving ring modulation and we'll take a closer look at this in the next section.

3) Structure Confirmation. Determining the Structure of each Tone goes hand-in-hand with confirming the role of each Partial. It is crucial to understand whether PCM or synthesizer sound sources are being used in each Partial. Moreover, the Structure determines whether ring modulation is being used to help create the final timbre. If ring

modulation is employed, we know that the settings of both Partials influence the ring modulated sound. Further, we know that Partial 2 controls the overall mix of the ring modulated signal. The Structure in use with the current Tone is displayed in the upper-left corner of each Partial display along with the PARTIAL MUTE status.

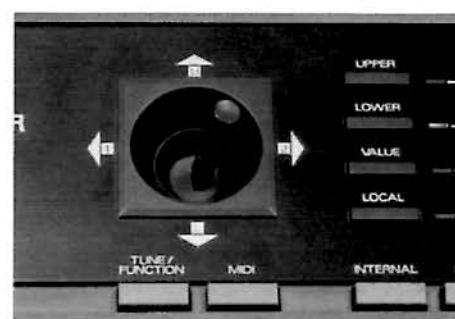
Understanding D-50 Configuration

After confirming the Key Mode, the role of each Partial and the Structure, we can advance to programming the more intimate levels of a Patch. While some parameters such as filter and envelope settings can be programmed directly, Common parameters such as LFO's and Pitch Envelope require additional care since they can influence more than one destination. For example, while WG Pitch can only be modulated by LFO-1, WG PW, TVF and TVA on each Partial can be modified by any of the three LFO's.

It's fairly easy to determine what LFO is routed to a given section by checking the LFO number in those local displays, and there are circumstances when the LFO assignment may need to be changed. Let's assume that you want to change the rate of pulse-width modulation in a Tone where PWM and WG Pitch share LFO-1. If you change the LFO-1's rate, you will also change the vibrato rate. The solution is to change the LFO used for PWM to LFO-2 or LFO-3, so that the rate can be set independent of vibrato. This is very important to keep in mind or your ability to perfect the desired sound may remain elusive.



•PARTIAL SELECT allows the programmer to move quickly to similar parameters on other Partials.



•The joystick is especially powerful when editing Balance.

On most synthesizers, edits made at the local level determine the final results of the overall sound. Since D-50 sounds are often comprised of components, care has to be exercised in setting the proper balance between sounds. Keep the combined roles of the Partial in mind while programming and make sure that each Partial is balanced properly in relation to the others.

Actual Editing Of A Factory Patch

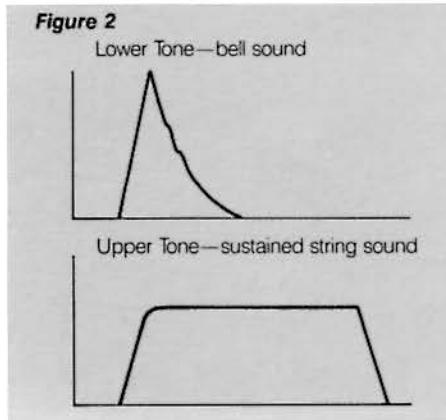
Since experience is the best education, let's edit one of the factory Patches step by step. First, select Patch 11 (Fantasia). If you've already modified or erased this sound from memory, it can be called up from the factory ROM card instead.

This sound is a mixture of bright metallic attack and soft analog sustain, so we can make an educated guess that both PCM and synthesizer sound sources are used. As an editing exercise, let's clarify the sustaining tone portion.

For starters, we need to determine which Partial are responsible for the sustained portion. Our first indication is



• Structures can be confirmed and edited by pressing L-TONE EDIT several times.



in the main display where the Key Mode is displayed as DUAL. This tells us that all four Partial are involved in making the composite sound. Next, let's confirm the role of each Partial. If you are using the PG-1000 programmer, the PARTIAL MUTE functions are immediately accessible. Using just the D-50 for editing, we need to get to a display which will allow use of the front panel PARTIAL MUTE buttons. Press the L-TONE EDIT button twice to get to a Partial display where we can see that the Partial status is 1111. This tells us that all Partial are being used for this Patch. Note that the D-50 can memorize Partial muting, so there are circumstances where Partial are not used at all in a Patch.

This display also shows that the Structure being used for the Lower Tone is Structure 6, which confirms that both Lower Partial are using PCM sounds. We can check the Upper Structure in a similar way, but first let's check the role of each component by using Partial muting. Press the PARTIAL MUTE switches for Lower Partial 2 and both Upper Partial so that the display shows 1000. Now only the sound of Lower Partial 1 is heard. By playing the keyboard, it is obvious that this Partial produces a sharp click at the beginning of each event.

Now let's listen to the other Partial in this Tone. Press the PARTIAL MUTE button for Lower Partial 1 and 2, thus muting the former and activating the

latter. The display should now read 0100. This component is quite metallic in nature and has a much longer decay than the previous timbre. Combined with Lower Partial 1, the two take on a bell-like quality.

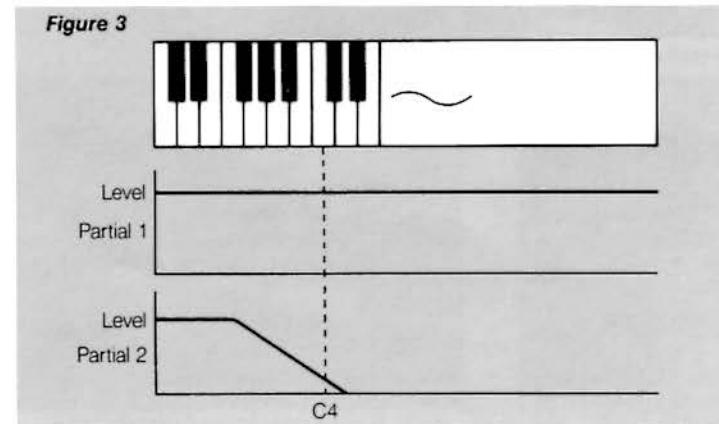
Since our objective is to edit the sustaining portion of the sound, we clearly have to shift our concentration to the Upper Tone. Any editing of the Lower Tone could only be detrimental to the timbre it is supposed to be producing!

Now let's confirm what sounds are being produced by the two Partial of the Upper Tone. Mute all but Upper Partial 1 using the PARTIAL MUTE and you should hear the soft, stringy quality of an analog synthesizer. This is our likely candidate for a quick editing job. Audition Upper Partial 2 in the same manner while playing different ranges of the keyboard. While the timbre is very similar to that of Partial 1, notice that it only sounds in lower octaves. This gives the lower registers a bit more fullness and is a sure sign of Bias at work. The bottom line is that editing this Partial will only have effect on the sound of the bottom few octaves, so this should not be the immediate focus of our attention.

So let's put this all together. The Lower Tone creates a metallic, ringing sound by combining a PCM click with a PCM bell. The warm sustained sound we want to brighten up is created largely by Upper Partial 1, as shown in Figure 3.



• All Partials besides Lower Partial 1 are muted in this example.



Partial 2 adds some reinforcement only in the lower range (Figure 3). Clearly our main suspect is Upper Partial 1.

When editing a given Partial, it is often necessary to work on another Partial, most often even on the same parameter. Here we re-introduce another very convenient programming aid in the form of the PARTIAL SELECT buttons. This function allows you to go from any display in any Partial to the same display in any other Partial instantly. The first four PATCH BANK buttons become PARTIAL SELECT buttons when you're in any display or the Partial level. To get to Upper Partial 1, press PARTIAL SELECT UPPER 1 and you should notice this change reflected in the status line at the top of the D-50's display, possibly accompanied by some value differences compared to the previous Partial's parameters. Note that without this programming aid, we would constantly be backing out of several levels of menus on one Partial and delving back into similar menus on others (the hard way)!

Modifying Partial Parameters

It's pretty easy to assume that this sound uses synthesizer sound sources for both Partial, but it's a good habit to verify the Structure number before editing. Indeed it is Structure 1 with its dual synthesizers. While waveform, modulation and other factors contribute to the timbre, experience tells us that most of the tone control comes from the TVF

when synthesized sound sources are used. Using the left and right SCROLL buttons, move to the TVF section and experiment with different Frequency settings. Bring in other Partial with PARTIAL MUTE to hear how the components work together. To try another approach, press the UNDO button which returns the parameter to its original position. Now move to the TVF ENV section and work with the envelope levels since these have an effect of the TVF Frequency as well. In either case, the settings should be made to your tastes.

These built-in programming aids make it easy to get around on the D-50. Once microprocessors found their way into electronic musical devices, knobs disappeared in favor of parameter select, menus and data entry. While this approach is more cost effective and service free, losing the knobs slowed things down a bit. Well, there's nothing like the PG-1000 to put you back in the fast lane! This add-on unit for your D-50 puts all the knobs back at your fingertips with digital accuracy. It uses the same PARTIAL SELECT technique so it's very easy to move around. The display changes each time you touch a knob to reflect the parameter's value and, as an added bonus, it also shows the values of the analogous parameters in the other three Partial. So, if you're editing the TVF Frequency of one Partial, the PG-1000 will display the TVF Frequency for all four Partial at once! That way it's easy to get a "vertical" view of what's happening with all the TVF's while the D-50's screen simultaneously gives you a

"horizontal" view of closely related timbres such as resonance. Using these two displays together provides a much larger, faster window on the D-50 world.

One word of caution about using the PG-1000 in performance mode. When you are in the master display of a Patch on the D-50, you can edit all the instrument's parameters without physically putting the D-50 into an edit mode. In this state, however, accidentally pressing a PATCH BANK or PATCH NUMBER button will change Patches and any edits will be lost. Since this cannot happen when the D-50 is in edit mode, we suggest that you take the implied precaution of working in edit mode.



• The PG-1000 makes programming the D-50 a breeze.



• Displaying the current setting using Parameter Request.

SOUND DATA

Taking Advantage of the D-50's Unique Features

When a complex array of parameters needs to be set just right to get the perfect sound, it is extremely helpful to have as many completed sounds available to draw from as possible. Why re-invent the wheel? The D-50 comes with a wide as-

sortment of sonic building blocks in its 64 factory Patches. In this section we give you some additional sounds for your library. Along the way, notice how each Patch is constructed since many of the D-50's features are put to the task

here. Once you've entered in the various parameters for each Patch, save them to internal or cartridge memory and experiment with combining the sounds in various ways with the Patches that you already have.

(Acoustic Guitar)

PATCH FACTOR

Patch Name			Key Mode			Chase			MIDI		
			Key Mode	Spl.P.	Bal.	Chase M.	Chase L.	Chase T.	Tx CH	Sep CH	
Acoustic Guitar 1			WHOLE	C4	71	ULU	50	50	B	OFF	
TUNE											
L-Key	U-Key	L-Fine	U-Fine	Bend.R	After	Port.T	Port.M	Hold.M	Out.M	Rev.Ty	Rev.Ba
-12	-12	00	+12	12	00	50	UL	UL	01	03	40
TONE PARAMETER (UPPER)											
Tone Name			Part	Structure	PITCH ENV						
AC-Guitar 1			Bal.	06	Velo	KF	T1	T2	T3	T4	LO
					00	00	20	20	20	20	L1
							20	00	00	00	L2
								00	00	00	SusL
									00	00	EndL
PITCH MODULATION			CHORUS			E Q			Wave		
LFO	Levr	Aftr	Tp	Rate	Dpth	Bal	Lf	Lg	Hf	HQ	Hg
00	26	03	02	38	46	49	840	+05	3.4	2.0	+08
WG PITCH			WG MODULATION			WG WAVEFORM			WG PULSE WIDTH		
Coarse	Fine	KF	LFO M.	PENV.M	Bender M.	Waveform	PCM No	PW	Velo	Aftr	LFO.S
P-1	C4	00	s1	OFF	OFF	SQU	23	00	00	00	+2
P-2	C5	00	s1	(-)	OFF	KF	SQU	59	00	00	+2
TVF			TVF ENV			TVA			TVA ENV		
Freq	Reso	KF	Bias	B.Lv	Dpth	Velo	KF (D)	KF (T)	Levl	Velo	Bias
P-1	100	00	1	>C4	00	00	00	00	100	+19	>G4
P-2	60	00	1/2	>C4	00	00	00	00	100	+08	>E4
TVF ENV TIME			TVF ENV LEVEL			TVF MODULATION			TVA		
T1	T2	T3	T4	T5	L1	L2	L3	SusL	Levl	Velo	Bias
P-1	00	00	00	00	100	100	100	100	100	+2	-02
P-2	00	00	00	00	100	100	100	100	100	+2	-07
TVA ENV TIME			TVA ENV LEVEL			TVA MODULATION			TVA		
T1	T2	T3	T4	T5	L1	L2	L3	SusL	Levl	Velo.T	KF (T)
P-1	02	76	00	00	00	100	00	00	00	+1	00
P-2	09	37	61	48	46	100	80	25	00	+1	00

This is a simulation of an acoustic guitar with nylon strings. Both Partials are created with PCM generators using Structure 6. EQ plays a further part in simulating the resonance of that particular instrument. While it is shown here using WHOLE mode, employing this sound for both Tones in DUAL mode

adds thickness to the effect if slight alterations are made to one Tone's fine tuning and timbre. This reduces the instrument to 8 voices, but then again real guitars only have six strings! Also remember other performance aspects that will lend realism to the effect. In order for this patch to sound like a guitar, you

have to think like a guitarist! They don't have things like sustain pedals and LFO's, for example. Since guitars and keyboards are completely different architecturally, sequencers like the MC-500 are often useful in getting intonation and chord arrangements just right.

(All PCM)

PATCH FACTOR

Patch Name			Key Mode			Chase			MIDI	
			Key Mode	Spilt.P	Bal.					
A11 PCM			DUAL	C4	32	ULU	50	50	B	OFF
TUNE			CONTROL			OUTPUT				
L-Key	U-Key	L-Fine	U-Fine	Bend.R	After	Port.T	Port.M	Hold.M	Out.M	Rev.Ty
+12	+12	00	00	12	00	64	UL	UL	01	03
TONE PARAMETER (UPPER)										
Tone Name			Part	Structure	PITCH ENV					
Noise			Bal.		Velo	KF	T1	T2	T3	T4
					00	00	20	20	20	20
							L0	L1	L2	SusL
								EndL		
PITCH MODULATION			CHORUS			E Q			Wave	
LFO	Levr	Aftr	Tp	Rate	Dpth	Bal	Lf	Lg	Hf	HQ
10	22	15	01	46	74	100	350	+09	9.5	6.0
									+0.9	
LFO1			SAW			100			Rate	
LFO2			TRI			00			00	
LFO3			TRI			00			00	
Sync										
P-1			P-2			P-3			P-4	
WG PITCH			WG MODULATION			WG WAVEFORM			WG PULSE WIDTH	
Coarse	Fine	KF	LFO M.	PENV.M	Bender M.	Waveform	PCM No	PW	Velo	Aftr
P-1	C4	00	s1	(+)	OFF	KF	SAW	52	00	00
P-2	C4	00	3/8	(-)	OFF	KF	SAW	68	00	00
P-5			P-6			P-7			P-8	
TVF			TVF ENV			TVF ENV TIME			TVF MODULATION	
Freq	Reso	KF	Bias	B.Lv	Dpth	Velo	KF (D)	KF (T)	LFO Select	LFO Depth
P-1	100	00	01	<A1	00	100	57	00	+1	00
P-2	100	00	01	<A1	00	100	00	00	+1	00
P-9			P-10			P-11			P-12	
TVA			TVA ENV			TVA ENV TIME			TVA MODULATION	
Levl	Velo	Bias	B.Lv	Velo.T	KF (T)	T1	L2	SusL	LFO Select	LFO Depth
P-1	100	+31	<A1	00	00	00	00	00	+1	00
P-2	75	00	<F5	-09	00	00	00	00	+1	00
P-13			P-14			P-15			P-16	
TVF ENV LEVEL			TVF ENV LEVEL			TVF ENV TIME			TVF MODULATION	
T1	T2	T3	T4	T5	L1	L2	L3	SusL	EndL	LFO Select
P-1	00	00	00	00	63	100	100	100	00	+1
P-2	01	00	00	00	63	58	100	100	00	00
P-17			P-18			P-19			P-20	
TVA			TVA ENV			TVA ENV TIME			TVA MODULATION	
Levl	Velo	Bias	B.Lv	Velo.T	KF (T)	T1	L2	SusL	LFO Select	LFO Depth
P-1	21	00	00	76	54	100	100	00	+1	00
P-2	18	57	00	70	58	100	89	00	+1	00
TONE PARAMETER (LOWER)			PITCH ENV			PITCH ENV			PITCH ENV	
Tone Name			Part	Structure	Velo	KF	T1	T2	T3	T4
Perc-Noise			Bal.		00	00	20	20	20	20
P-21			P-22			P-23			P-24	
PITCH MODULATION			CHORUS			E Q			Wave	
LFO	Levr	Aftr	Tp	Rate	Dpth	Bal	Lf	Lg	Hf	HQ
00	22	15	04	46	67	100	300	+09	4.8	0.3
									+11	
LFO1			LFO2			LFO3			Sync	
P-25			P-26			P-27			P-28	
WG PITCH			WG MODULATION			WG WAVEFORM			WG PULSE WIDTH	
Coarse	Fine	KF	LFO M.	PENV.M	Bender M.	Waveform	PCM No	PW	Velo	Aftr
P-1	C2	00	s1	(+)	OFF	KF	SAW	68	00	00
P-2	C3	00	s1	(-)	OFF	KF	SQU	66	14	+02
P-29			P-30			P-31			P-32	
TVF			TVF ENV			TVF ENV LEVEL			TVF MODULATION	
Freq	Reso	KF	Bias	B.Lv	Dpth	Velo	KF (D)	KF (T)	LFO Select	LFO Depth
P-1	100	00	5/4	<A1	00	100	00	00	+1	00
P-2	100	00	5/8	<A1	00	74	00	02	+1	00
P-33			P-34			P-35			P-36	
TVA			TVA ENV			TVA ENV LEVEL			TVA MODULATION	
Levl	Velo	Bias	B.Lv	Velo.T	KF (T)	T1	L2	SusL	EndL	LFO Select
P-1	100	+23	<C7	-04	00	00	00	00	00	+1
P-2	100	+24	<A1	00	00	00	00	00	00	00
P-37			P-38			P-39			P-40	
TVF ENV TIME			TVF ENV LEVEL			TVF ENV TIME			TVF MODULATION	
T1	T2	T3	T4	T5	L1	L2	L3	SusL	EndL	LFO Select
P-1	00	00	00	00	63	100	100	100	00	+1
P-2	00	38	35	03	63	100	79	25	15	00
P-41			P-42			P-43			P-44	
TVA ENV TIME			TVA ENV LEVEL			TVA ENV LEVEL			TVA MODULATION	
T1	T2	T3	T4	T5	L1	L2	L3	SusL	EndL	LFO Select
P-1	00	52	00	00	46	100	00	00	00	+1
P-2	12	54	64	54	55	100	69	18	00	00

As if you hadn't guessed, this sound is also created completely with PCM sounds on all four Partials. While PCM sounds are usually individually recogniz-

able, the blend of the four timbres creates an entirely new effect. This sound works well in the background with a variety of other instruments. It is also quite

effective at doing ostinato lines and other sequenced effects.

(Syn-Strings Hi 1)

PATCH FACTOR

Patch Name			Key Mode			Chase			MIDI									
			Key Mode	Split.P	Bal.				Tx CH	Sep CH								
Syn-Strings Hi 1			DUAL	C4	70	ULU	50	50	B		OFF							
TUNE																		
L-Key	U-Key	L-Fine	U-Fine	Bend.R	After	Port.T	Port.M	Hold.M	Out.M	Rev.Ty	Rev.Ba	T.Vol						
+12	+12	-02	+06	02	00	50	UL	UL	01	09	61	73						
TONE PARAMETER (UPPER)																		
Tone Name			Part Bal.	Structure	PITCH ENV			OUTPUT										
Syn-Strings 3			57	03	Velo	KF	T1	T2	T3	T4	L0	L1	L2	SusL	EndL			
Syn-Strings 3					00	00	20	20	20	20	00	00	00	00	00			
PITCH MODULATION			CHORUS			E Q			Wave			Rate	Dely	Sync				
LFO	Levr	Aftr	Tp	Rate	Dpth	Bal	Lf	Lg	Hf	HQ	Hg	LFO1	TRI	74	00	OFF		
09	36	22	01	61	33	86	250	+01	5.7	0.7	-01	LFO2	TRI	52	00	OFF		
												LFO3	TRI	76	00	OFF		
WG PITCH			WG MODULATION			WG WAVEFORM			WG PULSE WIDTH									
Coarse	Fine	KF	LFO M.	PENV.M	Bender M.	Waveform	PCM No	PW	Velo	Aftr	LFO.S	LFO.D						
P-1	C3	-06	1	A&L	OFF	KF	SQU	51	00	00	00	+3	66					
P-2	C3	00	1	A&L	OFF	KF	SAW	01	18	00	00	+3	34					
TVF			TVF ENV			TVA			TVA ENV									
Freq	Reso	KF	Bias	B.Lv	Dpth	Velo	KF (D)	KF (T)	Levl	Velo	Bias	B.Lv	Velo.T	KF (T)				
P-1	83	00	1	<B4	00	100	100	00	95	+15	<D#4	-04	03	00				
P-2	55	00	1/2	>G4	-02	41	20	00	96	+33	<C#5	00	00	00				
TVF ENV TIME			TVF ENV LEVEL			TVF MODULATION			TVA									
T1	T2	T3	T4	T5	L1	L2	L3	SusL	EndL	LFO Select	LFO Depth	Aftr Touch						
P-1	00	64	00	00	69	100	00	00	00	+1	00	+03						
P-2	03	44	92	72	69	100	50	25	00	+1	00	00						
TVF ENV TIME			TVF ENV LEVEL			TVA MODULATION			TVA									
T1	T2	T3	T4	T5	L1	L2	L3	SusL	EndL	LFO Select	LFO Depth	Aftr Touch						
P-1	36	57	40	54	54	100	100	100	00	+1	00	00						
P-2	20	30	66	77	54	40	100	88	00	+1	00	+01						
TONE PARAMETER (LOWER)																		
Tone Name			Part Bal.	Structure	PITCH ENV													
Syn-Strings 4			60	03	Velo	KF	T1	T2	T3	T4	L0	L1	L2	SusL	EndL			
Syn-Strings 4					00	00	10	20	20	20	-03	00	00	00	00			
PITCH MODULATION			CHORUS			E Q			Wave			Rate	Dely	Sync				
LFO	Levr	Aftr	Tp	Rate	Dpth	Bal	Lf	Lg	Hf	HQ	Hg	LFO1	TRI	77	11	OFF		
07	20	18	01	52	57	45	500	+05	3.4	0.5	00	LFO2	TRI	00	00	OFF		
												LFO3	TRI	61	00	OFF		
WG PITCH			WG MODULATION			WG WAVEFORM			WG PULSE WIDTH									
Coarse	Fine	KF	LFO M.	PENV.M	Bender M.	Waveform	PCM No	PW	Velo	Aftr	LFO.S	LFO.D						
P-1	C3	-02	1	A&L	(+)	KF	SQU	61	01	00	00	+3	62					
P-2	C3	00	1	(-)	OFF	KF	SQU	01	23	00	00	+3	83					
TVF			TVF ENV			TVA			TVA ENV									
Freq	Reso	KF	Bias	B.Lv	Dpth	Velo	KF (D)	KF (T)	Levl	Velo	Bias	B.Lv	Velo.T	KF (T)				
P-1	00	00	1	<B4	00	100	100	00	100	+12	<A#3	00	01	00				
P-2	60	00	1	<F4	-05	08	33	00	100	+13	<F3	00	02	00				
TVF ENV TIME			TVF ENV LEVEL			TVF MODULATION			TVA									
T1	T2	T3	T4	T5	L1	L2	L3	SusL	EndL	LFO Select	LFO Depth	Aftr Touch						
P-1	62	64	57	00	69	100	00	37	00	+1	00	+02						
P-2	00	57	00	00	69	100	00	37	00	+1	00	+01						
TVA ENV TIME			TVA ENV LEVEL			TVA MODULATION			TVA									
T1	T2	T3	T4	T5	L1	L2	L3	SusL	EndL	LFO Select	LFO Depth	Aftr Touch						
P-1	39	80	40	54	54	100	80	00	00	+1	00	00						
P-2	22	39	55	77	53	48	100	90	95	+1	00	+01						

This Patch is targeted at the string programs on the SUPER JX and other analog synths. While digital synthesizers are sometimes characterized as having thin string sounds, this Patch has a fuller sound as a result of mixing the elements

of acoustic instruments together with synthesized strings.

By combining different PCM and synthesized Partials, the D-50 can create anything from a realistic string quartet to a cheesy string machine. In this particu-

lar case the PCM sounds provide both a core effect and an overall polish.

(Gamelan 03)

PATCH FACTOR

Patch Name			Key Mode			Chase			MIDI					
			Key Mode	Splt.P	Bal.	Chase M.	Chase L.	Chase T.	Tx CH	Sep CH				
Gamelan 03			DUAL	C4	46	ULU	50	50	B	OFF				
TUNE			CONTROL			OUTPUT								
L-Key	U-Key	L-Fine	U-Fine	Bend.R	After	Port.T	Port.M	Hold.M	Out.M	Rev.Ty				
00	00	-28	-21	07	+01	34	UL	UL	01	04				
TONE PARAMETER (UPPER)														
Tone Name			Part	Structure	PITCH ENV									
Gam Bell 1			Bal.		Velo	KF	T1	T2	T3	T4				
			50	06	00	00	20	20	20	00				
					L1		T2	T3	L1	L2				
							T3	L1	SusL	EndL				
PITCH MODULATION			CHORUS			E Q			OUTPUT					
LFO	Levr	Aftr	Tp	Rate	Dpth	Bal	Lf	Lg	Hf	HQ	Hg			
00	24	00	06	53	48	11	88	-06	250	0.3	00			
LFO01			TRI	70	00	OFF								
LFO02			TRI	50	00	OFF								
LFO03			TRI	30	00	OFF								
WG PITCH			WG MODULATION			WG WAVEFORM			WG PULSE WIDTH					
Coarse	Fine	KF	LFO M.	PENV.M	Bender M.	Waveform	PCM No	PW	Velo	Aftr	LFO.S	LFO.D		
P-1	D#2	-50	5/4	A&L	OFF	OFF	SQU	69	00	00	+2	00		
P-2	C3	+42	1/4	A&L	OFF	KF	SQU	06	00	00	+2	00		
TVF			TVF ENV			TVF MODULATION			TVF ENV					
Freq	Reso	KF	Bias	B.Lv	Dpth	Velo	KF (D)	KF (T)	Levl	Velo	Bias	B.Lv	Velo.T	KF (T)
P-1	60	00	1/2	<C4	00	00	00	00	89	+20	>C5	-02	00	00
P-2	60	00	1/2	<C4	00	00	00	00	100	+12	>A1	00	00	00
TVF ENV TIME			TVF ENV LEVEL			TVF MODULATION			TVF ENV					
T1	T2	T3	T4	T5	L1	L2	L3	SusL	EndL	LFO Select	LFO Depth	Aftr Touch		
P-1	00	00	00	00	100	100	100	100	00	+2	00	00		
P-2	00	00	00	00	100	100	100	100	00	+2	00	00		
TVF ENV TIME			TVF ENV LEVEL			TVF MODULATION			TVF ENV					
T1	T2	T3	T4	T5	L1	L2	L3	SusL	EndL	LFO Select	LFO Depth	Aftr Touch		
P-1	00	68	100	100	67	100	00	00	00	+3	00	00		
P-2	00	63	100	100	60	100	00	00	00	+3	00	00		
TVA			TVA ENV			TVA MODULATION			TVA ENV					
T1	T2	T3	T4	T5	L1	L2	L3	SusL	EndL	LFO Select	LFO Depth	Aftr Touch		
P-1	00	68	100	100	67	100	00	00	00	+3	00	00		
P-2	00	63	100	100	60	100	00	00	00	+3	00	00		
TVA ENV TIME			TVA ENV LEVEL			TVA MODULATION			TVA ENV					
T1	T2	T3	T4	T5	L1	L2	L3	SusL	EndL	LFO Select	LFO Depth	Aftr Touch		
P-1	00	68	100	100	67	100	00	00	00	+3	00	00		
P-2	00	63	100	100	60	100	00	00	00	+3	00	00		
TVA			TVA ENV			TVA MODULATION			TVA ENV					
T1	T2	T3	T4	T5	L1	L2	L3	SusL	EndL	LFO Select	LFO Depth	Aftr Touch		
P-1	00	68	100	100	67	100	00	00	00	+3	00	00		
P-2	00	63	100	100	60	100	00	00	00	+3	00	00		
TVA ENV TIME			TVA ENV LEVEL			TVA MODULATION			TVA ENV					
T1	T2	T3	T4	T5	L1	L2	L3	SusL	EndL	LFO Select	LFO Depth	Aftr Touch		
P-1	00	44	100	100	65	100	00	00	00	+3	00	00		
P-2	00	60	100	100	54	100	00	00	00	+3	00	00		
TVA			TVA ENV			TVA MODULATION			TVA ENV					
T1	T2	T3	T4	T5	L1	L2	L3	SusL	EndL	LFO Select	LFO Depth	Aftr Touch		
P-1	00	44	100	100	65	100	00	00	00	+3	00	00		
P-2	00	60	100	100	54	100	00	00	00	+3	00	00		

Once again PCM waveforms are used to simulate realism in this metallic instrument. Rather than producing the clear tone of a bell, the gamelan has more of a rich and complex effect. The biggest lesson in this Patch is the

way in which Key Follow is used with the various Partial's WG Pitch. The KF settings are programmed differently for each Partial in such a way that only one plays a regular scale. If you listen to a variety of folk and ethnic music from

around the world, it soon becomes apparent that there is plenty of music that cannot be realized using the western scale. Experiment with this same technique when simulating ethnic instruments in your own programs.

(Bohemian)

PATCH FACTOR

Patch Name			Key Mode			Chase			MIDI											
			Key Mode	Split.P	Bal.				Chase M.	Chase L.	Chase T.									
Bohemian			DUAL	C4	47	ULU	50	50	B	OFF										
TUNE			CONTROL			OUTPUT														
L-Key	U-Key	L-Fine	U-Fine	Bend.R	After	Port.T	Port.M	Hold.M	Out.M	Rev.Ty	Rev.Ba	T.Vol								
00	00	00	00	02	00	40	UL	UL	01	03	26	88								
TONE PARAMETER (UPPER)																				
Tone Name			Part Bal.	Structure	PITCH ENV															
Pulse			50	01	Velo	KF	T1	T2	T3	T4	LO	L1	L2	SusL	EndL					
					00	00	00	07	00	22	-02	+05	00	00	00					
PITCH MODULATION			CHORUS			E Q														
LFO	Levr	Aftr	Tp	Rate	Dpth	Bal	Lf	Lg	Hf	HQ	Hg	LFO1	Wave	Rate	Dely	Sync				
01	15	12	01	48	48	18	125	00	5.7	0.3	-06	LFO2	TRI	74	00	OFF				
LFO3	TRI	70	00	64	00	00	00	00	00	00	00	LFO3	TRI	64	00	OFF				
WG PITCH			WG MODULATION			WG WAVEFORM			WG PULSE WIDTH											
Coarse	Fine	KF	LFO M.	PENV.M	Bender M.	Waveform	PCM No	PW	Velo	Aftr	LFO.S	LFO.D	LFO1	TRI	74	00	OFF			
P-1	C4	+04	1	(+)	(+)	KF	SQU	01	05	+03	00	+1	00	LFO2	TRI	70	00	OFF		
P-2	C4	-04	S1	(+)	(-)	KF	SQU	01	00	00	00	+1	00	LFO3	TRI	64	00	OFF		
TVF			TVF ENV			TVA			TVA ENV											
Freq	Reso	KF	Bias	B.Lv	Dpth	Velo	KF (D)	KF (T)	Levl	Velo	Bias	B.Lv	Velo.T	KF (T)						
P-1	24	00	7/8	>A4	-04	58	12	00	100	+16	>C5	-02	01	00	LFO1	TRI	74	00	OFF	
P-2	25	00	1	>C4	-05	70	36	00	00	100	+13	>C5	-02	01	00	LFO2	TRI	70	00	OFF
TVF ENV TIME			TVF ENV LEVEL			TVF MODULATION														
T1	T2	T3	T4	T5	L1	L2	L3	SusL	EndL	LFO Select	LFO Depth	Aftr Touch								
P-1	00	100	100	00	100	100	100	100	00	+1	02	+02								
P-2	22	100	00	00	68	100	00	00	00	+1	04	+02								
TVA ENV TIME			TVA ENV LEVEL			TVA MODULATION														
T1	T2	T3	T4	T5	L1	L2	L3	SusL	EndL	LFO Select	LFO Depth	Aftr Touch								
P-1	10	24	88	100	41	50	100	98	100	+3	00	00								
P-2	04	28	90	90	33	48	100	98	100	+3	00	00								
TONE PARAMETER (LOWER)																				
Tone Name			Part Bal.	Structure	PITCH ENV															
Breath			80	06	Velo	KF	T1	T2	T3	T4	LO	L1	L2	SusL	EndL					
					00	00	20	20	20	20	00	00	00	00	00					
PITCH MODULATION			CHORUS			E Q														
LFO	Levr	Aftr	Tp	Rate	Dpth	Bal	Lf	Lg	Hf	HQ	Hg	LFO1	Wave	Rate	Dely	Sync				
00	00	00	08	50	20	18	125	-04	6.7	0.3	+06	LFO2	TRI	74	50	OFF				
LFO3	TRI	50	00	30	00	00	00	00	00	00	00	LFO3	TRI	30	00	OFF				
WG PITCH			WG MODULATION			WG WAVEFORM			WG PULSE WIDTH											
Coarse	Fine	KF	LFO M.	PENV.M	Bender M.	Waveform	PCM No	PW	Velo	Aftr	LFO.S	LFO.D	LFO1	TRI	74	00	OFF			
P-1	C3	+22	1	OFF	OFF	NOM	SQU	35	00	00	00	+1	00	LFO2	TRI	70	00	OFF		
P-2	C2	-28	1	OFF	OFF	NOM	SQU	34	00	00	00	+1	00	LFO3	TRI	64	00	OFF		
TVF			TVF ENV			TVA			TVA ENV											
Freq	Reso	KF	Bias	B.Lv	Dpth	Velo	KF (D)	KF (T)	Levl	Velo	Bias	B.Lv	Velo.T	KF (T)						
P-1	60	00	1/2	<C4	00	00	00	00	100	+19	>C5	-02	02	00	LFO1	TRI	74	00	OFF	
P-2	60	00	1/2	<C4	00	00	00	00	00	100	+26	>C5	-05	01	00	LFO2	TRI	70	00	OFF
TVF ENV TIME			TVF ENV LEVEL			TVF MODULATION														
T1	T2	T3	T4	T5	L1	L2	L3	SusL	EndL	LFO Select	LFO Depth	Aftr Touch								
P-1	00	00	00	00	100	100	100	100	00	+2	00	00	00	LFO3	TRI	64	00	OFF		
P-2	00	00	00	00	100	100	100	100	00	+2	00	00	00							
TVA ENV TIME			TVA ENV LEVEL			TVA MODULATION														
T1	T2	T3	T4	T5	L1	L2	L3	SusL	EndL	LFO Select	LFO Depth	Aftr Touch								
P-1	22	100	64	00	44	98	100	00	00	+3	00	00	00	LFO1	TRI	74	00	OFF		
P-2	00	97	00	00	41	100	92	08	00	+3	00	00	00	LFO2	TRI	70	00	OFF		

In this Patch the PCM sounds of two woodwind attacks are combined with synthesizer sounds in such a way that they don't attract attention as being woodwinds. Instead, they contribute to the whole. The P-ENV is also employed

to subtly alter the pitch during the attack.

Structure 1 is used in the Upper Tone to create a completely different effect for the remainder of the sound. The end result works well in melodies and harmonies. The added touch of those PCM

wind attacks also adds a nice effect when playing staccato chords.

(Chorus)

PATCH FACTOR

Patch Name			Key Mode			Chase			MIDI									
			Key Mode	Split.P	Bal.				Chase M.	Chase L.	Chase T.							
	Chorus		DUAL	C4	39	ULU	50	50	B	OFF								
TUNE			CONTROL			OUTPUT												
L-Key -12	U-Key +24	L-Fine 00	U-Fine -02	Bend.R 02	After 00	Port.T 100	Port.M UL	Hold.M UL	Out.M 01	Rev.Ty 01	Rev.Ba 66	T.Vol 100						
TONE PARAMETER (UPPER)																		
Tone Name			Part	Structure	PITCH ENV													
Koe			Bal.	07	Velo	KF	T1	T2	T3	T4	LO	L1	L2	SusL	EndL			
PITCH MODULATION			CHORUS			E Q			Wave			Rate	Dely	Sync				
LFO	Levr	Aftr	Tp	Rate	Dpth	Bal	Lf	Lg	Hf	HQ	Hg	LFO1	TRI	75	93	KEY		
16	00	00	01	52	62	59	63	00	9.5	0.3	+12	LFO2	SAW	100	00	OFF		
LFO3												01	00	01	ON			
WG PITCH			WG MODULATION			WG WAVEFORM			WG PULSE WIDTH									
Coarse	Fine	KF	LFO M.	PENV.M	Bender M.	Waveform	PCM No	PW	Velo	Aftr	LFO.S	LFO.D						
P-1	C3	+10	1	(+)	(-)	KF	SAW	67	61	00	00	-01	100					
P-2	C1	-02	3/4	(-)	(+)	KF	SAW	61	00	00	00	+3	00					
TVF			TVF ENV			TVA			TVA ENV									
Freq	Reso	KF	Bias	B.Lv	Dpth	Velo	KF (D)	KF (T)	Levl	Velo	Bias	B.Lv	Velo.T	KF (T)				
P-1	43	30	7/8	<A1	00	00	00	00	83	00	>G#5	-12	00	01				
P-2	91	30	7/8	<A1	00	00	00	00	42	00	>G3	-12	00	01				
TVF ENV TIME			TVF ENV LEVEL			TVF MODULATION			TVA MODULATION									
T1	T2	T3	T4	T5	L1	L2	L3	SusL	EndL	LFO Select	LFO Depth	Aftr	Touch					
P-1	00	44	00	00	52	100	00	00	00	+3	00	+07	+07					
P-2	00	44	00	00	52	100	00	00	100	+3	00	+07	+07					
TVA ENV TIME			TVA ENV LEVEL			TVA MODULATION			TVA MODULATION									
T1	T2	T3	T4	T5	L1	L2	L3	SusL	EndL	LFO Select	LFO Depth	Aftr	Touch					
P-1	41	00	00	05	62	100	100	100	100	-3	29	+01	+01					
P-2	41	00	00	00	62	100	100	100	100	+3	29	+01	+01					
TONE PARAMETER (LOWER)																		
Tone Name			Part	Structure	PITCH ENV													
Uragoe			Bal.	07	Velo	KF	T1	T2	T3	T4	LO	L1	L2	SusL	EndL			
PITCH MODULATION			CHORUS			E Q			Wave			Rate	Dely	Sync				
LFO	Levr	Aftr	Tp	Rate	Dpth	Bal	Lf	Lg	Hf	HQ	Hg	LFO1	TRI	74	40	OFF		
08	00	00	01	40	100	75	63	+06	80	0.3	+10	LFO2	TRI	100	00	OFF		
LFO3												76	00	00	OFF			
WG PITCH			WG MODULATION			WG WAVEFORM			WG PULSE WIDTH									
Coarse	Fine	KF	LFO M.	PENV.M	Bender M.	Waveform	PCM No	PW	Velo	Aftr	LFO.S	LFO.D						
P-1	C5	00	1	(+)	(-)	KF	SQU	66	82	+07	+07	+3	00					
P-2	C6	+06	1	(+)	OFF	KF	SQU	75	82	+07	-07	+3	00					
TVF			TVF ENV			TVA			TVA ENV									
Freq	Reso	KF	Bias	B.Lv	Dpth	Velo	KF (D)	KF (T)	Levl	Velo	Bias	B.Lv	Velo.T	KF (T)				
P-1	52	00	2	<B4	00	00	100	00	80	00	<C4	00	04	00				
P-2	52	00	2	<F4	-05	00	33	00	80	00	>G#4	00	00	00				
TVF ENV TIME			TVF ENV LEVEL			TVF MODULATION			TVA MODULATION									
T1	T2	T3	T4	T5	L1	L2	L3	SusL	EndL	LFO Select	LFO Depth	Aftr	Touch					
P-1	00	64	00	00	69	00	63	56	00	+1	00	+01	+01					
P-2	00	57	00	00	69	00	63	56	00	+1	00	+01	+01					
TVA ENV TIME			TVA ENV LEVEL			TVA MODULATION			TVA MODULATION									
T1	T2	T3	T4	T5	L1	L2	L3	SusL	EndL	LFO Select	LFO Depth	Aftr	Touch					
P-1	30	38	100	100	62	100	100	100	100	+1	00	00	00					
P-2	30	31	55	77	62	100	100	100	100	+1	00	00	00					

This Patch does things a bit differently than in our previous examples. Structure 7 is used in both Tones to combine PCM with ring modulation. Most of the sound comes from Partial 1 in each Tone, with just a little ring modula-

tion coming from the other Partial. In addition, each Tones has its own Chorus settings and the interaction between them provides plenty of action in this sound.

Several other things are worth taking note of in this example. First, the TVA

Bias controls are set up in such a way that Upper Tones are played by the lower end of the keyboard and Lower Tones are controlled from the high range. Secondly, notice how the settings of the two EQ sections are applied to different ranges.

(Poly-Synth)

PATCH FACTOR

Patch Name			Key Mode			Chase			MIDI									
			Key Mode	Splt.P	Bal.				Chase M.	Chase L.	Chase T.	Tx CH	Sep CH					
Poly-Synth			DUAL	C4	72	ULU	50	50	B		OFF							
TUNE			CONTROL				OUTPUT											
L-Key	U-Key	L-Fine	U-Fine	Bend.R	After	Port.T	Port.M	Hold.M	Out.M	Rev.Ty	Rev.Ba	T.Vol						
00	00	00	00	02	00	50	UL	UL	01	03	28	84						
TONE PARAMETER (UPPER)																		
Tone Name		Part	Structure		PITCH ENV													
PCM-Synth		73	06		Velo	KF	T1	T2	T3	T4	L0	L1	L2	SusL	EndL			
WG PITCH			WG MODULATION				WG WAVEFORM					WG PULSE WIDTH						
Coarse	Fine	KF	LFO M.	PENV.M	Bender M.	Waveform	PCM No	PW	Velo	Aftr	LFO.S	LFO.D						
P-1	C4	+29	0	OFF	OFF	SQU	14	00	00	00	+2	00						
P-2	C5	00	s1	(-)	OFF	KF	SQU	58	00	00	00	+2	00					
TVF					TVF ENV				TVA				TVA ENV					
Freq	Reso	KF	Bias	B.Lv	Dpth	Velo	KF (D)	KF (T)	Levl	Velo	Bias	B.Lv	Velo.T	KF (T)				
P-1	60	00	1/2	>C4	00	00	00	00	100	+05	<C4	-03	00	02				
P-2	60	00	1/2	>C4	00	00	00	00	100	+07	<A1	00	00	02				
TVF ENV TIME					TVF ENV LEVEL				TVF MODULATION									
T1	T2	T3	T4	T5	L1	L2	L3	SusL	EndL	LFO Select	LFO Depth	Aftr Touch						
P-1	00	00	00	00	100	100	100	100	00	+02	00	00						
P-2	00	00	00	00	100	100	100	100	00	+02	00	00						
TVA ENV TIME					TVA ENV LEVEL				TVA MODULATION									
T1	T2	T3	T4	T5	L1	L2	L3	SusL	EndL	LFO Select	LFO Depth	Aftr Touch						
P-1	00	76	00	00	100	00	00	00	00	+1	00	00						
P-2	00	29	68	54	40	100	82	21	00	+1	00	00						
TONE PARAMETER (LOWER)																		
Tone Name			Part	Structure		Velo	KF	T1	T2	T3	T4	L0	L1	L2	SusL	EndL		
Reso-Synth			45	01		00	00	08	20	20	20	+03	00	00	00	00		
PITCH MODULATION			CHORUS				E Q					Wave			Rate	Dely	Sync	
LFO	Levr	Aftr	Tp	Rate	Dpth	Bal	Lf	Lg	Hf	HQ	Hg	LFO1	TRI	75	08	OFF		
00	26	15	01	44	63	100	63	00	250	0.3	00	LFO2	TRI	50	00	OFF		
P-1	C3	+06	1	(+)	OFF	KF	SAW	01	18	00	-07	+2	00					
P-2	C3	00	1	A&L	(-)	KF	SAW	01	97	00	-04	+2	00					
WG PITCH					WG MODULATION				WG WAVEFORM				WG PULSE WIDTH					
Coarse	Fine	KF	LFO M.	PENV.M	Bender M.	Waveform	PCM No	PW	Velo	Aftr	LFO.S	LFO.D	LFO1	TRI	75	08	OFF	
P-1	C3	+06	1	(+)	OFF	KF	SAW	01	18	00	-07	+2	00					
P-2	C3	00	1	A&L	(-)	KF	SAW	01	97	00	-04	+2	00					
TVF					TVF ENV				TVA				TVA ENV					
Freq	Reso	KF	Bias	B.Lv	Dpth	Velo	KF (D)	KF (T)	Levl	Velo	Bias	B.Lv	Velo.T	KF (T)				
P-1	79	22	1	<C4	00	100	00	00	100	+10	>C#2	00	00	00				
P-2	47	26	1	<C4	00	100	00	00	100	+10	>C#2	00	00	00				
TVF ENV TIME					TVF ENV LEVEL				TVF MODULATION				TVA MODULATION					
T1	T2	T3	T4	T5	L1	L2	L3	SusL	EndL	LFO Select	LFO Depth	Aftr Touch	T1	32	85	61	89	
P-1	00	32	85	61	89	100	43	00	00	+02	00	00						
P-2	00	32	85	61	89	100	43	00	00	+02	00	00						
TVA ENV TIME					TVA ENV LEVEL				TVA MODULATION				TVA ENV LEVEL					
T1	T2	T3	T4	T5	L1	L2	L3	SusL	EndL	LFO Select	LFO Depth	Aftr Touch	T1	00	72	41	37	
P-1	00	00	72	41	37	100	100	43	00	+1	00	00						
P-2	00	02	69	41	38	100	100	54	00	+1	00	00						

This Patch gets its name by default, yet the timbre is quite different from those found on other instruments. The sharp attack sound that is so hard to attain on conventional synthesizers is easily produced using the D-50's PCM transients for the first stage of the event. As a result, this Patch can be used for a variety of tasks including backing chords, solo and bass.

(H-Organ After LFO)

PATCH FACTOR

Patch Name			Key Mode			Chase			MIDI							
H-Organ After LFO			Key Mode	Splt.P	Bal.	Chase M.	Chase L.	Chase T.	Tx CH	Sep CH						
DUAL			C4	47		ULU	50	50	B	OFF						
TUNE			CONTROL			OUTPUT										
L-Key	U-Key	L-Fine	U-Fine	Bend.R	After	Port.T	Port.M	Hold.M	Out.M	Rev.Ty	Rev.Ba	T.Vol				
00	00	00	00	00	00	00	UL	UL	01	09	57	65				
TONE PARAMETER (UPPER)																
Tone Name			Part	Structure	PITCH ENV											
Organ Oto			Bal.		Velo	KF	T1	T2	T3	T4	L0	L1	L2	SusL	EndL	
Organ Oto			50	06	00	00	00	15	00	22	-09	-02	00	00	-09	
PITCH MODULATION			CHORUS			E Q			Wave			Rate	Dely	Sync		
LFO	Levr	Aftr	Tp	Rate	Dpth	Bal	Lf	Lg	Hf	HQ	Hg					
05	20	16	01	40	55	47	300	+04	2.4	6.0	-03	LFO1	TRI	78	00	OFF
												LFO2	TRI	00	00	OFF
												LFO3	TRI	00	00	OFF
WG PITCH			WG MODULATION			WG WAVEFORM			WG PULSE WIDTH							
Coarse	Fine	KF	LFO M.	PENV.M	Bender M.	Waveform	PCM No	PW	Velo	Aftr	LFO.S	LFO.D				
P-1	C4	-05	1	(-)	OFF	KF	SAW	50	00	-07	-07	+1	00			
P-2	C5	+03	1	(+)	OFF	KF	SAW	48	00	-07	-07	+1	00			
TVF			TVF ENV			TVA			TVA ENV							
Freq	Reso	KF	Bias	B.Lv	Dpth	Velo	KF (D)	KF (T)	Levl	Velo	Bias	B.Lv	Velo.T	KF (T)		
P-1	31	00	3/4	<A1	00	63	00	02	92	+03	>C5	-02	00	00		
P-2	31	00	3/8	<A1	00	63	00	02	100	+15	>F3	-05	00	00		
TVF ENV TIME			TVF ENV LEVEL			TVF MODULATION			TVF MODULATION							
T1	T2	T3	T4	T5	L1	L2	L3	SusL	EndL	LFO Select	LFO Depth	Aftr Touch				
P-1	75	97	00	00	100	86	00	00	00	+1	00	-07				
P-2	74	85	00	00	100	100	00	00	00	+1	00	-07				
TVA ENV TIME			TVA ENV LEVEL			TVA MODULATION			TVA MODULATION							
T1	T2	T3	T4	T5	L1	L2	L3	SusL	EndL	LFO Select	LFO Depth	Aftr Touch				
P-1	00	100	100	06	100	100	100	100	00	+1	00	00				
P-2	00	100	100	06	100	100	100	100	00	+1	00	00				
TONE PARAMETER (LOWER)																
Tone Name			Part	Structure	PITCH ENV											
Organ ATK			Bal.		Velo	KF	T1	T2	T3	T4	L0	L1	L2	SusL	EndL	
Organ ATK			64	03	00	00	00	11	00	22	+42	-02	00	00	+42	
PITCH MODULATION			CHORUS			E Q			Wave							
LFO	Levr	Aftr	Tp	Rate	Dpth	Bal	Lf	Lg	Hf	HQ	Hg					
00	100	00	06	57	45	55	63	-12	840	0.3	+01	LFO1	TRI	73	00	OFF
												LFO2	TRI	00	00	OFF
												LFO3	TRI	48	00	OFF
WG PITCH			WG MODULATION			WG WAVEFORM			WG PULSE WIDTH							
Coarse	Fine	KF	LFO M.	PENV.M	Bender M.	Waveform	PCM No	PW	Velo	Aftr	LFO.S	LFO.D				
P-1	C3	+11	1	OFF	OFF	KF	SAW	21	00	-07	-07	+1	00			
P-2	C3	00	1	(+)	OFF	KF	SQU	21	22	00	+03	+3	66			
TVF			TVF ENV			TVA			TVA ENV							
Freq	Reso	KF	Bias	B.Lv	Dpth	Velo	KF (D)	KF (T)	Levl	Velo	Bias	B.Lv	Velo.T	KF (T)		
P-1	31	00	3/4	<A1	00	63	00	02	100	+03	>F4	-04	00	00		
P-2	43	24	5/8	<A1	00	00	00	02	100	+07	>G4	-02	00	00		
TVF ENV TIME			TVF ENV LEVEL			TVF MODULATION			TVF MODULATION							
T1	T2	T3	T4	T5	L1	L2	L3	SusL	EndL	LFO Select	LFO Depth	Aftr Touch				
P-1	00	97	00	00	100	100	100	100	00	+1	00	-07				
P-2	74	85	00	00	100	100	100	100	00	+1	00	+01				
TVA ENV TIME			TVA ENV LEVEL			TVA MODULATION			TVA MODULATION							
T1	T2	T3	T4	T5	L1	L2	L3	SusL	EndL	LFO Select	LFO Depth	Aftr Touch				
P-1	00	53	100	100	06	100	85	00	00	+1	00	00				
P-2	00	100	100	63	06	100	100	00	00	+1	00	00				

This Patch makes no attempts to be anything other than a traditional organ sound. The main effect to consider here is the way in which aftertouch is routed to simulate the movement of a rotating speaker. Since there are three LFO's for

each Tone, LFO-2 and LFO-3 could also be put to use doing something else. Tone is focused on the PCM sounds, especially the key click or popping sound associated with percussive organ sounds. This has also been elusive with the ana-

log synthesizer and since you just don't see too many organs anymore, maybe the world is waiting for you to resurrect the killer organ sound!

(Ac-Bs Ac-Pf Split)

PATCH FACTOR

Patch Name			Key Mode			Chase			MIDI			
Ac-Bs Ac-Pf split			Key Mode	Splt.P	Bal.	Chase M.	Chase L.	Chase T.	Tx CH	Sep CH		
SPLIT			F4	61		ULU	50	50	B	OFF		
TUNE			CONTROL			OUTPUT						
L-Key 00	U-Key 00	L-Fine 00	U-Fine 00	Bend.R 02	After +03	Port.T 62	Port.M U	Hold.M U	Out.M 01	Rev.Ty 01	Rev.Ba 50	T.Vol 100
TONE PARAMETER (UPPER)												
Tone Name			Part Bal.	Structure	PITCH ENV							
Ac-Piano 3			48	03	Velo	KF	T1	T2	T3	T4	LO	
					00	00	20	20	20	20	L1	
							00	00	00	00	L2	
											SusL	
											EndL	
PITCH MODULATION			CHORUS			E Q			Wave			
LFO 00	Levr 24	Aftr 00	Tp 01	Rate 52	Dpth 30	Bal 38	Lf 125	Lg +00	Hf 3.4	HQ 0.3	Hg +03	
LFO01			TRI	74	50	OFF						
LFO02			TRI	50	00	OFF						
LFO03			TRI	30	00	OFF						
WG PITCH			WG MODULATION			WG WAVEFORM			WG PULSE WIDTH			
Coarse P-1	Fine C 2	KF 00	LFO M. s1	PENV. M. A&L	Bender M. OFF	Waveform SQU	PCM No 18	PW 00	Velo 00	Aftr 00	LFO. S +2	
P-2	C 3	00	s1	A&L	OFF	SAW	51	81	-03	00	+2	
P-2											00	
TVF			TVF ENV			TVA			TVA ENV			
Freq P-1	Reso 60	KF 00	Bias 1/2	<C4	00	Dpth 00	Velo 00	KF (D) 00	KF (T) 00	Levl 100	Velo +50	
P-2	25	1	<C4	00		00	00	00	00	100	<G#5	
P-2											02	
P-2											03	
TVF ENV TIME			TVF ENV LEVEL			TVF MODULATION			TVA MODULATION			
T1 P-1	T2 00	T3 00	T4 00	T5 00	L1 100	L2 100	L3 100	SusL 100	EndL 00	LFO Select +2	LFO Depth 00	
P-2	61	00	00	00	100	00	00	00	00	+2	00	
P-2											+01	
TVA ENV TIME			TVA ENV LEVEL			TVA MODULATION			TVA MODULATION			
T1 P-1	T2 00	T3 67	T4 67	T5 65	L1 100	L2 60	L3 28	SusL 00	EndL 00	LFO Select +3	LFO Depth 00	
P-2	67	65	63	45	100	60	28	00	00	+3	00	
P-2											00	
TONE PARAMETER (LOWER)												
Tone Name			Part Bal.	Structure	PITCH ENV							
Ac-Bass 1			21	03	Velo	KF	T1	T2	T3	T4	LO	
					00	00	20	20	20	20	L1	
							00	00	00	00	L2	
											SusL	
											EndL	
PITCH MODULATION			CHORUS			E Q			Wave			
LFO 07	Levr 00	Aftr 00	Tp 08	Rate 54	Dpth 53	Bal 00	Lf 150	Lg +10	Hf 250	HQ 0.3	Hg 00	
LFO01			TRI	74	53	KEY						
LFO02			TRI	50	00	OFF						
LFO03			TRI	30	00	OFF						
WG PITCH			WG MODULATION			WG WAVEFORM			WG PULSE WIDTH			
Coarse P-1	Fine C 4	KF 00	LFO M. 1	PENV. M. OFF	Bender M. OFF	Waveform SQU	PCM No 30	PW 00	Velo 00	Aftr 00	LFO. S +2	
P-2	C 3	+01	1	(+)	OFF	KF	52	48	+07	00	+2	
P-2											00	
TVF			TVF ENV			TVA			TVA ENV			
Freq P-1	Reso 60	KF 00	Bias 1/2	<C4	00	Dpth 00	Velo 100	KF (D) 00	KF (T) 00	Levl 100	+40	
P-2	19	5/8	<C4	00	100	36	00	00	00	100	<B2	
P-2											-04	
P-2											04	
P-2											00	
TVF ENV TIME			TVF ENV LEVEL			TVF MODULATION			TVA MODULATION			
T1 P-1	T2 00	T3 55	T4 00	T5 69	L1 100	L2 00	L3 00	SusL 00	EndL 00	LFO Select +2	LFO Depth 00	
P-2	27	69	76	69	100	57	33	00	00	+2	00	
P-2											00	
TVA ENV TIME			TVA ENV LEVEL			TVA MODULATION			TVA MODULATION			
T1 P-1	T2 00	T3 97	T4 00	T5 31	L1 100	L2 00	L3 00	SusL 00	EndL 00	LFO Select +3	LFO Depth 00	
P-2	45	00	68	24	100	100	44	00	00	+3	00	
P-2											00	

This Patch uses SPLIT mode to simulate an acoustic bass/piano duo. Since the piano alone can be a little sparse, the complement of the additional instrument goes a long way. Just add a drum machine and you're a trio!

One of the interesting features of this Patch is that the acoustic bass sound changes depending on the aftertouch. Lower Partial 2 uses a sawtooth wave which jumps an octave when PW is driven to 0 via an aftertouch setting

of -07. This lends the harmonic effect of a fretless bass and makes this Patch a natural for all kinds of jazz bass applications.

MIDI FUNCTIONS

MIDI COMPATIBILITY

MIDI—Keys to the World

As with just about everything else in the music world these days, the D-50 has MIDI. And as with just about everything else in the D-50, there are some MIDI features that may seem unfamiliar. In this section we'll concentrate on the D-50's MIDI implementation.

Many readers may already be familiar with MIDI, but for the benefit of our new friends MIDI stands for Musical Instrument Digital Interface. A few simple connections serve as a way for a variety of instruments and other electronic music equipment to work as an integrated system. A detailed explanation of MIDI is beyond the scope of this book and we recommend reading publications dedicated to this subject.

Relationship Of Keyboard And MIDI Controls

The major application of MIDI is to communicate note information between the D-50 and other gear like synthesizers and sequencers. This data includes when a key is played, what note it is, how hard it is struck and when it is released. The D-50 can both transmit and receive this information and can receive on two different MIDI channels. This makes the unit ideal as either a master controller or slave synthesizer.



One of the more powerful MIDI features on the D-50 is the ability to treat the two Tones as two different synthesizers from an external MIDI controller such as sequencer. This hinges on two things—the Key Mode must be SEPARATE or SEP-S and the given Patch must be programmed in such a way that the Separate Channel is set differently than the overall Basic Channel. Please note that the Lower Tone receiving on the Basic Channel will accept all types of MIDI data such as pitch bend, control change, aftertouch, etc. while the Upper Tone receiving on the Separate Channel can only receive note-on/off data.

Pages 57 through 60 of the D-50 Advanced Owner's Manual contain diagrams showing the relationship of sound sources to the keyboard and MIDI. At first this may seem unnecessarily complex, but the D-50 offers a wide range of configuration possibilities which allow it to integrate easily into any application. Many of these diagrams only apply to situations where the D-50 is being controlled from a MIDI guitar, which we'll address momentarily. Taking a few minutes to verify your understanding of these various options will ensure that you get the most from the D-50, especially in conjunction with other MIDI equipment.

It is important to understand the relationship of the internal Key Mode with the MIDI Mode of the master controller. Setting Key Mode does not automatically set a MIDI Mode. The MIDI spec provides for Poly and Mono Modes and the D-50 can respond to either. In a straight Poly Mode, an instrument's voices respond polyphonically to commands coming in on a single MIDI channel (assuming Omni is off). MIDI



•The D-50 responds to Mono Mode in the same way as the S-220.



•The GM-70 Guitar-To-MIDI Converter

Mono Mode is used so that different voices are controlled by separate MIDI channels. The D-50 cannot be put into Mono Mode from the front panel. Instead, it must be sent an appropriate Mode Message from the external controller. This configuration is only really practical for use with a MIDI guitar setup such as the GM-70. The major benefit is that each string can control an individual voice including separate pitch bend for each.

Like the S-220, MKS-50 and MKS-70, the D-50 can receive note on/off and pitch bend information on a separate channel for each voice (Basic Channel, Basic Channel +1, Basic Channel +2, etc.). Note that this effect does not "wrap around" to Channel 1 when higher channels are used, so only Basic Channels of 11 or lower are appropriate when using a 6-string guitar controller in Mono Mode. Other data such as controller and patch change information is received by either the Basic Channel or the Global Channel, as determined by the Control parameter in the MIDI-1 display. This way commands such as program changes can have an appropriate global effect on the entire instrument. If the Control function is set to ModeOff, the D-50 cannot receive Mode Messages.

Using The D-50 In A MIDI System

Let's take a closer look at setting up the D-50 for proper integration with other MIDI devices. The ability to set the Transmit Channel within each Patch separately from the Basic Channel on which the instrument receives is a powerful feature. Figure 1 describes a system where the D-50 is used as a master controller for recording tracks into the MC-500 sequencer. These tracks are then played back to the D-50 and three other MIDI devices. Setting Local Off on the D-50 disables the D-50's ability to control the internal voices directly. Instead, the soft Thru on the MC-500 enables the incoming signals from the D-50 to merge with existing sequencer tracks.

In Figure 2, the MIDI channel assignments are arranged in such a way that each instrument receives different tracks. If we change the D-50 to a Patch with the settings shown in Figure 3, the D-50 will not play its own sounds, but will control Synthesizer A. The D-50 can still respond to any data playing back from the MC-500 simultaneously. These kinds of considerations become important if you wish to merge live performance with sequenced tracks.

Next, let's turn to proper setting of the receive channels when SEPARATE mode is used. If the Patch Factor MIDI controls are set as shown in Figure 4, the D-50's two Tones can act as separate synthesizers responding to two distinct MIDI channels, thus bringing an additional set of voices to MIDI set-ups with a limited number of sound sources. In this case the Lower Tone will respond to the Basic Channel (Channel 1), while the Upper Tone will receive information on the Separate Channel (Channel 5). Remember from our earlier discussion that the Separate Channel will only receive note on-off data.

It is also possible to use a D-50 Tone to reinforce an external sound source with a layering effect. Setting a D-50 Patch Factor to the settings in Figure 5 sets the Lower Tone for Channel 1 and the Upper Tone for Channel 2. In this way the Upper Tone and Synthesizer A respond to Channel 2. This relationship may be seen more clearly in Figure 6. By changing the Separate Channel appropriately, the Upper Tone can form a layer with any of the external devices.

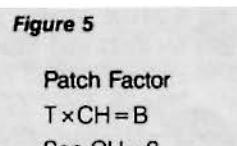
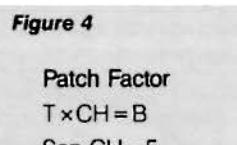
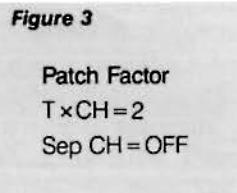
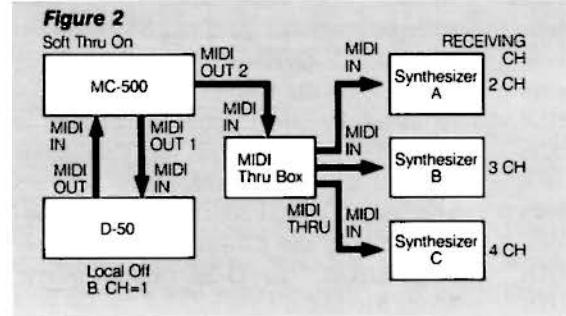
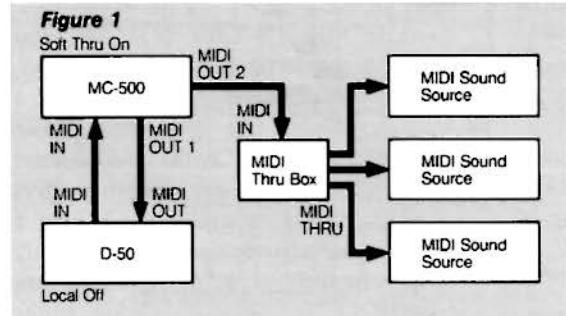
These various techniques are valuable when using sequencers for many different lines or when the sound of a single synthesizer is not strong enough to carry a part alone. Setting the appropriate

Basic Channel, Separate Channel, Global Channel and Local On/Off may require a bit of planning in each musical situation, but the time invested will bring out the true power of any MIDI system using the D-50.

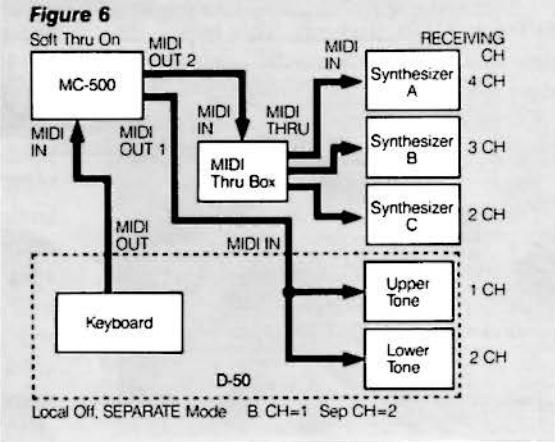
Pedal Switch And External Controls

The Pedal Switch and External Control settings are set in two different places on the D-50. One is for the internal effect on the D-50 and the other determines the effect these pedals have on external MIDI devices. It is important to understand these differences or very strange things can happen when using a MIDI system and the D-50's pedals.

The TUNE/FUNCTION Control display allows these two pedals to take on a predetermined internal function. For example, the Pedal Switch could be set to change Patches, while the External Control adds modulation. Depressing these pedals will only perform these functions for the D-50.



• The MC-500 brings sequencing power to any MIDI system.



On the other hand, these pedals do indeed send messages out to other MIDI devices. The type of message is determined in the MIDI-4 display, however. Without carefully setting both sections for matching effects, the results of using one of these pedals can be unpredictable, if not disastrous! For example, if the TUNE/FUNCTION Pedal SW is set to P-SFT (Patch Shift) and the MIDI Pedal SW is set to 64 (Sustain) as in Figure 7, two different things will happen when the Pedal Switch is depressed. The D-50 will change Patches while external MIDI devices will sustain!

Looking at a slightly different scenario, if the TUNE/FUNCTION Pedal SW is set to Portamento, pressing the Pedal Switch will only turn portamento on inside the D-50. This can be remedied by setting the MIDI-4 Pedal SW parameter to 65, which is Portamento On/Off in the MIDI specification. Now both devices will respond to portamento at the same time, although their rates are set independently on each instrument. Note that the PORTAMENTO switch in the left-hand section does send Portamento On/Off to external MIDI gear.

We can draw several conclusions from all of this. If you only want a given pedal to affect the external devices, set the appropriate parameter in TUNE/FUNCTION to Off. If only the D-50 is affected, set the proper MIDI-4 parameter to a MIDI Controller number that is not implemented on the external device(s). This last technique is required since there is no Off position for these parameters. If you want both instruments to react in the same way when a pedal is activated, refer to the MIDI implementation chart of the instruments in question to determine which MIDI Controllers are valid.

Figure 7

Function
Pedal SW=P-SFT
MIDI
Pedal SW=64

MIDI Systems Combining The PG-1000 And MC-500

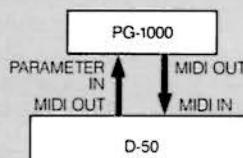
Since the PG-1000 is such a powerful programming tool, let's take a moment to discuss the considerations of using it when other external MIDI devices are connected to the D-50. It is important to understand the roles of the MIDI IN, MIDI OUT, MIDI THRU and PARAMETER IN jacks on the PG-1000 to attain the full benefits of such a system.

When using only the D-50 and PG-1000, patching as shown in Figure 8 is sufficient. The PARAMETER IN jack on the PG-1000 is designed to receive system exclusive data from the D-50 when a PARAMETER REQUEST is issued and should be connected to the D-50's MIDI OUT. Conversely, the PG-1000 MIDI OUT jack sends data from the programmer to the D-50's MIDI IN jack. This is necessary since the PG-1000's MIDI IN jack does not accept system exclusive data.

Adding a moderate amount of MIDI gear would normally require changing some MIDI cables when the PG-1000 is necessary. Setting up an advanced MIDI system, it becomes necessary to reconfigure the system in order to program from the PG-1000. For these reasons, let's look at some alternatives when additional MIDI gear is being used.

Figure 9 shows the configuration of a simple MIDI performance system. Connection of the PG-1000 is fairly straightforward and shouldn't cause many problems. The main consideration is to make certain that the D-50's MIDI OUT ultimately gets sent to the PG-1000's PARAMETER IN, even if it goes through a MIDI Thru Box along the way.

Figure 8



•Rear panel of the PG-1000 including PARAMETER IN.



•Transmitting the Patch data from the D-50 to the PG-1000 using PARAMETER REQUEST.

The situation gets a bit more complex when integrating a sequencer like the MC-500 into the same system. Systems where the sequencer is used as the core element can vary depending upon the D-50's role. If the D-50 is to be used only as a slave, the connections shown in Figure 10 will work. The PG-1000 mixes the data coming from the sequencer and/or master controller with its own system exclusive data and sends it all out the MIDI OUT to the D-50's MIDI IN jack. This way D-50 sounds can be edited or created from the PG-1000 while the instrument is being played from an external source.

Figure 9

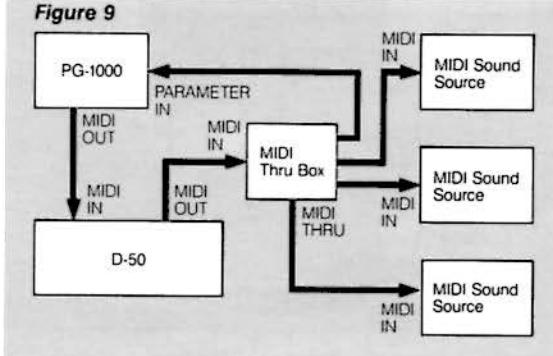
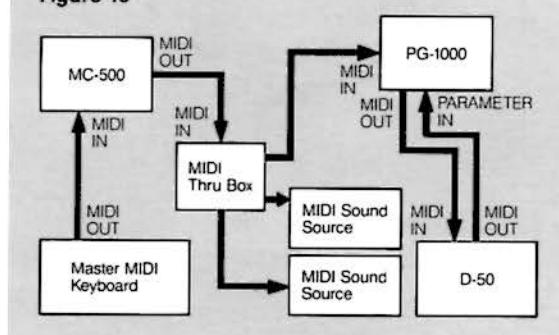


Figure 10



It is also possible to save D-50 Patches to disk using the MC-500. The diagram in Figure 11 show the proper connections for this technique. Note that the Soft Thru should be engaged on the MC-500 or the signal from the PG-1000 will not get to the D-50. While this function is usually engaged when using a master keyboard, it never hurts to make certain.

Next, we turn to the possibility of using the D-50 as a master keyboard for the system. Here the D-50's MIDI output must reach the MC-500 and the MC-500 must be able to communicate back to the D-50. If the PARAMETER REQUEST on the PG-1000 is to be functional, we must also ensure that the MIDI output of the D-50 is available at the PG-1000's PARAMETER IN jack. Figure 10 illustrates the solution to this potentially puzzling scenario. This allows recording performances and data from the D-50 to the MC-500, playback of tracks or data from the MC-500 to the D-50, as well as PG-1000 programming of the D-50 all at one time.

Earlier we alluded to storing D-50 Patch data on the MC-500's floppy disks. This is extremely useful since the cost of floppy disks is significantly less than that of memory cards. Conversely, memory cards have much faster access times, an important consideration in live performance. The solution is to use MC-500 disks to store a large library of D-50 Patches and load the appropriate combination into memory cards for performances.

The actual process of dumping system exclusive data (Patch information) is extremely simple. First, press the D-50's DATA TRANSFER switch. Next, put the MC-500 in record mode. Finally, hold down the DATA TRANSFER SWITCH on the D-50 and press B. Dump simultaneously. The 64 internal programs will be sent to the MC-500 where it can be stored to disk. The step of holding down DATA TRANSFER is crucial when using the MC-500. This tells the D-50 to make the transfer without "handshaking". If you just press B. Dump, handshaking is required and the process will not work

properly with the MC-500. (Handshaking means that the transmitting device sends some data and expects the receiving unit to acknowledge it with a handshake or "O.K." message before continuing. This technique is more efficient, however, it only works with specific external gear such as another D-50.)

Recalling the Patch data from the MC-500 is done in a similar way. The Memory Protect must be turned off in the D-50's TUNE/FUNCTION display in order for it to accept data. Make sure that you have saved any important Patches in memory before actually doing the transfer as all internal memory will be erased. The D-50 must be set to receive on the same MIDI channel that the data was originally sent on. Press DATA TRANSFER, then hold DATA TRANSFER and press B. Load. After loading the sounds from disk, press play on the MC-500 and the new set of Patches should be sent to the D-50's internal memory.

Figure 11

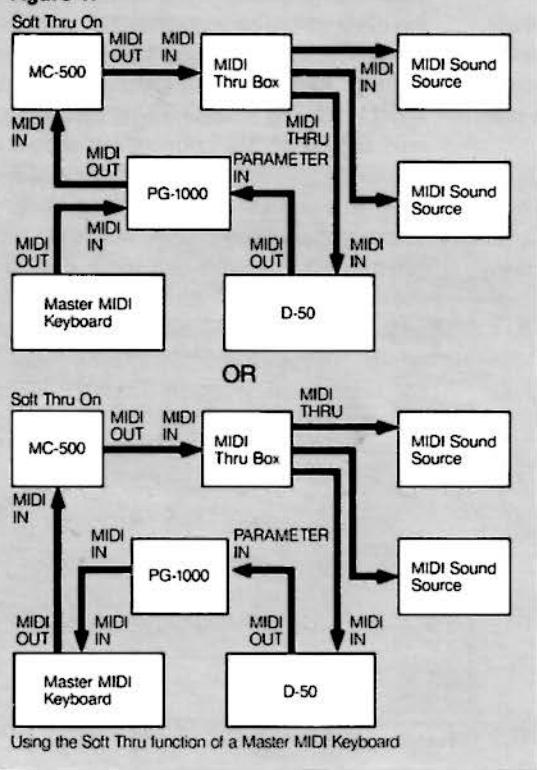
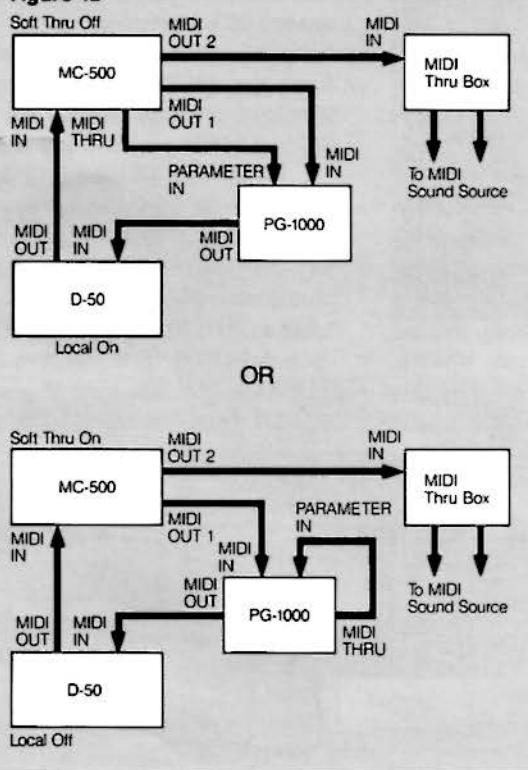


Figure 12



Blank Chart

In conclusion, it is obvious that the D-50 has a great number of parameters that work together to make up each Patch. With fewer variables it might be easy to keep track of them all in your head, however the D-50 requires keeping track of not only the parameters, but the way in which they interact. The most effective way to keep track of these controls is to write the settings down and we've even included

a blank Patch Chart just for that purpose. Feel free to make as many photocopies of this page as you wish for your own use.

Recording Patch data this way can not only be helpful in editing, but in understanding how existing Patches are constructed. All in all, Patch Charts present the easiest way to obtain an overview of all the D-50 components and how they work with one another.

We trust that you now have a firm grasp on working with the D-50. Don't worry if you still have a feeling that you don't know it all—nobody does. That's a tall order when there are literally an infinite number of sonic possibilities at your fingertips! Expertise grows with experience and we can only point you in the right direction—the rest is up to you! Good luck and enjoy!

PATCH FACTOR

Patch Name			Key Mode			Chase			MIDI										
			Key Mode	Splt.P	Bal.	Chase M.	Chase L.	Chase T.	Tx CH	Sep CH									
TUNE			CONTROL						OUTPUT										
L-Key	U-Key	L-Fine	U-Fine	Bend.R	After	Port.T	Port.M	Hold.M	Out.M	Rev.Ty	Rev.Ba	T.Vol							
TONE PARAMETER (UPPER)																			
Tone Name			Part Bal.	Structure	PITCH ENV														
					Velo	KF	T1	T2	T3	T4	L0	L1	L2	SusL	EndL				
PITCH MODULATION			CHORUS			E Q			Wave			Rate	Dely	Sync					
LFO	Levr	Aftr	Tp	Rate	Dpth	Bal	Lf	Lg	Hf	HQ	Hg	LFO1							
												LFO2							
												LFO3							
WG PITCH			WG MODULATION			WG WAVEFORM			WG PULSE WIDTH										
Coarse	Fine	KF	LFO M.	PENV.M	Bender M.	Waveform	PCM No	PW	Velo	Aftr	LFO.S	LFO.D							
P-1																			
P-2																			
TVF					TVF ENV			TVA			TVA ENV								
Freq	Reso	KF	Bias	B.Lv	Dpth	Velo	KF (D)	KF (T)	Levl	Velo	Bias	B.Lv	Velo.T	KF (T)					
P-1																			
P-2																			
TVF ENV TIME					TVF ENV LEVEL			TVF MODULATION											
T1	T2	T3	T4	T5	L1	L2	L3	SusL	EndL	LFO Select	LFO Depth	Aftr Touch							
P-1																			
P-2																			
TVA ENV TIME					TVA ENV LEVEL			TVA MODULATION											
T1	T2	T3	T4	T5	L1	L2	L3	SusL	EndL	LFO Select	LFO Depth	Aftr Touch							
P-1																			
P-2																			
ONE PARAMETER (LOWER)			Tone Name			Part Bal.	Structure	PITCH ENV											
								Velo	KF	T1	T2	T3	T4	L0	L1	L2	SusL	EndL	
PITCH MODULATION			CHORUS			E Q			Wave			Rate	Dely	Sync					
LFO	Levr	Aftr	Tp	Rate	Dpth	Bal	Lf	Lg	Hf	HQ	Hg	LFO1							
												LFO2							
												LFO3							
WG PITCH			WG MODULATION			WG WAVEFORM			WG PULSE WIDTH										
Coarse	Fine	KF	LFO M.	PENV.M	Bender M.	Waveform	PCM No	PW	Velo	Aftr	LFO.S	LFO.D							
P-1																			
P-2																			
TVF					TVF ENV			TVA			TVA ENV								
Freq	Reso	KF	Bias	B.Lv	Dpth	Velo	KF (D)	KF (T)	Levl	Velo	Bias	B.Lv	Velo.T	KF (T)					
P-1																			
P-2																			
TVF ENV TIME					TVF ENV LEVEL			TVF MODULATION											
T1	T2	T3	T4	T5	L1	L2	L3	SusL	EndL	LFO Select	LFO Depth	Aftr Touch							
P-1																			
P-2																			
TVA ENV TIME					TVA ENV LEVEL			TVA MODULATION											
T1	T2	T3	T4	T5	L1	L2	L3	SusL	EndL	LFO Select	LFO Depth	Aftr Touch							
P-1																			
P-2																			
TONE NAME			Part Bal.			PITCH ENV													
						Velo	KF	T1	T2	T3	T4	L0	L1	L2	SusL	EndL			
PITCH MODULATION			CHORUS			E Q			Wave			Rate	Dely	Sync					
LFO	Levr	Aftr	Tp	Rate	Dpth	Bal	Lf	Lg	Hf	HQ	Hg	LFO1							
												LFO2							
												LFO3							
WG PITCH			WG MODULATION			WG WAVEFORM			WG PULSE WIDTH										
Coarse	Fine	KF	LFO M.	PENV.M	Bender M.	Waveform	PCM No	PW	Velo	Aftr	LFO.S	LFO.D							
P-1																			
P-2																			
TVF					TVF ENV			TVA			TVA ENV								
Freq	Reso	KF	Bias	B.Lv	Dpth	Velo	KF (D)	KF (T)	Levl	Velo	Bias	B.Lv	Velo.T	KF (T)					
P-1																			
P-2																			
TVF ENV TIME					TVF ENV LEVEL			TVF MODULATION											
T1	T2	T3	T4	T5	L1	L2	L3	SusL	EndL	LFO Select	LFO Depth	Aftr Touch							
P-1																			
P-2																			
TVA ENV TIME					TVA ENV LEVEL			TVA MODULATION											
T1	T2	T3	T4	T5	L1	L2	L3	SusL	EndL	LFO Select	LFO Depth	Aftr Touch							
P-1																			
P-2																			

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