



THE OFFICIAL PUBLICATION OF THE YAMAHA USERS GROUP

TX802 FM Digital Tone Generator



JUNE 1987

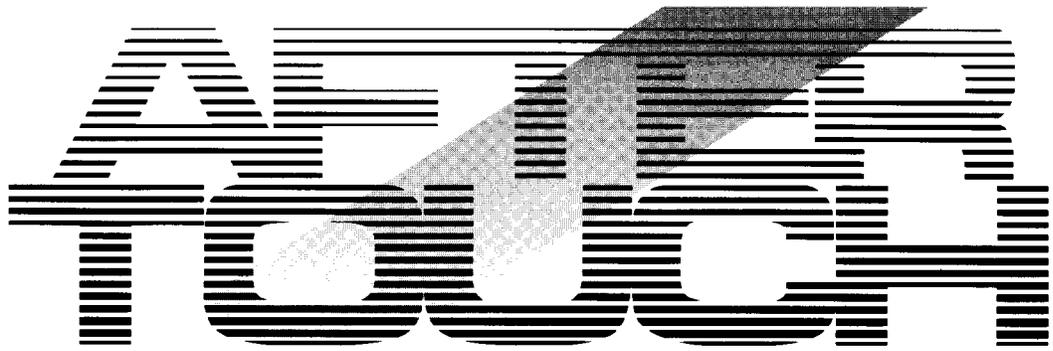
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From The Editor

ONCE AGAIN, I want to use this column to pass along some standard information that continues to be important for AfterTouch readers. Before we get to that, however, let's start with a quick look at what you can expect to find in this issue and the next issue:

This Month: This issue features the return of the Evatone Sound Sheet. Our first set of Evatone Disks appeared in the May, June, and July 1986 issues of AfterTouch. This month, our Sound Sheet will introduce you to Yamaha's exciting new WX7 MIDI Wind Controller, featuring compositions and performances by Sal Gallina, a top New York studio musician. The Sound Sheet is bound between pages 6 and 7 of the issue—give it a listen!

In addition, there is an introduction to Yamaha's new 6-operator FM digital tone generator, the TX802. You will also find a set of edited RX5 voices, new reader DX7 patches, and an article that discusses the basics of the Micro Tuning capabilities found in the new generation of DX7 instruments (DX7 II FD, DX7 II D, DX7s, and TX802).

Next Month: In July, we are going to devote almost the entire issue to material from readers! Most importantly, two popular columns will return (after an extended, six-month holiday): the Questions column, in which we answer queries from readers, and the Final Touch column, in which we feature hot tips from readers. There will also be an article that describes some interesting musical uses of the MEP4 MIDI Event Processor, plus reader patches, and more. See you then.

Back Issues: If a request for back issues is combined with a subscription request or other material, chances are it will not be fulfilled. All requests for AfterTouch subscriptions must go to our Mailing List input service. After the addresses are entered, the letters are normally kept on file, in keeping with various postal regulations. To be absolutely sure that you receive any available back issues that you want, make back issue requests separately, and include the indication "ATTN: Back Issues" on the envelope. Please do not send back issue requests on the attached subscription postcard.

Warranty Cards & AfterTouch: We have received a number of letters from Yamaha users complaining that they expected an AfterTouch subscription because they recently purchased a Yamaha product and sent in a warranty card, but still haven't received an issue. It is true that our initial (1985) mailing was developed from a warranty card list, but no subscriptions were sent to those names—just a sample mailing of the first three issues. In order to receive a free subscription, you need to send us your request on the attached postcard below.

Product Literature: All requests for specific product literature must go directly to Yamaha (Yamaha Music Corporation USA, P.O. Box 6600, Buena Park, CA 90622). We at AfterTouch are happy to receive specific questions concerning the use of Yamaha professional music products, and we will answer as many of them as we can in the Questions column; however, requests for general product information must be sent directly to Yamaha.

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After you have filled in the relevant information, put a stamp on the postcard and mail it to us. When we receive the card, we'll put you on our permanent mailing list, and you will receive twelve issues of AfterTouch absolutely free! There is absolutely no obligation, and no other strings are attached.

(By the way, if you received *this* issue in the mail, you are already on our permanent mailing list, so you don't need to send in another card.)

Also, don't limit yourself to just sending in your address: Let us know what you want to read, and what *you* have to offer (see page 19 for details). We look forward to your input.

To receive AFTERTOUCH every month, absolutely free, just put your name and address on the enclosed card and mail it to us.

Micro Tuning

Exploring The Micro Tuning Capabilities Of The DX7 II FD/D. By Howard Sandroff.



DX7 II FD digital FM synthesizer.

On The DX7 II FD/D

Each of these tables gives the Micro Tuning data found in the Edit mode LCD displays for the octave C3-C4, including the note name, coarse and fine tune values, and the number of tuning units (TU) used to represent each note. In

addition, the deviation of each note from equal temperament in cents is indicated in the column labelled "ΔET." The size of the interval between consecutive notes is also indicated in tuning units (TU) and cents.

Micro Tuning data for Preset #1: Equal Temperament.

Note Name	Coarse Tune	Fine Tune	Tuning Units	Δ ET Cents	Interval Size TU	Interval Size Cents
>>> C 3 <<<	C 3	+0	(5034)	+0.00		
>>> C#3 <<<	C# 3	+0	(5120)	+0.00	86	100.78
>>> D 3 <<<	D 3	+0	(5205)	+0.00	85	99.61
>>> D#3 <<<	D# 3	+0	(5290)	+0.00	85	99.61
>>> E 3 <<<	E 3	+0	(5376)	+0.00	86	100.78
>>> F 3 <<<	F 3	+0	(5461)	+0.00	85	99.61
>>> F#3 <<<	F# 3	+0	(5546)	+0.00	85	99.61
>>> G 3 <<<	G 3	+0	(5632)	+0.00	86	100.78
>>> G#3 <<<	G# 3	+0	(5717)	+0.00	85	99.61
>>> A 3 <<<	A 3	+0	(5802)	+0.00	85	99.61
>>> A#3 <<<	A# 3	+0	(5888)	+0.00	86	100.78
>>> B 3 <<<	B 3	+0	(5973)	+0.00	85	99.61
>>> C 4 <<<	C 4	+0	(6058)	+0.00	85	99.61

THE CURRENT GENERATION of Yamaha 6-operator synthesizers and tone generators (DX7 II FD, DX7 II D, DX7s, and TX802) gives electronic musicians a number of expanded possibilities for the creation of new timbres. However, the Micro Tuning options open up other universes that offer even greater potential for the exploration of new harmonies and melodies.

The DX7 II Micro Tuning Presets

The DX7 II contains eleven preset Micro Tunings. These can be divided into two groups. There are nine diatonic tunings, as follows:

- 1) Equal Temperament
- 2) Pure (Major)
- 3) Pure (Minor)
- 4) Mean Tone
- 5) Pythagorean
- 6) Werckmeister
- 7) Kirnberger
- 8) Vallotti & Young
- 9) 1/4 Shifted Equal

Of these nine diatonic tunings, five (presets #1, #6, #7, #8, and #9) are "closed" tunings,

while the remaining four (presets #2, #3, #4, and #5) are "open" tunings. The basic difference is that an "open" tuning must be tuned relative to a specific key or tonal center, while a "closed" tuning remains the same for all keys or tonal centers.

The remaining two presets are true Micro Tunings:

- 10) 1/4 Tone
- 11) 1/8 Tone

Both are "micro" tunings because they include pitches that are not part of a diatonic scale. Both of these Micro Tunings (presets #10 and #11) are "closed" and equally tempered. The 1/4 Tone preset divides the octave into 24 equal parts, while the 1/8 Tone preset divides the octave into 48 equal parts.

Of course, the DX7 II also provides memory for two user programmable Micro Tunings. This is where the DX7 II offers the greatest potential for exploration. However, before one can attempt to create an interesting experimental tuning, it is necessary to understand the basic parameters of the Micro Tuning system used in the DX7 II.

Background Information

Twelve-tone equal-tempered tuning is perhaps the most widespread method of deriving specific pitch material in Western music. Equal temperament is often credited to composer/theorist Andreas Werckmeister [1645-1706], although its roots can be traced back at least two hundred years earlier. Its acceptance in general musical practice was not widespread until the middle of the 19th century.

The basic principle of equal temperament is to divide the octave into twelve equal steps. This equal division facilitates the musical usefulness of all twelve pitches regardless of their specific relationship to any given tonic in any given key.

Since the frequency ratio of an octave is 2:1, the frequency ratio of a semitone (S)—one twelfth of an octave—can be determined by the following equation:

$$S^{12} = 2; \text{ therefore, } S = \sqrt[12]{2} = 1.05946$$

Since tuning schemes are based upon the ratio of intervals (the octave is 2:1, a perfect fifth is 3:2, and so on), it is necessary to find numeri-

Continued on page 16

Note Name	Coarse Tune	Fine Tune	Tuning Units	Δ ET Cents	Interval Size TU	Interval Size Cents
>>> C 3 <<<	C 3	+14	(5048)	+16.41	60	70.31
>>> C#3 <<<	C# 3	-12	(5108)	-14.06	114	133.59
>>> D 3 <<<	D 3	+17	(5222)	+19.92	95	111.33
>>> D#3 <<<	D# 3	+27	(5317)	+31.64	60	70.31
>>> E 3 <<<	E 3	+1	(5377)	+1.17	96	112.50
>>> F 3 <<<	F 3	+12	(5473)	+14.06	60	70.31
>>> F#3 <<<	F# 3	-13	(5533)	-15.23	114	133.59
>>> G 3 <<<	G 3	+15	(5647)	+17.58	60	70.31
>>> G#3 <<<	G# 3	-10	(5707)	-11.72	95	111.33
>>> A 3 <<<	A 3	+0	(5802)	+0.00	114	133.59
>>> A#3 <<<	A# 3	+28	(5916)	+32.81	60	70.31
>>> B 3 <<<	B 3	+3	(5976)	+3.52	96	112.50
>>> C 4 <<<	C 4	+14	(6072)	+16.41		

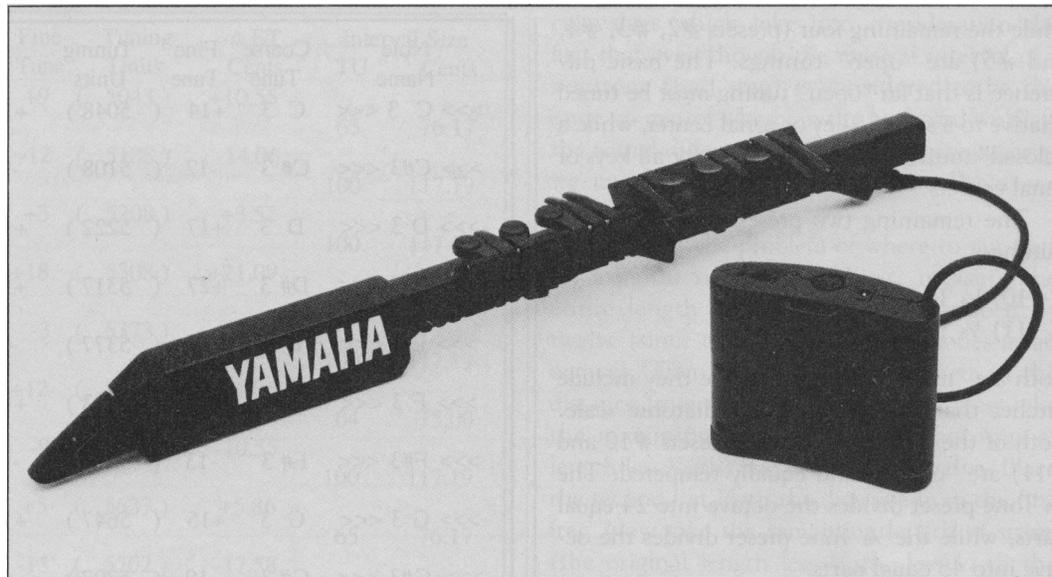
Micro Tuning data for Preset #2: Pure (Major)—key of C major.

Micro Tuning data for Preset #3: Pure (Minor)—key of A minor.

Note Name	Coarse Tune	Fine Tune	Tuning Units	Δ ET Cents	Interval Size TU	Interval Size Cents
>>> C 3 <<<	C 3	+14	(5048)	+16.41	60	70.31
>>> C#3 <<<	C# 3	-12	(5108)	-14.06	95	111.33
>>> D 3 <<<	D 3	-2	(5203)	-2.34	114	133.59
>>> D#3 <<<	D# 3	+27	(5317)	+31.64	60	70.31
>>> E 3 <<<	E 3	+1	(5377)	+1.17	96	112.50
>>> F 3 <<<	F 3	+12	(5473)	+14.06	60	70.31
>>> F#3 <<<	F# 3	-13	(5533)	-15.23	114	133.59
>>> G 3 <<<	G 3	+15	(5647)	+17.58	60	70.31
>>> G#3 <<<	G# 3	-10	(5707)	-11.72	95	111.33
>>> A 3 <<<	A 3	+0	(5802)	+0.00	114	133.59
>>> A#3 <<<	A# 3	+28	(5916)	+32.81	60	70.31
>>> B 3 <<<	B 3	+3	(5976)	+3.52	96	112.50
>>> C 4 <<<	C 4	+14	(6072)	+16.41		

WX7 Sound Sheet

An Introduction To The Attached Evatone Sound Sheet, Featuring Yamaha's New MIDI Wind Controller. By Tom Darter.



WX7 MIDI wind controller.

THIS ISSUE FEATURES the return of the Evatone Sound Sheet. Our first set of Evatone Disks appeared in the May, June, and July 1986 issues of *AfterTouch*. This month, the Sound Sheet is a musical introduction to Yamaha's exciting new WX7 MIDI Wind Controller, featuring compositions and performances by Sal Gallina. Sal is a top New York studio musician who has worked with a number of artists on such labels as RCA, CBS, Polygram, Arista, and Capitol.

Side 1 of the Sound Sheet displays the expressive power of the WX7 in a series of solo voice performances. Except where noted, the tone generator used was a TX81Z.

- 1) E. Guitar
- 2) Power 01
- 3) Violin
- 4) Flute 01
- 5) A. Guitar
- 6) Clarinet
- 7) A. Bass 01 (DX7 II)
- 8) E. Bass 01 (DX7 II)
- 9) Sax 01
- 10) Strings

Side 2 of the Sound Sheet features two Sal Gallina compositions, "Rock 1" and "Orchestral 1."

"Rock 1" was created in the studio with tape overdubs. On the first pass, the drum part (generated by an RX5) was recorded, along with the "rhythm guitar" part. Actually, the rhythm guitar part is the WX7 controlling a TX81Z with the "Power 01" patch. On the second pass, Sal added the "bass," which was again the WX7,

this time controlling a DX7 II with the "E. Bass 02" patch. On the third and final pass, Sal recorded the "lead guitar"—WX7 controlling a TX81Z with the "E. Guitar" patch.

"Orchestral 1" was created in real time, with no overdubs. Sal used various Strings voicings on the TX81Z, with pitch shifts and other effects used to create complex voicings. In addition, he made use of the WX7's "sustain" feature: To begin with, 4 string voices were assigned to MIDI channel 1, and the other 4 were assigned to MIDI channel 2. Sal began by playing on channel 2, and then engaged the "sustain." While the notes on MIDI channel 2 were sustaining, he switched to MIDI channel 1 and played the other 4 string voices in real time.

Both an SPX90 and a REV7 were used throughout the recording—the REV7 for reverb, and the SPX90 for delay, flanging, pitch shift, and other signal processing effects.

For those who are interested in more information on the WX7, Sal Gallina has written a book: **Expressive FM Applications**. The book is being published by the Yamaha Music Foundation, and will be included with your WX7. It will also be available in the fall at your local book store or Yamaha music dealer. The 86-page book will come complete with a demonstration cassette (which will be new material, not a duplicate of the Sound Sheet in this issue), as well as complete voice data and special effects setups for all the material on the cassette. In all, there will be data for 32 TX81Z voices and 32 DX7 II voices.

DX7

RICKN-GRETCH.
A New DX7
Voice By
Chris Corso.

SINE	34	0	0	0	OFF	3
WAVE	SPEED	DELAY	FMD	AMD	SYNC	PMS

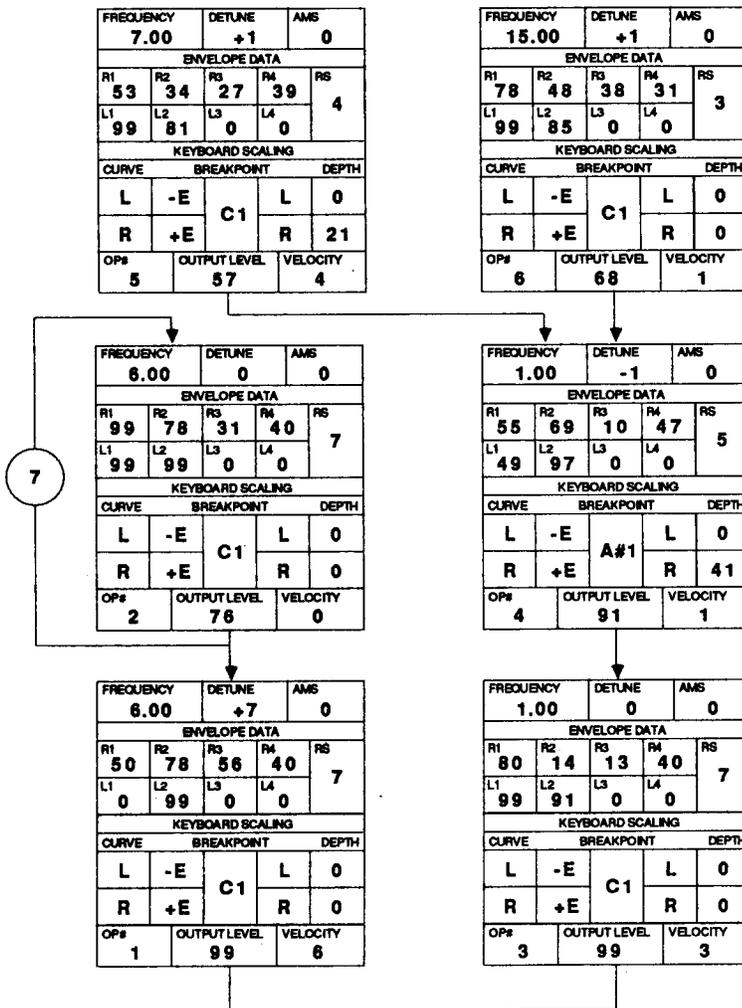
R1	R2	R3	R4	C2
99	99	99	99	
L1	L2	L3	L4	KEY TRANSPOSE
50	50	50	50	ON

PITCH ENVELOPE

OSC. SYNC

FUNCTIONS					
POLY	2	0	OFF	OFF	0
POLYMONO	RANGE	STEP	MODE	GLISSANDO	TIME
	PITCH BEND		PORTAMENTO		

(CONTROLLER)	RANGE	PITCH	AMPLITUDE	EQ BIAS
MOD WHEEL	0	OFF	OFF	OFF
FOOT CONTROL	0	OFF	OFF	OFF
BREATH CONTROL	0	OFF	OFF	OFF
AFTERTOUCH	0	OFF	OFF	OFF



ALGORITHM #15

Notes:

This is a "Pink Floyd" type of guitar sound.

DX7

STEP ORGAN. A New DX7 Voice By Bruno Choiniere.

ALGORITHM #32

FREQUENCY	1.00	DETUNE	0	AMS	0
ENVELOPE DATA					
R1	99	R2	99	R3	99
L1	99	L2	99	L3	99
L4	0				
KEYBOARD SCALING					
CURVE	L	BREAKPOINT	A-1	DEPTH	0
OP#	R	OUTPUT LEVEL	R	VELOCITY	0

FREQUENCY	2.00	DETUNE	0	AMS	0
ENVELOPE DATA					
R1	29	R2	99	R3	99
L1	47	L2	99	L3	99
L4	0				
KEYBOARD SCALING					
CURVE	L	BREAKPOINT	A-1	DEPTH	0
OP#	R	OUTPUT LEVEL	R	VELOCITY	0

FREQUENCY	3.00	DETUNE	0	AMS	0
ENVELOPE DATA					
R1	23	R2	99	R3	99
L1	47	L2	99	L3	99
L4	0				
KEYBOARD SCALING					
CURVE	L	BREAKPOINT	A-1	DEPTH	0
OP#	R	OUTPUT LEVEL	R	VELOCITY	0

FREQUENCY	4.00	DETUNE	0	AMS	0
ENVELOPE DATA					
R1	19	R2	99	R3	99
L1	47	L2	99	L3	99
L4	0				
KEYBOARD SCALING					
CURVE	L	BREAKPOINT	A-1	DEPTH	0
OP#	R	OUTPUT LEVEL	R	VELOCITY	0

FREQUENCY	6.00	DETUNE	0	AMS	0
ENVELOPE DATA					
R1	16	R2	99	R3	99
L1	47	L2	99	L3	99
L4	0				
KEYBOARD SCALING					
CURVE	L	BREAKPOINT	A-1	DEPTH	0
OP#	R	OUTPUT LEVEL	R	VELOCITY	0

FREQUENCY	8.00	DETUNE	0	AMS	0
ENVELOPE DATA					
R1	15	R2	99	R3	99
L1	47	L2	99	L3	99
L4	0				
KEYBOARD SCALING					
CURVE	L	BREAKPOINT	A-1	DEPTH	0
OP#	R	OUTPUT LEVEL	R	VELOCITY	0

TRI	35	0	0	0	ON	3
WAVE	SPEED	DELAY	PAD	AMD	SYNC	RMS
R1	99	R2	99	R3	99	C3
L1	50	L2	50	L3	50	KEY TRANSPOSE
L4	50					ON
PITCH ENVELOPE						
OSC. SYNC						

FUNCTIONS						
POLY	1	0	OFF	OFF	OFF	0
POLYMONO	RANGE	STEP	MODE	GLISSANDO	PORTAMENTO	TIME
(CONTROLLER)	RANGE	PITCH	AMPLITUDE	EG BIAS		
MOD WHEEL	99	ON	OFF	OFF	OFF	OFF
FOOT CONTROL	0	OFF	OFF	OFF	OFF	OFF
BREATH CONTROL	0	OFF	OFF	OFF	OFF	OFF
AFTERTOUCH	0	OFF	OFF	OFF	OFF	OFF



DX7

SOFT STEEL.
A New DX7
Voice By
Bryan Pape.

SINE	15	0	0	0	ON	0
WAVE	SPEED	DELAY	FMD	AMD	SYNC	PMB
R1	R2	R3	R4	C2		
99	99	99	99	KEY TRANSPOSE		
L1	L2	L3	L4	OFF		
50	50	50	50	OSC. SYNC		
PITCH ENVELOPE						

FUNCTIONS					
POLY	12	0	OFF	OFF	0
POLY/MONO	RANGE	STEP	MODE	GLISSANDO	TIME
	PITCH BEND		PORTAMENTO		
(CONTROLLER)	RANGE	PITCH	AMPLITUDE	EG BIAS	
MOD WHEEL	99	OFF	ON	OFF	
FOOT CONTROL	0	OFF	OFF	OFF	
BREATH CONTROL	0	OFF	OFF	OFF	
AFTERTOUCH	0	OFF	OFF	OFF	

FREQUENCY	DETUNE	AMS		
0.50	0	1		
ENVELOPE DATA				
R1	R2	R3	R4	RS
95	28	27	43	0
L1	L2	L3	L4	
99	99	99	0	
KEYBOARD SCALING				
CURVE	BREAKPOINT	DEPTH		
L	-L	L	0	
R	-L	A-1	R	0
OP#	OUTPUT LEVEL	VELOCITY		
3	92	3		

FREQUENCY	DETUNE	AMS		
1.00	0	1		
ENVELOPE DATA				
R1	R2	R3	R4	RS
95	28	27	43	0
L1	L2	L3	L4	
99	99	50	0	
KEYBOARD SCALING				
CURVE	BREAKPOINT	DEPTH		
L	-L	L	0	
R	-L	A-1	R	0
OP#	OUTPUT LEVEL	VELOCITY		
6	99	0		

FREQUENCY	DETUNE	AMS		
0.50	0	1		
ENVELOPE DATA				
R1	R2	R3	R4	RS
88	92	71	43	0
L1	L2	L3	L4	
99	99	90	90	
KEYBOARD SCALING				
CURVE	BREAKPOINT	DEPTH		
L	-L	L	0	
R	-L	A-1	R	0
OP#	OUTPUT LEVEL	VELOCITY		
2	90	1		

FREQUENCY	DETUNE	AMS		
1.00	0	1		
ENVELOPE DATA				
R1	R2	R3	R4	RS
83	0	27	43	0
L1	L2	L3	L4	
99	99	0	0	
KEYBOARD SCALING				
CURVE	BREAKPOINT	DEPTH		
L	-L	L	0	
R	-L	A-1	R	0
OP#	OUTPUT LEVEL	VELOCITY		
5	88	3		

FREQUENCY	DETUNE	AMS		
0.50	0	1		
ENVELOPE DATA				
R1	R2	R3	R4	RS
99	0	0	43	0
L1	L2	L3	L4	
99	99	0	0	
KEYBOARD SCALING				
CURVE	BREAKPOINT	DEPTH		
L	-L	L	0	
R	-L	A-1	R	0
OP#	OUTPUT LEVEL	VELOCITY		
1	99	4		

FREQUENCY	DETUNE	AMS		
1.00	0	1		
ENVELOPE DATA				
R1	R2	R3	R4	RS
88	28	27	43	0
L1	L2	L3	L4	
99	99	99	0	
KEYBOARD SCALING				
CURVE	BREAKPOINT	DEPTH		
L	-L	L	0	
R	-L	A-1	R	0
OP#	OUTPUT LEVEL	VELOCITY		
4	99	4		

ALGORITHM #4

These DX7 voices can also be loaded into all the other Yamaha 6-operator FM digital synthesizers and tone generators, including the DX5, TX7, TX216, TX816, TF1, DX1 DX7s, TX802, and DX7 II FD/D.

TX802

YAMAHA HAS TAKEN the expanded technology of its growing family of second-generation DX7 digital FM synthesizers and packaged it in a new rack-mount FM digital tone generator—the TX802. Like the other members of this new generation, the DX7 II FD, DX7 II D, and DX7s, the TX802 uses the industry standard DX7 6-operator, 32-algorithm voice as its starting point; but, also like its older brothers, it offers a number of important new features.

Like all members of the new 6-operator generation, the TX802 has a faster DAC (Digital-to-Analog converter) and a more powerful CPU (Central Processing Unit). The higher resolution and faster computation provided by these new components gives the TX802 a cleaner, clearer, warmer sound. Any patch created on a first generation 6-operator instrument will sound better when transferred to the TX802.

The TX802 also bears a kinship with Yamaha's other recent FM tone generators, the FB-01 and TX81Z, in that it is *multi-timbral*. The TX802 has the same 16-note capacity of the DX7 II, but these 16 notes are created by eight independent tone generators; therefore, the TX802 can play up to eight different timbres at the same time. In the TX802's extensive Performance mode, each timbre can be assigned its own MIDI channel, note range, and number of notes (in multiples of two).

Memory

The TX802 features a memory that is much expanded over that of the first generation of 6-operator synthesizers and tone generators. First of all, it comes with 128 factory preset voices, which are a permanent part of the instrument's Read-Only Memory (ROM). In addition, the Internal memory has capacity for 64 user-programmable voices. Beyond this, an additional 64 voices can be accessed from a RAM4 cartridge via the cartridge port on the instrument's front panel. As many as 256 voices can be available for use at any one time.

In addition to the 64 Voice memories, the TX802's Internal memory has capacity for 64 Performance memories, 2 user-defined Micro Tuning memories, and an extensive System Setup memory.

The TX802 features a 40×2 backlit LCD and an easy-to-use front panel. The eight Mode Select buttons call up a number of different operations. The Performance Select and Voice Select buttons allow you to call up a Performance or a Voice for playing or editing. The System Setup, Utility, Performance Edit, Voice Edit (I), and Voice Edit (II) buttons each call up a menu with eight items, which are selected using the eight Parameter Select buttons situated under the LCD. The function of the Store/Compare button depends on the situation. On the TX802, both the Performance Edit mode and the Voice Edit mode offer Edit/Compare (unlike the DX7 II, which only allows Edit/Compare in Voice Edit mode).

Performance Select Mode

As mentioned above, the TX802 contains eight independent tone generators, each of which produces two notes. Each tone generator has its own rear-panel audio output. Each tone generator can be set to a different voice and MIDI channel, and can be played as an independent instrument with 2-note polyphony. It is also possible to link several tone generators together to form an instrument with 4-note to 16-note polyphony.

A combination of settings for these eight tone generators is called a Performance. There are 64 Performance memories in the TX802, and an additional 64 Performance memories can be stored (for immediate access) on a RAM4 cartridge. These settings are created—or altered—in Performance Edit mode.

Performance Edit Mode

When you call up the Performance Edit menu, you have access to these eight items:

- 1) Receive Channel, Alternate Assign, Forced Damp
- 2) Volume
- 3) Output Assign
- 4) Low/High Note Limit
- 5) MIDI Note Shift
- 6) Micro Tune Scale Select and Key Select
- 7) Performance Detune
- 8) Performance Name

Each one of these parameters can be set independently for each one of the eight tone gen-

**A First Look At
Yamaha's New
6-Operator FM
Digital Tone
Generator. By
Tom Darter.**

This chart shows the parameters that can be programmed in the TX802's Performance Edit mode.

Tone Generators	1	2	3	4	5	6	7	8
Voice number	Banks I, C, A, B 1-64							
Channel	1-16, omni							
Forced Damp	on/off							
Volume	0-99							
Output Assign	off, I, II, I + II							
Low Limit	C-2 - G8							
High Limit	C-2 - G8							
Note Shift	-24 - +24							
Micro Tuning Scale	P1-11, I1-2, C1-63							
Micro Tuning Key	C-B							
Detune	-7 - +7							
Performance Name	20 characters							

erators in the TX802. (See the accompanying diagram.)

System Setup Mode

This is where you make various settings (MIDI and otherwise) for the TX802 itself. When you call up the System Setup menu, you have access to the following items:

- 1) MIDI Receive
- 2) MIDI Control Number Assign
- 3) Performance Select (MIDI Program Change)
- 4) MIDI System Exclusive
- 5) Cartridge Bank Select
- 6) Micro Tuning Edit
- 7) Master Tuning
- 8) Internal Memory Protect

"MIDI Receive" allows you to specify how five types of incoming MIDI data will be received.

"MIDI Control Number Assign" allows you to program the Control Number Table, and lets you re-assign incoming MIDI Controller messages. Any incoming control number (0-31 and 64-127) can be assigned to any of the following functions:

- off
- Modulation Wheel
- Breath Control
- Foot Control
- Portamento Time
- Volume
- Sustain Switch
- Portamento Switch

"Performance Select" is where you determine how Performance memories will be selected by incoming MIDI Program Change messages.

All of the settings created in System Setup Edit mode (with one exception) are saved as part of the System Setup memory. The exception is Micro Tuning—any user-created Micro Tuning must be stored in Micro Tuning memories 1 or 2 (or on a RAM cartridge formatted for Micro Tunings), because the Micro Tuning Edit Buffer is *not* part of the System Setup memory.

Utility Mode

The Utility mode contains a number of important MIDI, cartridge, and initializing functions. When you call up the Utility menu, you have access to the following items:

- 1) MIDI Transmit
- 2) Save to Cartridge
- 3) Load from Cartridge
- 4) Format Cartridge
- 5) Initialize Edit Buffer
- 6) Initialize Control Number Table
- 7) Recall Edit Buffer
- 8) Copy

If you call up MIDI Transmit (Utility menu item #1), you have the choice of any of the following data, for transmission over MIDI to either another TX802 or to a MIDI storage device such as the MDF 1 MIDI Data Filer:

- Voice Edit Buffer
- 1-32 Voice Data
- 33-64 Voice Data
- Performance Edit Buffer
- 1-64 Performance Data
- System Setup Data
- Micro Tuning Edit Buffer
- Micro Tuning 1-2 Data
- Micro Tuning Cartridge Data

The Save to Cartridge function (Utility menu item #2) saves the entire contents of the TX802's Internal memory to cartridge. The Internal memory includes the following:

- Performance Memories 1-64
- Voice Memories 1-64
- System Setup Memory
- Micro Tuning Memories 1-2

The Load from Cartridge function (Utility menu item #3) gives you the option of loading the Internal memory with or without the System Setup data on the cartridge.

The Copy function (Utility menu item #8) gives you a number of possibilities for copying voice data from one operator to another (in Voice Edit mode), making Voice programming much less time-consuming. You have the following Copy options:

- EG and Scaling:
 - EG parameters
 - Rate Scaling parameters
 - Level Scaling parameters
- Oscillator
 - Oscillator Mode
 - Frequency
 - Detune
- Operator
 - Oscillator parameters
 - Velocity Sensitivity
 - Amplitude Modulation Sensitivity (AMS)

New Voice Parameters

The original DX7 layout featured a two-layered programming system: Voice data, which was programmable for each of the 32 voice memory locations; and Function data, which was programmable but global (in other words, it operated the same way for each Voice memory). Following the lead of later first-generation 6-operator units like the TX7 and TX816, the new generation includes what used to be called "function data" as part of each Voice memory. As a matter of fact, these parameters are no longer called "function parameters" (as they were in the TX7 and TX816); instead, they are simply considered part of the expanded voice of the new generation of DX7 instruments. On the TX802, parameters that used to be called "Voice" data are accessed via the Voice Edit (I) menu, while parameters that used to be called "Function" data are accessed using the Voice

Edit (II) menu—on the DX7 II, these parameters are now called "Voice Effect" data.

To make comparison to the original DX7 easier, let's look at the new Voice parameters of the second 6-operator generation. Here are the new Voice parameters to be found in the TX802's Voice Edit (I) menu:

- Fractional Scaling
- LFO Mode
- Pitch EG Range
- Pitch EG Velocity

In addition, the range of Amplitude Modulation Sensitivity (AMS) has been expanded from 0-3 to 0-7.

The Voice Edit (II) menu of the TX802 (involving parameters that used to be called Function data) includes the following new parameters:

- Key Mode
- Random Pitch
- Pitch Bias

Because the TX802 is multi-timbral, it does not have the following new Voice parameters found on the DX7 II:

- Unison mode
- Pitch Bend mode
- Sostenuato Footswitch (control number 66)
- Soft Footswitch (control number 67)
- Foot Controller #2
- Real-Time Parameter Change

Even so, Voices created on any of the DX7 II synthesizers are completely compatible with the TX802. Obviously, the Performance memories of the DX7 II will not transfer into the TX802, since the two units have completely different approaches to the creation of Performance settings.

Even though it offers significant advances over the original DX7, the new TX802 is also compatible with its predecessor. All of your existing DX7 voices can be transferred into the TX802 with no difficulty—and the new parameters offered by the TX802 can be added easily to your existing voices.

Fractional Scaling

On the original DX7, Level Scaling allowed a change in level or timbre across the range of

Continued on page 19

RX5

A New RX5 Voice Edit By Vincent Bitetti.

Notes:

This gated snare drum effect is just one example of the many "gate" possibilities obtainable with the RX5.

Voice Name: RX5 Gated Snare Origin: Int-SD 1			
JOB #	PARAMETER	RANGE	NEW VALUE
02	Pitch	-3600 ~ 2400	-0300 cent
03/1	Attack Rate	1 ~ 99	99
03/2	Decay 1 Rate	1 ~ 99	48
03/3	Decay 1 Level	1 ~ 60	60
03/4	Decay 2 Rate	1 ~ 99	16
03/5	Release Rate	1 ~ 99	61
03/6	Gate Time	100 ~ 6500	0150 ms
04/1	Bend Rate	-60 ~ 60	00
04/2	Bend Range	1 ~ 60	00
05	Inst Level	0 ~ 31	28
06	Sound Loop	OFF / ON	ON

RX5

A New RX5 Voice Edit By Vincent Bitetti.

Notes:

If you have ever seen "Voyage to the Bottom of the Sea," you will recognize this sound.

Voice Name: SonarReflection Origin: Crt-Cstnt			
JOB #	PARAMETER	RANGE	NEW VALUE
02	Pitch	-3600 ~ 2400	-2400 cent
03/1	Attack Rate	1 ~ 99	74
03/2	Decay 1 Rate	1 ~ 99	57
03/3	Decay 1 Level	1 ~ 60	60
03/4	Decay 2 Rate	1 ~ 99	62
03/5	Release Rate	1 ~ 99	51
03/6	Gate Time	100 ~ 6500	1100 ms
04/1	Bend Rate	-60 ~ 60	00
04/2	Bend Range	1 ~ 60	00
05	Inst Level	0 ~ 31	31
06	Sound Loop	OFF / ON	ON

RX5

A New RX5
Voice Edit By
Vincent Bitetti.

Notes:

This is an interesting sound effect; in fact, it sounds a lot like a new DX7 II FD/D voice.

Voice Name: Meteorite		Origin: Int-China	
JOB #	PARAMETER	RANGE	NEW VALUE
02	Pitch	-3600 ~ 2400	+1000 cent
03/1	Attack Rate	1 ~ 99	32
03/2	Decay 1 Rate	1 ~ 99	34
03/3	Decay 1 Level	1 ~ 60	21
03/4	Decay 2 Rate	1 ~ 99	47
03/5	Release Rate	1 ~ 99	01
03/6	Gate Time	100 ~ 6500	6500 ms
04/1	Bend Rate	-60 ~ 60	02
04/2	Bend Range	1 ~ 60	-29
05	Inst Level	0 ~ 31	27
06	Sound Loop	OFF / ON	ON

RX5

A New RX5
Voice Edit By
Vincent Bitetti.

Notes:

This voice edit utilizes extreme looping and pitch effects.

Voice Name: TrainThruTunnel		Origin: Crt-FMprc1	
JOB #	PARAMETER	RANGE	NEW VALUE
02	Pitch	-3600 ~ 2400	-3500 cent
03/1	Attack Rate	1 ~ 99	37
03/2	Decay 1 Rate	1 ~ 99	26
03/3	Decay 1 Level	1 ~ 60	60
03/4	Decay 2 Rate	1 ~ 99	59
03/5	Release Rate	1 ~ 99	32
03/6	Gate Time	100 ~ 6500	6500 ms
04/1	Bend Rate	-60 ~ 60	38
04/2	Bend Range	1 ~ 60	-11
05	Inst Level	0 ~ 31	28
06	Sound Loop	OFF / ON	ON

Micro Tuning

Continued from page 5

Note Name	Coarse Tune	Fine Tune	Tuning Units	Δ ET Cents	Interval Size TU	Cents
>>> C 3 <<<	C 3	+9	(5043)	+10.55	65	76.17
>>> C#3 <<<	C# 3	-12	(5108)	-14.06	100	117.19
>>> D 3 <<<	D 3	+3	(5208)	+3.52	100	117.19
>>> D#3 <<<	D# 3	+18	(5308)	+21.09	65	76.17
>>> E 3 <<<	E 3	-3	(5373)	-3.52	100	117.19
>>> F 3 <<<	F 3	+12	(5473)	+14.06	64	75.00
>>> F#3 <<<	F# 3	-9	(5537)	-10.55	100	117.19
>>> G 3 <<<	G 3	+5	(5637)	+5.86	65	76.17
>>> G#3 <<<	G# 3	-15	(5702)	-17.58	100	117.19
>>> A 3 <<<	A 3	+0	(5802)	+0.00	100	117.19
>>> A#3 <<<	A# 3	+14	(5902)	+16.41	65	76.17
>>> B 3 <<<	B 3	-6	(5967)	-7.03	100	117.19
>>> C 4 <<<	C 4	+9	(6067)	+10.55		

Micro Tuning data for Preset #4: Mean Tone—key of C major.

Micro Tuning data for Preset #5: Pythagorean—key of C major.

Note Name	Coarse Tune	Fine Tune	Tuning Units	Δ ET Cents	Interval Size TU	Cents
>>> C 3 <<<	C 3	-5	(5029)	-5.86	96	112.50
>>> C#3 <<<	C# 3	+5	(5125)	+5.86	78	91.41
>>> D 3 <<<	D 3	-2	(5203)	-2.34	77	90.23
>>> D#3 <<<	D# 3	-10	(5280)	-11.72	97	113.67
>>> E 3 <<<	E 3	+1	(5377)	+1.17	77	90.23
>>> F 3 <<<	F 3	-7	(5454)	-8.20	97	113.67
>>> F#3 <<<	F# 3	+5	(5551)	+5.86	77	90.23
>>> G 3 <<<	G 3	-4	(5628)	-4.69	97	113.67
>>> G#3 <<<	G# 3	+8	(5725)	+9.38	77	90.23
>>> A 3 <<<	A 3	+0	(5802)	+0.00	77	90.23
>>> A#3 <<<	A# 3	-9	(5879)	-10.55	97	113.67
>>> B 3 <<<	B 3	+3	(5976)	+3.52	77	90.23
>>> C 4 <<<	C 4	-5	(6053)	-5.86		

cal values which take into consideration the fact that even though the musical interval of a semitone (half step) is considered to be the same no matter where on the keyboard we play, the actual difference in frequency gets larger as we move up the keyboard and smaller as we move down.

Consider the problem of where to put frets on a guitar fingerboard. First, measure the entire length of the string and divide it by twelve (since there are twelve semitones in an octave). Then place the first fret $\frac{1}{12}$ th of the distance from the end of the string. Now take the remaining length of string (the original length less $\frac{1}{12}$ th) and divide it by twelve. Place the second fret $\frac{1}{12}$ th the distance from the first fret. Now take the remaining length of string (the original length less $\frac{1}{12}$ th, less $\frac{1}{12}$ th the remaining length) and divide it by twelve. Place the third fret $\frac{1}{12}$ th the distance from the second fret. And so on. What occurs is a gradually decreasing distance between frets, all of which are equal to the interval of a semitone.

A far simpler way of managing the numbers is to decide that the musical interval of a semitone (half-step) is equal to $\frac{1}{12}$ th of an octave, and that an octave is made up of 1200 equal parts called "cents." Therefore, an equally tempered semitone is equal to 100 cents. This is the method that music theorists have been using for years to study intonation systems.

In equal tempered tuning, only the octave is acoustically correct—or "pure." All other intervals are out of tune with respect to the harmonic series. Our ears have simply adjusted to this system which, although imperfect, spreads the inevitable tuning inaccuracies to all intervals and through every key.

On the other hand, deriving a scale from the ratios of the harmonic series yields pure intervals—but in one key only. To illustrate this point, call up the Pure (Major) preset in the Key of C. Now, play a number of major triads. Those that are closely related to C major (such as C, F, and G) will sound perfectly in tune, while others (such as D, E, and A) will seem badly out of tune.

Understanding The DX7 II Micro-Tuning Values

Examining the preset Micro Tunings in the DX7 II may be a little confusing at first. That's because the designers of the DX7 II found it

more convenient to divide the octave into 1024 parts instead of 1200. This came to pass, no doubt, because 1024 is one of those magic (power of 2) computer numbers, while 1200 is obviously not.

Let's take a close look at the result. Both 1200 cents and 1024 DX7 II increments are equal to one octave. By dividing 1200 by 1024, we discover that 1 DX7 II increment (or Tuning Unit) is equal to 1.171875 cents. 100 cents (an equal tempered semitone) are equal to 85.3333 DX7 II increments (Tuning Units). Therefore, the DX7 II's Fine tuning increment is equal to 1.17185 cents. The DX7 II's Coarse increment is equal to approximately 85 Tuning Units, which equals approximately 100 cents (or 1 semitone).

This can be confirmed by examining the Equal Temperament Preset. From Single Voice Mode, press the Edit/Compare button; then press the Micro Tune button (29) until you see the Micro Tune display. With the cursor on Table Select use the +1/YES and -1/NO data entry buttons to call up Preset #1 (Equal Temperament) in the display. Now press the Utility (Tune) button (#14) until you see the Micro Tuning display.

This display is designed to show you the Micro Tuning values of three notes at a time; however, only the note that is between the multiple arrows is available for editing/tuning.

With the cursor in the Coarse position, use the Micro Tune Key Set Keys (Internal & Cartridge) to call up A3 between the arrows. You will see this display beneath A3:

A3 + 0(5802)

Move the cursor to Fine and press the +1/YES data entry button once. Now the display underneath A3 will read as follows:

A3 + 1(5803)

This means that we have just adjusted the pitch of A3 up one Fine increment (1.17185 cents) above the equal tempered pitch of A3. Notice that the four digit number also advanced by one. That number tells us how many Tuning Units we are above zero, which is the lowest key in the MIDI system, C# - 2.

Use the data entry slider to advance the increments until the display underneath A3 reads as follows:

A3 + 42(5844)

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Note Name	Coarse Tune	Fine Tune	Tuning Units	Δ ET Cents	Interval Size TU	Interval Size Cents
>>> C 3 <<<	C 3	+10	(5044)	+11.72	76	89.06
>>> C#3 <<<	C# 3	+0	(5120)	+0.00	88	103.13
>>> D 3 <<<	D 3	+3	(5208)	+3.52	87	101.95
>>> D#3 <<<	D# 3	+5	(5295)	+5.86	82	96.09
>>> E 3 <<<	E 3	+1	(5377)	+1.17	92	107.81
>>> F 3 <<<	F 3	+8	(5469)	+9.38	77	90.23
>>> F#3 <<<	F# 3	+0	(5546)	+0.00	92	107.81
>>> G 3 <<<	G 3	+6	(5638)	+7.03	82	96.09
>>> G#3 <<<	G# 3	+3	(5720)	+3.52	82	96.09
>>> A 3 <<<	A 3	+0	(5802)	+0.00	92	107.81
>>> A#3 <<<	A# 3	+6	(5894)	+7.03	82	96.09
>>> B 3 <<<	B 3	+3	(5976)	+3.52	92	107.81
>>> C 4 <<<	C 4	+10	(6068)	+11.72		

Micro Tuning data for Preset #6: Werckmeister.

Micro Tuning data for Preset #7: Kirnberger.

Note Name	Coarse Tune	Fine Tune	Tuning Units	Δ ET Cents	Interval Size TU	Interval Size Cents
>>> C 3 <<<	C 3	+9	(5043)	+10.55	77	90.23
>>> C#3 <<<	C# 3	+0	(5120)	+0.00	88	103.13
>>> D 3 <<<	D 3	+3	(5208)	+3.52	86	100.78
>>> D#3 <<<	D# 3	+4	(5294)	+4.69	79	92.58
>>> E 3 <<<	E 3	-3	(5373)	-3.52	95	111.33
>>> F 3 <<<	F 3	+7	(5468)	+8.20	79	92.58
>>> F#3 <<<	F# 3	+1	(5547)	+1.17	90	105.47
>>> G 3 <<<	G 3	+5	(5637)	+5.86	82	96.09
>>> G#3 <<<	G# 3	+2	(5719)	+2.34	83	97.27
>>> A 3 <<<	A 3	+0	(5802)	+0.00	91	106.64
>>> A#3 <<<	A# 3	+5	(5893)	+5.86	79	92.58
>>> B 3 <<<	B 3	-1	(5972)	-1.17	95	111.33
>>> C 4 <<<	C 4	+9	(6067)	+10.55		

Micro Tuning

Continued from page 17

Micro Tuning data for Preset #10: 1/4 Tone.

Note Name	Coarse Tune	Fine Tune	Tuning Units	Δ ET Cents	Interval Size TU	Interval Size Cents
>>> C 2 <<<	C 3	+0	(5034)	+0.00	43	50.39
>>> C#2 <<<	C# 3	-43	(5077)	-50.39	43	50.39
>>> D 2 <<<	C# 3	+0	(5120)	+0.00	42	49.22
>>> D#2 <<<	C# 3	+42	(5162)	+49.22	43	50.39
>>> E 2 <<<	D 3	+0	(5205)	+0.00	43	50.39
>>> F 2 <<<	D# 3	-42	(5248)	-49.22	42	49.22
>>> F#2 <<<	D# 3	+0	(5290)	+0.00	43	50.39
>>> G 2 <<<	E 3	-43	(5333)	-50.39	43	50.39
>>> G#2 <<<	E 3	+0	(5376)	+0.00	42	49.22
>>> A 2 <<<	E 3	+42	(5418)	+49.22	43	50.39
>>> A#2 <<<	F 3	+0	(5461)	+0.00	43	50.39
>>> B 2 <<<	F# 3	-42	(5504)	-49.22	42	49.22
>>> C 3 <<<	F# 3	+0	(5546)	+0.00	43	50.39
>>> C 3 <<<	F# 3	+0	(5546)	+0.00	43	50.39
>>> C#3 <<<	G 3	-43	(5589)	-50.39	43	50.39
>>> D 3 <<<	G 3	+0	(5632)	+0.00	42	49.22
>>> D#3 <<<	G 3	+42	(5674)	+49.22	43	50.39
>>> E 3 <<<	G# 3	+0	(5717)	+0.00	43	50.39
>>> F 3 <<<	A 3	-42	(5760)	-49.22	42	49.22
>>> F#3 <<<	A 3	+0	(5802)	+0.00	43	50.39
>>> G 3 <<<	A# 3	-43	(5845)	-50.39	43	50.39
>>> G#3 <<<	A# 3	+0	(5888)	+0.00	42	49.22
>>> A 3 <<<	A# 3	+42	(5930)	+49.22	43	50.39
>>> A#3 <<<	B 3	+0	(5973)	+0.00	43	50.39
>>> B 3 <<<	C 4	-42	(6016)	-49.22	42	49.22
>>> C 4 <<<	C 4	+0	(6058)	+0.00		

Now press the -1/YES data entry button once, and observe that the note name in the display changes.

A#3 -43(5845).

It is at this midway point that the pitch changes to the next note sharp or flat. Notice also that the range from +42 and -43 equals 85, which is the rounded off value equal to 100 cents. Meanwhile, the number in parentheses also changes by one increment. I've found it easier to follow this number (the total number of Tuning Units above zero) rather than try to remember if I was tuning something to be so many increments sharp of one pitch or flat of the next.

Now, return the display underneath A3 to its original value:

A3 +0(5802)

Move the cursor to Coarse and press the +1/YES data entry button once. You will now see this display beneath A3:

A#3 +0(5888)

The note has just changed from A3 to A#3, and the Tuning Unit number has changed from 5802 to 5888—which is a difference of 86 increments instead of 85. That's because the actual value of 1 semitone is equal to 85.3333 Tuning Units: Since the increments are limited to integer values only, the DX7 II rounds off the .3333 by giving every third semitone a value of 86 instead of 85. This happens four times in each octave of the Equal Temperament preset.

See, it only seems confusing. Just remember that each semitone of 100 cents is equal to 85 (or 86) Fine increments (Tuning Units) or 1 Coarse increment. Each note can be tuned to any pitch in the MIDI range. You should also know that the DX7 II derives all of its tunings based around the pitch of A3 being equal to 440Hz; this is true even for the open tunings—Pure (Major), Pure (Minor), Mean tone, Pythagorean—in all keys.

If you would like further information on the Micro Tuning system in the DX7 II, you might want to read the two Supplemental Booklets Yamaha has published for the DX7 II FD/D. They are called "Exploring the Preset Microtunings" and "The Mathematics & History of Microtuning." Ask for them at your nearest Yamaha dealer.

TX802

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the keyboard. It offered a choice of level-scaling curves, plus variable depth.

The new 6-operator generation (including the TX802) provides an enhanced version of this parameter—Fractional Scaling. Using Fractional Scaling, the output level of each individual operator can be varied in 3-key groups for each operator, so that you can create virtually any level or timbre curve.

Micro Tuning

Recently, there has been a lot of discussion about alternate tuning capabilities, often called Micro Tuning. This unique feature is available on the TX802 (and on all of the other second-generation 6-operator instruments).

Basically, Micro Tuning lets you tune each

key on the keyboard individually. The tuning range can be within a few cents of the original pitch, or it can operate over a range of octaves. You can play Bach in the tuning of his era; or you can tune the entire keyboard in reverse. (For more information about Micro Tuning, see the article beginning on page 4 of this issue of AfterTouch.)

* * * *

The new TX802 represents another significant advancement in musical capability for the new generation of FM digital 6-operator synthesizers and tone generators. At a list price of \$1895.00, it offers an attractive combination of multi-timbral Performances with the enhanced sound and features of the DX7 II.

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