

# YAMAHA

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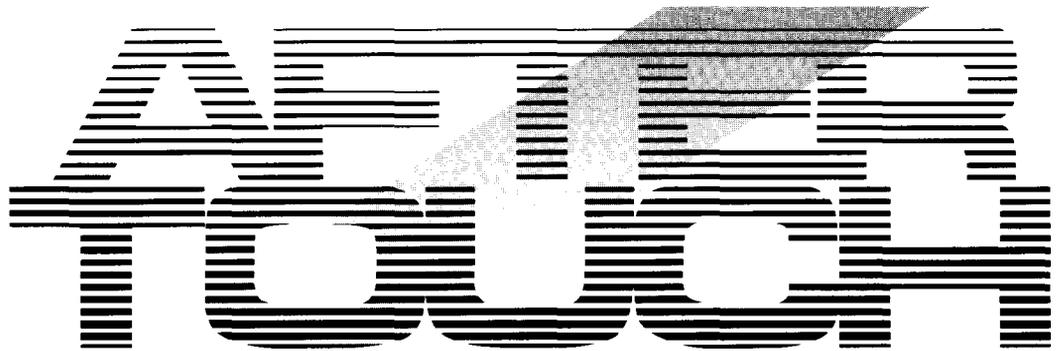
## QX5



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**4 SPX90**

Step-by-step instructions for using the SPX90 digital multi-effects processor to create automatic harmonization through MIDI control. By Kevin Laubach.

**8 Studio 100 System**

Tips on recording song demos with the Yamaha Studio 100 System. By Vincent Bitetti.

**10 QX5**

An introduction to Yamaha's newest digital sequence recorder, complete with a chart that compares QX5 features to QX1 features. By Scott Plunkett.

**13 YCAMS Diary**

Presenting a new AfterTouch feature—AfterTouch readers sharing their musical experiences with Yamaha musical products. The first installment: A personal record of a MIDI adventure in academia. By Professor Ardean W. Watts.

**15 Performance Controllers**

How to use Yamaha's extensive set of synthesizer controllers to fine-tune your performances and personalize your music. By Brad Vinikow.

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# From The Editor

**B**EFORE CONTINUING WITH the look at MIDI begun in this column last month, I would like to correct an error that appeared elsewhere in that issue (November 1986). On page 6, in the second paragraph of the Notes accompanying the MEP4 Setup created by Bob Frye, we inadvertently included some incorrect information concerning the settings for the four MEP4 processors. The paragraph should have read as follows: *The four processors are set to pass the following notes: B4 (processor 1), F#4 (processor #2), A3 (processor 3), and F#3 (processor 4). All four processors must be on.*

We're sorry for any confusion this may have caused. Now, on with MIDI:

Basically, MIDI (the Musical Instrument Digital Interface) allows instruments to give each other certain basic kinds of information. If a key is played on one instrument, its MIDI OUT port passes along that "Note On" information to another instrument's MIDI IN port, so that the key played on instrument 1 can actually produce a sound from both instruments. In addition, most current MIDI instruments will also transmit the velocity with which the key was played, so that the overall volume of both instruments can be controlled simultaneously. When the key on instrument 1 is released, a "Note Off" message is sent, and the note being played by instrument 2 will also cease.

Of course, even this simple information from instrument 1 will have an effect on instrument 2 only if it has been set up to receive the information coming from instrument 1. Even

though most MIDI information travels along a single MIDI cable, the information itself is divided into different "channels." In addition, receiving instruments operate in different "modes," each of which makes the instrument deal with the incoming information in certain specific ways. This month, let's take a closer look at MIDI *channels*.

MIDI information travels along a single cable because MIDI is a serial interface. This means that all portions of each packet of information are sent along the MIDI connection in series, one portion at a time. In the basic digital language of computers, the smallest portion is a *bit* (which is either a "0" or a "1"). These bits are usually combined into groups of eight, each of which is called a *byte*.

Most basic MIDI information can be transmitted using only a few bytes of MIDI code. In order to increase the flexibility of the basic interface, the designers of MIDI created a system that allows pieces of MIDI information to be assigned to a specific "channel." They included specifications for up to 16 different "channels" of MIDI information.

The word "channel" has been in quotes here because MIDI channels are not physical channels at all. Although they can separate musical instruments into discrete elements, the information does not reside on separate segments of tape, nor does it flow through separate audio cables.

Most basic packets of MIDI information

*Continued on page 19*

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# SPX90

## Use The SPX90 To Create Automatic Harmonization. By Kevin Laubach.

**Y**AMAHA'S SPX90 DIGITAL EFFECTS Processor can be used to create a wide variety of effects, including reverb, chorusing, stereo delay, and so on. The SPX90 also responds to MIDI, which opens up many other possibilities for effects such as gated reverb or delayed vibrato (where the effect is triggered by MIDI note input).

While some of these MIDI applications may be readily apparent, other more involved techniques may also be realized. One such technique is described here—it uses the SPX90 in conjunction with a MIDI sequencer to create automatic harmony parts from any audio source. This could be used in a live performance situation to add background harmonies to the lead vocal, or to create a dual lead line from a single guitarist. Although this technique does require a bit of preparation beforehand, the results are remarkable, and could not be achieved in any other way.

### Using The SPX90 As A Standard Harmonizer

Pitch Change is one of the many presets in the SPX90. There are 4 kinds of Pitch Change

available: Presets 21-24, called Pitch Change A-D. Each of these presets has different capabilities and different parameters (to create different effects). For the examples in this article, we will use preset 21: Pitch Change A.

To use the SPX90 as a standard harmonizer, follow these steps:

1. Use the up and down cursor keys until "21" blinks on the LED display.
2. Press the Recall button. The LCD display will now read:

```
PITCH CHANGE A
PITCH= + 0
```

3. Press the up cursor key seven times; the LCD display will now read:

```
PITCH CHANGE A
PITCH= + 7
```

Now, if you play middle C on a piano and feed it into the SPX90 with this setting, the output will be a piano playing a G above middle C (see diagram 1).

### Using MIDI To Change The Pitch Interval

Experiment with the pitch interval on the SPX90 by using the up and down cursor keys. Notice that the LCD display shows the pitch difference in semitones (half-steps). Also notice that the maximum pitch change is plus or minus one octave.

Now use the MIDI input on the SPX90 to change the interval of the pitch change. This will have *exactly* the same effect as changing the interval by using the up and down cursor keys, but it can be done much more quickly and accurately from a MIDI keyboard: The SPX90 actually reads the MIDI notes coming in, and sets the pitch change by reading the interval from middle C, as shown in the accompanying chart (see diagram 2). Actually, the "base key" or "unison key" can be programmed to be any note from C1 to C6, but (to avoid confusion) we will assume that it is left at the original setting of C3.

For example, if you play F above middle C on the MIDI keyboard, the pitch change interval will be set at a perfect fourth. The LCD on the SPX90 will read "+ 5," and if you play a middle C on the piano, the output from the

Diagram 2: Pitch change interval determined by the input from a MIDI keyboard.

Note Pressed	Display	Interval
C	-12	-8va
C#	-11	M7
D	-10	m7
D#	-9	M6
E	-8	m6
F	-7	P5
F#	-6	TT
G	-5	P4
G#	-4	M3
A	-3	m3
A#	-2	M2
B	-1	m2
C	0	unison
C#	1	m2
D	2	M2
D#	3	m3
E	4	M3
F	5	P4
F#	6	TT
G	7	P5
G#	8	m6
A	9	M6
A#	10	m7
B	11	M7
C	12	+8va

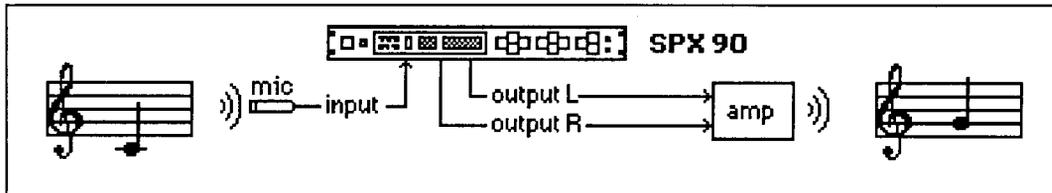
SPX90 will be F above middle C (see diagram 3). If you play D on the piano, the SPX90 will transpose it by the same interval (a perfect fourth) and the output will be a G (see diagram 4).

If you then select another interval such as a

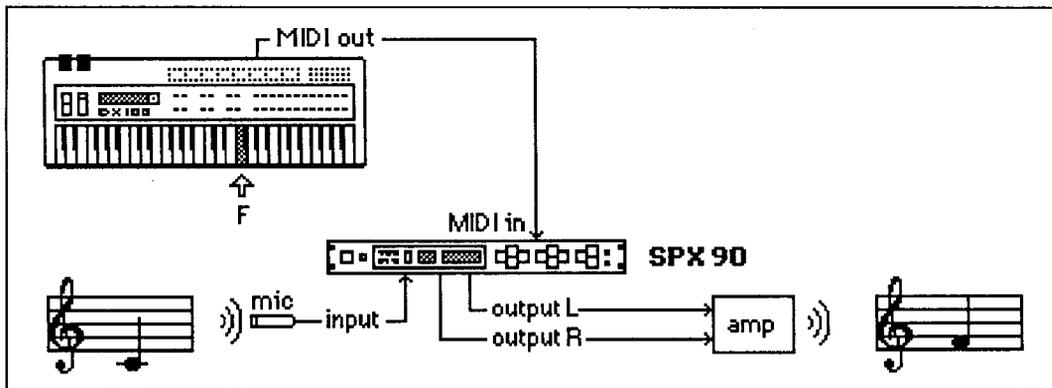
minor third by playing Eb above middle C on the MIDI keyboard, the SPX90 will transpose the D from the piano up a minor third, and the output will be an F (see diagram 5).

The last interval (note) that you select using the MIDI keyboard will remain in effect until a

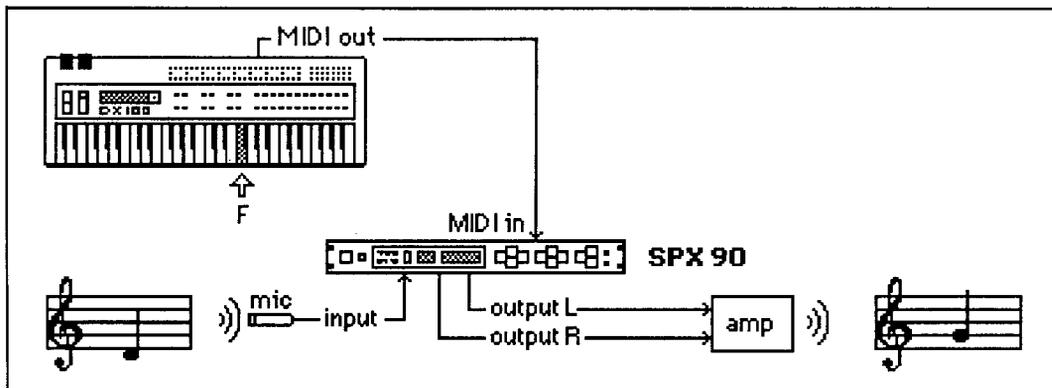
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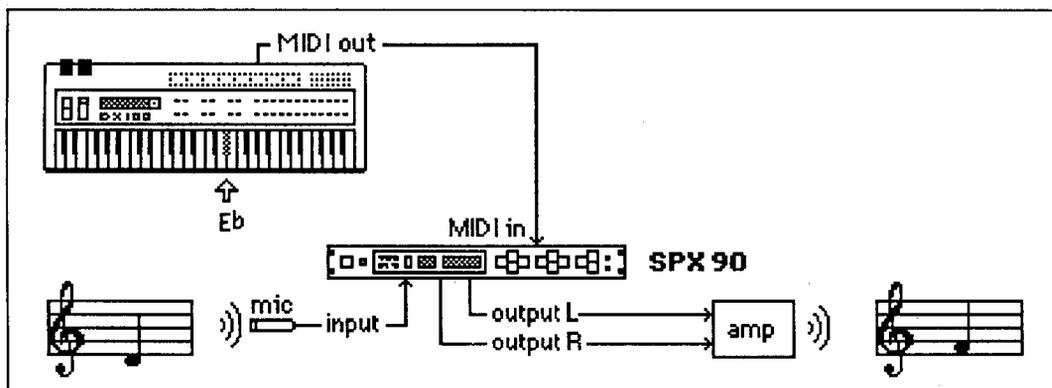
*Diagram 1: Pitch change output from the SPX90 when the setting is +7.*



*Diagram 3: Pitch change output from the SPX90 when the setting of +5 is set by a MIDI keyboard and middle C is played on the piano.*



*Diagram 4: Pitch change output from the SPX90 when the setting of +5 is set by a MIDI keyboard and D above middle C is played on the piano.*



*Diagram 5: Pitch change output from the SPX90 when the setting of +3 is set by a MIDI keyboard.*

# SPX90

*Continued*

new interval (note) is played—there is no need to hold the key down.

Remember, the MIDI keyboard is setting the *interval* of pitch change; it is NOT determining the actual note that the SPX90 will transpose to.

## Using A MIDI Sequencer To Change The Pitch Interval

Let's say that you want to play a broken C Major chord on the piano, and would like to add a harmony part automatically using the SPX90:



Diagram 6: MIDI notes to use to achieve the desired harmony intervals when using a MIDI sequencer.

Interval	Display	Note Pressed
8va	-12	C
M7	-11	C#
m7	-10	D
M6	-9	D#
m6	-8	E
P5	-7	F
TT	-6	F#
P4	-5	G
M3	-4	G#
m3	-3	A
M2	-2	A#
m2	-1	B
unison	0	C
m2	+1	C#
M2	+2	D
m3	+3	D#
M3	+4	E
P4	+5	F
TT	+6	F#
P5	+7	G
m6	+8	G#
M6	+9	A
m7	+10	A#
M7	+11	B
+8va	+12	C

If you set the SPX90 Pitch Change to a major third (+4) using either the up and down cursor keys or a MIDI keyboard, you will not get the desired output from the SPX90; instead, you will get a harmony that remains a major third above the original part:



Since the interval between the incoming melody note and the desired output (harmony) note changes, the solution is to change the interval in the SPX90 as you are playing the part. This can be done automatically using a MIDI sequencer. Since the SPX90 can read any MIDI notes that are sent to it, notes can be sent from either a MIDI keyboard or a MIDI sequencer. The SPX90 will of course respond the same way to either one.

To determine the part that the sequencer would have to play in order to get the desired harmony part, use the following steps:

1. Determine the intervals between the melody and harmony notes:



2. Use the accompanying chart to determine what MIDI note to use to achieve the correct interval (see diagram 6).

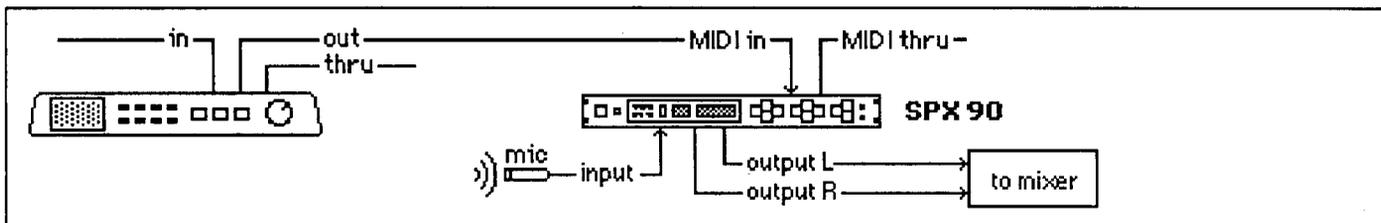
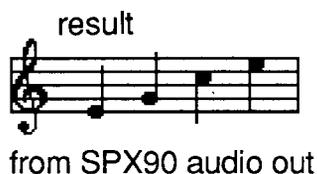
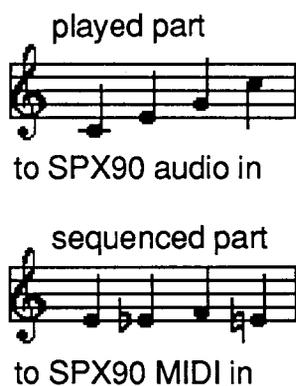


Diagram 7: Basic MIDI connections for hooking a MIDI sequencer up to the SPX90.

3. Record the part into the sequencer. It may be helpful to write the part out first—it won't be very musical:



4. Send the MIDI OUTput of the sequencer to the MIDI IN of the SPX90 (see diagram 7).  
5. Play sequence while playing the C Major chord part on the piano:



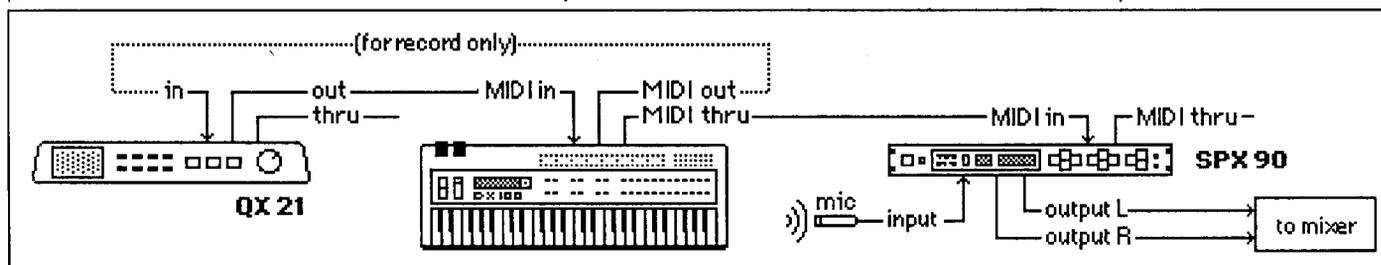
### Using This Technique In A Live Performance

In a real performance situation, it may be helpful to use two tracks of your sequencer—one to change intervals on the SPX90, and one to play another accompaniment part. This way, the auto harmonization will always be in sync with the actual performance (see diagram 8).

Although it does take some time to figure out and record the pitch intervals into the sequencer, the end result can be well worth the effort. If you have a personal computer, you may want to find out if there is any software available that can create the harmony difference part automatically. If you are ambitious, you could use several tracks of a sequencer to control several SPX90s for 3- and 4-part harmonizations!

**MIDI Note:** If you are using a sequencer that allows multiple MIDI channels from a single MIDI OUT connector, you will probably want to direct one of the MIDI channels to only the SPX90. This is easily done by pressing the SPX90's Utility button twice and then using the up and down cursor keys to adjust the MIDI Receive Channel to a unique number.

Diagram 8: Basic MIDI connections for hooking a MIDI sequencer up to the SPX90 and a MIDI synthesizer for use in live performance.



# Studio 100 System

## Step-By-Step Recording Tips For The Studio 100 System. By Vincent Bitetti.

IN THE AUGUST 1986 ISSUE of *AfterTouch*, we talked about the various components of the Studio 100 System. This issue, we're going to explain how to record a complete song demo using the FSK and MIDI capabilities of the system. With FSK, we can achieve perfectly "synced" overdubs. This will allow us to record a number of different parts using many of the sounds of the DX100 digital synthesizer.

The RX21 is the heartbeat of this System, the QX21 is the brain, and the MT1X is the historian. The System uses two recorders, one tape/analog, the other digital. The bulk of this article will deal with the MIDI aspects involved in digital recording with the QX21 sequencer and the DX100 synthesizer.

The key is to plan ahead as much as possible. Sounds should be decided on and moved to

one bar of silence and use it as many times as needed while putting together the drum patterns during song mode.

The drums won't actually be recorded now—they will be recorded during final mixdown. Once you've finished putting your drum patterns together in Song Mode on the RX21 and you've gotten all your sounds organized (the procedures for these operations are described in details in the owners manuals), you're ready to start.

### FSK & MIDI

FSK (frequency-shift keying) is the means by which we are able to do multiple overdubs with the sequencer in perfect time. This is where the YMC10 comes into play—this ingenious little device changes FSK signal into MIDI signal and vice versa (complete instructions for this procedure are given on page 33 of the MT1X owners manual).

After recording the sync track using the YMC10, we're ready to start. We're going to listen to the RX21 through MS10 speakers by way of the Auxiliary Send and Return on the MT1X, so that we can monitor the drums during the recording of our sequences. The MIDI clocks will be sent from the RX21 after the YMC10 has converted the FSK to MIDI, and the QX21 will start to play (set it to external clock).

Since the YMC10 has two MIDI outputs, you can connect the sequencer directly to the YMC10 and bypass the RX21 if you wish. One last note here—FSK is very much like SMPTE time code in that it has a tendency to bleed on to the adjacent track of the tape recorder. On the MT1X, FSK is always on track one, possibly making track two unusable, depending on the level and type of sound used. If, however, we do all our sequenced parts on tracks three and four, we can later bounce (or ping-pong) those tracks to track two, leaving tracks three and four open for other instruments—guitar and vocal for example—leaving the FSK tone intact in case we want to start over from scratch.

### Program Changes & Sequencing Tips

Begin by recording your first part onto the QX21. This can be anything—a bass line, sound effects, a melody, and so on. Use the DX100 to your maximum advantage. If you choose to start



*The System 100: QX21 digital sequence programmer, RX21 digital rhythm programmer, DX100 FM digital synthesizer, MT1X Multi-track cassette recorder, and two KS10 keyboard speakers, all mounted on an ST100 stand.*

the DX100's 24 Internal Memory locations for fast and easy access—to facilitate program changes and for saving the data to tape if necessary. The song length should be decided on, and the song structure should be written into the drum machine.

If the composition is going to start with music or sound effects before the drums come in, you'll need some blank measures on the RX21 for the FSK to drive the RX21, which sends MIDI clocks to the QX21, which fires the DX100, which is then recorded on the MT1X four-track cassette tape recorder. You can record

your song with sound effects (such as storm wind, wave, alarm call, doppler fx, racing car, etc.), then move into a bass line, then later drop back to sound effects, and so on, you could conceivably have up to four, five, maybe even six or seven program changes taking place on your first track. This will cut down on the amount of ping-ponging you'll have to do later (which can add considerable noise to the tape).

After the first track is recorded into the QX21, make a Track Exchange. If some of your program changes aren't perfect, record them on track one of the QX21 by pressing the patch numbers while in Record Mode; then, do a Track Down operation on the same MIDI channel. The data on the two tracks—the program changes and all the sequenced parts—will now be merged. When working with sequencers, remember that they usually have the ability to record in real time and step time. Also, most of them post-quantize (the QX series is unique in that it has a safety, or buffer, zone), allowing the user to experiment with different note values to achieve different effects without losing the original performance. Realistic sequences with human feel usually employ all three methods of recording: real time, real time quantized, and step time parts.

While monitoring the playback, be aware of volume changes from patch to patch on the DX100. To make mixing easier, you may want to adjust the levels of each patch by using the Operator Output Level editing function of the DX100, so that you're not constantly adjusting the sliders during final mixdown.

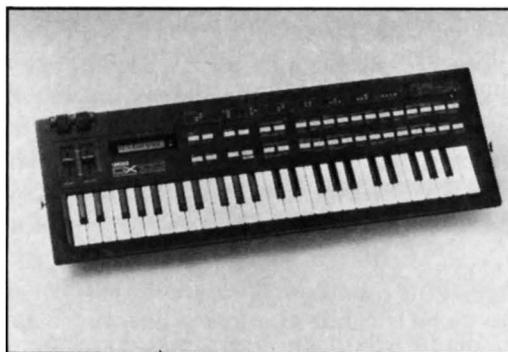
### Overdubs & Effects

We now have the foundation laid. If track three has three parts and six program changes, we can do more of the same on track four using the techniques described earlier. This time, though, we'll be using the FSK to make all of the parts playback in time with the material already recorded on track three. While hearing back what we've already recorded, we can write our parts for track four of the MT1X onto the QX21 sequencer.

The MT1X must be in its safe mode—that is, the Record Select switches must be set to the off position, and track four must be set to receive line input (again, please refer to the owners manual for specifics). Press Play on the MT1X, and you'll hear the drums and the recorded

music on track three. If the QX21 is in Record Mode, it will be ready to receive MIDI data from the DX100 synthesizer.

After you've recorded all your parts and program changes and they meet with your satisfaction, commit them to tape. If you're satisfied with the sequences that have been recorded on tracks three and four, bounce them to track two (please refer to the MT1X owners manual for instruction on this procedure).



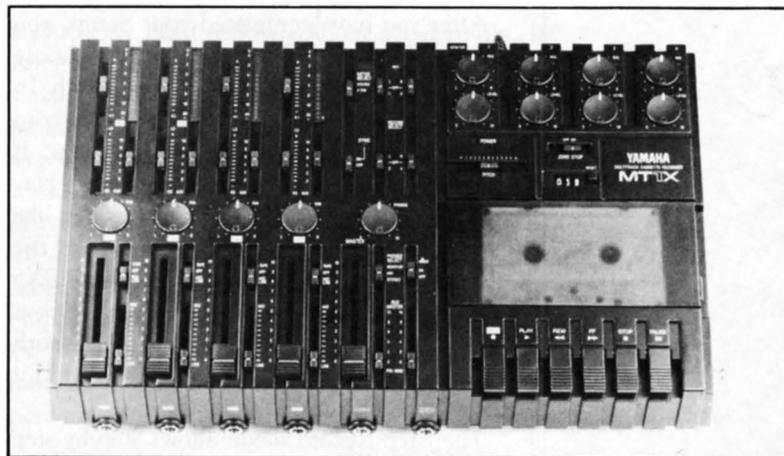
*DX100 FM digital synthesizer.*

We're now ready to record our final two tracks. Since the auxiliary send and return on the MT1X is being used by the RX21, it would be a good idea to "print" any effects to tape. The vocal and guitar tracks could benefit greatly from the use of an SPX90 at this time. Also, the drums could sound like cannons if an SPX90 were used in the final mixdown.

### Mixdown

Connect a two-track stereo cassette deck to the stereo outputs of the MT1X and make your final master recording, adjusting levels, panning, and EQ to your taste.

*MT1X multitrack cassette recorder.*



# QX5

## An Introduction To Yamaha's Newest Digital Sequence Recorder. By Scott Plunkett.

**T**HE QX5 IS THE LATEST ADDITION to the Yamaha family of MIDI digital sequence recorders. Although it bears a close physical resemblance to the QX21, the QX5 actually combines many of the features found on the QX1 as well as the QX21.

The QX5 has 8 Tracks and 32 Macros, on which it can store up to 20,000 notes (15,000 when velocity data is also recorded). A Track is capable of containing MIDI data from up to 16 channels. A Macro can be anything from a musical phrase or program change to a complete Track. This means that rather than repeat a phrase over and over, you can load it into a Macro and "Call" it from the main sequence whenever necessary. This allows you to conserve memory, and also offers a flexible system for composing and arranging.

### Setup

Before you begin recording, you should know that the QX5 offers you a number of Setup options. For example, you can reset the time signature every time you record, so that different time signatures can be played simultaneously. The MIDI channels you are recording can be changed or filtered by using the Channelizing feature. The QX5 normally records all MIDI data (including System Exclusive); but, if you want to ignore certain types, you can filter them out with the Record Filter. You can also record while using the Internal Clock or while the QX5 is synchronized to tape or MIDI. All of these and other Record parameters can be stored in one of four Setup Memories and recalled at any time.

### Recording On The QX5

After you have completed your Setup, you have three different Record modes to choose from: 1) Real Time Record, 2) Punch In Record, and 3) Step Record. Real Time Record functions just like an analog tape recorder. It records everything you play, exactly as you play it in real time. Punch In Record is exactly like Real Time Record, except that you can set the punch-in and punch-out measures; the QX5 will automatically do the punching for you. This is particularly useful when you need both hands to play a part and can't spare a hand for the QX5.

The Step Record mode allows step-by-step

input of music data. Note length, gate time, and velocity can be set from the QX5 front panel. Rests can be generated, and notes can be deleted and tied. Note data is input from a MIDI keyboard.

Also, the gate time, velocity, tie, and rest parameters can be assigned to any MIDI controller. This means that, for instance, you can assign the tie parameter to a Data Entry button—every time a tie is needed, you can use the Data Entry button instead of the QX5 front panel. This makes it possible to control almost all of the necessary parameters in Step Mode from the master keyboard.

### Editing Sequences

After you have finished recording, you are ready to take advantage of the QX5's extensive editing capabilities. There are actually three levels in the Edit Mode: 1) Track Edit, 2) Measure Edit, and 3) Event Edit.

Track Edit is where Track management takes place. Since recording and editing always take place on Track 1, you will find yourself wanting to do quite a bit of Track shuffling in order to make room for new material or to perform an edit. In the Track Edit mode, you can Clear a Track or Macro, Exchange a Track with another Track or Macro, or Copy a Track to another Track or Macro. The Track Down command allows you to merge two Tracks together.

As part of the Track management function of Track Edit, there are three commands of the cut-and-paste variety. The Cut command gives you the ability to cut Track 1 at any measure and paste the deleted section into another Track. The insert command takes all of the data in Track 1 and inserts it into any other Track at the measure you specify. With the Extract command, you can take virtually any MIDI data—including MIDI channel, control change, and tempo change data—and move it from Track 1 to another Track. This is helpful if a number of parts with different MIDI channel assignments have been merged to a Track and you want to separate one of the parts for editing.

The remaining jobs in Track Edit are for changing data throughout a Track. Clock Move is for moving all of the events in a Track forward or backward in time. There are 96 clocks per quarter-note; so, for example, if you add 48 clocks to a Track, all events will start an eighth-note later. Thin Out is a useful feature for sav-

ing memory space. It cuts out about half of any specified continuous controller or pitch bend data. Since continuous controllers generate huge amounts of data, you can thin tracks more than once and still have smooth sounding changes. Shift, the last Track Edit job, makes it possible to shift channel, note, controller, or Marco data up or down. For instance, if you wanted two tone generators on different channels to play the same part, you could copy the original performance to Track 2, then shift Track 1 up or down to put it on another channel.

Measure Edit lets you edit specific regions within a Track. With Copy, you can choose any measure or measures to be copied onto the end of the Track. So, if you want a four bar phrase to repeat eight times, you can record the first four bars and then use Copy to build up the Track. Delete takes selected measures out of the Track and moves all subsequent measure up to fill the gap. Remove lets you specify just about any kind of MIDI data and take it out of selected measures. You can even remove all data if you like and, unlike Delete, the blank measures will remain. Along these same lines, Create inserts empty measures of any time signature wherever you want in the Track. If you have a musical composition that changes time signatures often, you can use Create to set up a time signature template before you start to record. After you are finished constructing the template, copy it to Track 2. Then, when you begin to record, the metronome will change with the changing time signatures.

The remaining jobs in Measure Edit are for altering the recorded data. You can use Quantize to clean up any timing errors in a measure or group of measures. You can change all of the gate times, offset note-on velocity, or transpose all notes in a selected region.

One of the new features that is very useful is Crescendo: This allows you to gradually change note-on velocities, either positive or negative, over a specified number of measures. "Repeat and fade" effects and panning effects between two MIDI sound generators can be created with Crescendo.

The Event Edit mode makes it possible to edit virtually any part of your performance. In this mode, you can individually edit notes, Aftertouch, Pitch Bend, Control change, Mode change, Program change, System Exclusive (this one can be fun), Macro calls, and

Tempo changes, as well as move Measure marks. This means that you no longer have to re-record a part because you happened to brush against a bad note during an otherwise perfect performance. Instead, you can simply enter the Event Edit mode and delete or reassign the offending note.

When you want to change a single note, you can enter Event Edit mode and scan the Track by pressing the START button. You will hear the individual notes and see them displayed on the LCD: This is called the Search mode. When you reach the note you want to change, you enter the Change mode. In the Change mode, you can move the note anywhere in the Track, change the type of event (change a note to a Macro call), change the MIDI channel of the event, change the MIDI note assignment (change a C to a G), change the velocity, change the duration of the note, insert the edited note (still retaining the original note), or Delete the note entirely.

### **Playback**

You begin playback by pressing START when you are finished recording or editing. Auto Locate allows you to jump to any measure you choose, so that you can work on a part in the middle of the song without having to constantly fast forward and rewind. Three Tempo Memories are provided for instant changes if, for example, you are recording at one tempo and playing back at another. The QX5 also gives you the ability to turn Tracks on and off while the sequence is playing.

### **Saving QX5 Data**

The QX5 memory is backed up by a battery, so you never need to worry about accidentally losing your sequence. However, when you want to make room for new sequences, the QX5 lets you save your work on cassette tape. The QX5 has a very flexible cassette save/load implementation. You can save Tracks and Macros individually or in groups. You can load all of the Tracks and Macros from cassette, or only specific Tracks or Macros; this is useful if you want to compare an old version of a part with a new version. The Floating Load mode even searches for empty Tracks and Macros in which to load data, and leaves the existing data untouched.

*Continued on page 12*

In addition to its cassette capabilities, the QX5 can send and receive System Exclusive bulk information over MIDI. This feature allows you to exchange sequence data with another QX5 or a computer. Like the cassette functions, you can save or load Tracks or Macros individually or in groups, and the Floating Load mode is available.

### MIDI Implementation

The QX5 gives you a number of MIDI setup options. In addition to the options discussed earlier—MIDI filtering, MIDI channelizing—the QX5 also transmits and receives Song Position Pointer. This means that if you have a QX21 (or any other device that responds to Song Position Pointer) synchronized to the QX5 through

MIDI, you can start the QX5 at any point in the song, and the QX21 will jump to the same point.

The amount of time it takes for each receiving device to respond to a Song Position message sometimes varies, so a delay feature is available that allows the QX5 to send out the Song Position and then wait for a specified period before it actually starts. This guarantees that all the receiving devices will be ready to play at the same time. If it becomes necessary, you can turn on or off the QX5's ability to send or receive MIDI Song Position, Song Select, Start, Continue, and Stop signals with the Remote In/Out features. There's also a MIDI Monitor that lets you see which MIDI channels are currently being transmitted or received.

*This chart compares many of the basic features of the QX5 with those of the QX1.*

QX1	QX5
8 Tracks	8 Tracks
32 Banks, 8 Chains	32 Macros
8 MIDI OUTputs	1 MIDI OUTput
384 clocks per quarter-note	96 clocks per quarter-note
80,000+ notes	20,000 notes
Unlimited memory with 5.25" internal disk drive	No internal disk drive
Bulk data storage on disk: 16 bulk memory locations	No bulk data memory available
No cassette interface	Cassette interface with flexible save & load operation
40x2 backlit LCD display	16x2 backlit LCD display
Chain Mode for continuous music playback	No Chain Mode
Step-entered data through Edit Mode	Step-entered data through new Step Record Mode
Punch-in capable	Punch-In and Punch-Out fully automated with Auto Locate
Extensive Track, Measure, Event Edit capability	Extensive Track, Measure, Event Edit Modes
Records with Internal Clock	Records with Internal Clock and External Clocks (MIDI and FSK)
1 MIDI channel per Track	16 MIDI channels per Track and Macro
Does not record System Exclusive data	Records System Exclusive data
Extensive Job Commands in Edit and Utility modes	New Job Commands include Shift Data, Crescendo, Extract Data, Thin Out, Rechannelize INput/OUTput

# YCAMS Diary

Professor Ardean Watts has a varied musical background: As a youth, he played piano in a number of college dance bands and, in the mid-Fifties, had one of the last regularly-working big bands in the Salt Lake City area. Upon graduation from college, he considered the possibility of a career as a concert pianist, but his first steady job was on the Music Faculty of the University of Utah, where he became director of the opera workshop and university choruses. In 1957, he joined the Utah Symphony Orchestra as pianist, and eventually became associate conductor, a post he held for 11 years. In addition, he was musical director of Ballet West for 15 years. Given this eclectic background, people should not have been surprised when, at age 53, he became curious about the new electronic musical instruments. What follows is the personal record of his first musical experiences with YCAMS at the University of Utah.

. . . .

WHEN MY SON BROUGHT a personal computer home at Christmastime a few years ago, I didn't comprehend how it might alter my life as a professional musician. However, it was obvious from my first elementary experience (putting a Bach two-part invention into the computer and hearing it played back) that here were powerful musical resources to be reckoned with.

I spent the summer of 1981 reading all I could about electronic music, as well as spending many hours in the classical electronic studio established on our campus by electronic pioneer Vladimir Ussachevsky. A tour of studios and educational institutions on the West Coast convinced me that there was a future for the new instruments being developed primarily for the popular music industry in our higher education Music Department.

By this time, the acronym MIDI was beginning to appear in advertisements, and there was much talk about a new synthesizer called the Yamaha DX7 coming out on the market. I had tasted the wonders of the Synclavier and Fairlight, but our department did not have the resources to consider these our primary instruments, so we added our names to the waiting list for DX7s. Two found their way into my living room, and five were placed in various faculty offices in the University Music Department.

My primary interest was to find applications

for these instruments that were compatible with our educational mission. The first major project was a concert and demonstration in May of 1985. The program included selections from the classical piano repertoire played on two DX7s MIDIed together, the *Symphony No. 11* by Henry Cowell played by a synthesizer ensemble consisting of five players (each player with two DX7s MIDIed together), and a short 8-track composition generated on the Yamaha QX1 digital sequencer (which had just come onto the market weeks before the concert). Hard copies of the first page of the computer piece were generated during the concert using Jim Miller's Personal Composer program running on our IBM XT computer; these were duplicated and passed out to those who attended at the end of the concert.

Encouraged by the response of the audience and the Music Department administration to our first public performance, I undertook a composition project during the summer in order to become familiar with our newly acquired TX816 FM system. Incidental music for a production of Shakespeare's *The Tempest* by the University Pioneer Memorial Theatre Company was created on the QX1 playing the TX816, utilizing a lot of spacey sounds along with rain, wind, and thunder, all done with DX7 voices. The score was recorded directly from our mixing system to tape, and was used in that form for the production (which played for four weeks).

By that time, I was interested in developing applications which might be of use to our orchestration and composition students. They have a difficult time getting competent performances of their efforts. To be able to hear and change things before they are performed publicly would be an incredible luxury for them. When my Department chairman and director of the University A Cappella choir proposed that I synthesize the orchestration of Carl Orff's brilliant cantata *Carmina Burana* for a live performance with his choir, I was intrigued particularly because it would necessitate my assembling or creating sound resources corresponding to a symphony orchestra for the TX816.

I began the process of auditioning thousands of voices we had acquired from DX PRO, Key Clique, Yamaha, and other sources to create a TX orchestra. My approach was to make available multiple timbres of each orchestral instru-

*Continued on page 14*

**A MIDI Adventure In Academia. By Ardean W. Watts.**

# YCAMS Diary *Continued*

ment in horizontal placement in all modules, so they could be mixed or matched. All of the voices were edited to provide numerous attack options, and all were to be controlled in volume by the Foot Controller with Amplitude Modulation Sensitivity to the maximum setting. In this mode, any controller could be used to make instrumental parts more expressive. Most of the voices came from our library, but there were specific needs which required making new voices. After about three months of this process, I had to settle for what I had and get on to the process of making the orchestral transcription and inputting it into the QX1.

Because I have conducted at least 20 performances of *Carmina Burana* with symphony orchestra and chorus, I knew exactly what the orchestration should sound like. Of course, many compromises had to be made to limit the colors to the eight available tracks of the QX1 and TX816. I quickly discovered that too many modules were being used up to realize the rich percussion demands of the Orff score, so I added a Sequential DrumTracks to the mix, equipped with some special sound chips from Digidrums. The drum machine was played by the lower half of one module track, leaving me free to utilize the notes from C3 up for voices in the module's memory.

The process of inputting the orchestration was laborious at first. I quickly gave up the practice of recording them live, because of the difficulties I might later have in controlling the synchronization with chorus. I ended up inputting all of the notes individually with one hand on the KX88 keyboard and the other on the QX1 keyboard. The first six measures took me several days, but my facility increased until near the end I could input an entire 2 to 3 minute piece in a few hours.

I considered the result to be about 75% successful in emulating the sounds Orff wanted from the symphony orchestra. I'm sure that could have been improved upon with more time, but the deadline of May 16, 1986, demanded that I make sacrifices in order to finish. The deadline for the completion actually came much earlier because of our decision to stage the *Carmina* performance as a ballet using the University's justly famous Utah Ballet Company.

The third phase of the project involved by far the greatest gamble. To require the chorus and dancers to perform to a pre-recorded tape

would have been no more than a mime performance, and was of little artistic interest to me. The real challenge was to find a way of manually outputting the performance data from the QX1 so that it could be controlled in real time in response to the conductor's signals. I was not willing to settle for the tempo control which is part of the QX1—what I needed was absolute control over every note as far as time was concerned. After a lengthy search, we found no device commercially available that would accomplish that task, so I asked my son, a senior electrical engineering student at the University of Utah who has custom-built a number of devices for me (including a DX7 pedal meter which gives a visual indication of exactly how far a pedal controller is depressed at a given instant), if he could produce such a device. The 90% odds he gave me were sufficient.

The week I finished inputting the final chorus of *Carmina* into the QX1, my son delivered the first version of the manual MIDI controller. We called it Milton's Box. It worked well enough to keep our hopes alive, but had sufficient problems to raise concerns. The second version performed slightly better, but still fell short of perfect control, especially when it came to predicting where subdivisions of the beat should fall. One week before our first performance, the final version was delivered with a caveat from the maker that "If this doesn't work there is nothing that I can do." A nervous test session found the device unusable. My son protested that there might be some anomaly which made it incompatible with the QX1—in testing it at home it had controlled the musical output of sequences recorded into Mark Of The Unicorn's Performer on the Apple Macintosh without problems.

That weekend I witnessed a MIDI miracle, and by Sunday had moved all of the files from the QX1 to the Performer program in the Macintosh computer. Although the Performer software does not accept time signature and tempo changes as part of its own stream of MIDI data, it read all of the strange time signatures of the Orff score without a hitch, and Milton's box performed its task magnificently. The box enables the player to select the note value he/she wishes to control by tapping a switch on the box. We were as incredulous as the students when I was able to follow the conductor per-

*Continued on page 20*

# Performance Controllers

IT'S A NEVER-ENDING QUEST to synthesize "real-world" sounds. FM digital synthesis is capable of producing realistic and expressive sounds, but it's your style that really brings the performance to life. One way to "show some style" is to express yourself with performance controllers.

You may already be familiar with several types of performance controllers; for example, you are probably using Wheel controllers for Pitch Bend and Modulation effects. There are a number of other controllers available for use with many Yamaha products, such as Continuous Slider, Push Switch, Momentary Switch, and Aftertouch.

All of these controllers have a variety of uses, but for now, let's focus on three of the most common performance controllers: Footswitch, Foot Controller, and Breath Controller. Within these types of controllers, this article will examine the Yamaha FC4, FC5, and FC8 Foot Switches, the Yamaha FC7, and FC9 Foot Controllers, and the Yamaha BC1 Breath Controller.

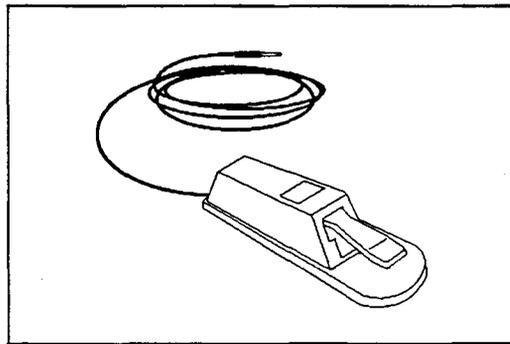
In the first section of the article, you'll read brief descriptions of the controllers listed above. Next, you'll find tips on how to use them with specific Yamaha keyboard controllers and tone generators. Finally, you'll discover that even though your system might not have inputs for some of these controllers, you can still take advantage of the exciting possibilities they offer through the use of Yamaha MIDI accessories.

## Yamaha Controllers

**FC4 Footswitch:** The FC4 is a piano-like pedal that can be used in a variety of applications. With many synthesizers (like the DX7), the FC4 can be used to control sustain or portamento on/off.

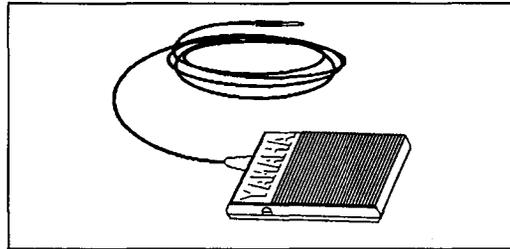
**FC5 Footswitch:** The FC5, designed as a simple foot switch rather than a piano-like foot pedal, can be used in applications similar to those of the FC4 or FC8. Although it can function as a sustain pedal, it is more commonly used for other on/off applications such as portamento.

**FC8 Footswitch:** The FC8 is also a piano-like pedal, specifically designed for use with Yamaha's PF80 and PF70 Electronic Pianos. When the FC8 is used for sustain with these two PF models, four levels of "half-pedal" sustain are

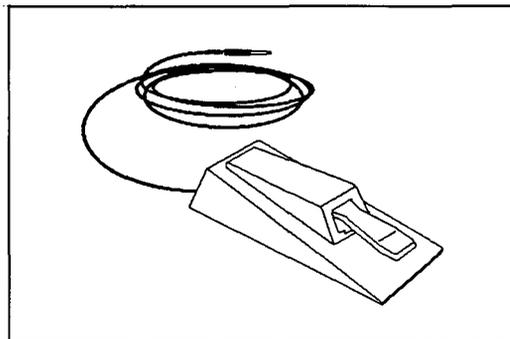


Use Synthesizer Controllers To Personalize Your Music. By Brad Vinikow.

FC4 Footswitch Controller.



FC5 Footswitch Controller.



FC8 Footswitch Controller.

available on most voices. When used with other instruments (such as the DX7 and older PF models) that are not designed to take advantage of the half-pedal capability, the FC8 will function as a normal on/off Footswitch.

**FC7 Foot Controller:** The FC7 is a continuous volume-type pedal. It uses a rotary potentiometer control, and is compatible with the older photo-interpret type of controller (such as the FC3A). Like the FC3A, the FC7 is a CV (Control Voltage) controller that can be plugged into the Volume or Modulation jack of a DX7 or other similar synthesizer. A spring-return feature lets you preset a position between on and off. You might think of this as "AfterTOE."

**FC9 Foot Controller:** The FC9 has 2 input jacks and 2 output jacks, and can be used to control the audio volume of 2 separate instruments. In addition, Output 2 can be switched

*Continued on page 16*

# Controllers *Continued*

to function as a CV (Control Voltage) controller (like the FC7), and can be plugged into the Volume or Modulation jack of most synthesizers. The FC9 also provides a Minimum Volume control that allows you to set the volume range.

**BC1 Breath Controller:** The BC1 allows you to add a new dimension of control to brass, horns, and other wind instrument voices. By blowing into the BC1's mouthpiece, you can articulate the phrasing of a wind instrument voice with added realism.

\* \* \* \*

So, you have your instrument and your controller(s) in front of you—now what? First, determine what type of a controller you are working with. Is it a switch-type controller, like the FC4, FC5, or FC8; or is it a continuous-type controller like the FC7 or FC9? Each type of controller lends itself to different applications.

## Switch-type Controllers

Switch-type controllers are best used to control functions that are either on or off, such as Sustain, Portamento, Sustain, or Soft Pedal.

Switch-type controllers can also be used to toggle between two modes. For example you might switch between Poly and Mono, or turn the Omni mode on and off.

You might also use your Footswitch controller to Start, Stop, or Continue your sequence or drum machine. This application frees up your hands for other things (like playing on the down beat).

## Continuous-type Controllers

Continuous-type controllers are best used for functions that respond to values between off and on, such as Volume and Portamento Time.

Many of the parameters that make up a voice, such as LFO Speed or Operator Output, are continuous. In some cases, you can use a continuous controller to vary a parameter in real time. This gives you the ability to change the timbre of a sound during performance. As is always the case, check to be sure your tone generator will respond to real-time parameter changes.

Tempo is another continuous function. Therefore, you might use your Foot Controller

to speed up or slow down a sequencer or drum machine.

## FM Programming Tips

It's beyond the scope of this article to discuss specific FM programming techniques. However, it is important for you to know that voices must be programmed to respond to a controller in order for you to hear an effect. In other words, certain parameters in each FM voice determine which controllers will have an effect on the voice, and what this effect will be.

As a place to start, look at the Function settings in a DX or TX voice. You'll see the current values for the various controllers. The possible sources (controllers) include Modulation Wheel, Foot Controller, Breath Controller, and Aftertouch. The possible destinations (parameters that will be controlled) include Pitch Bend, Pitch Bend Range, Amplitude, and EG Bias.

Other FM parameters that determine the overall effect of controllers on a voice are Pitch Modulation Depth, Amplitude Modulation Depth, Pitch Modulation Sensitivity, and the EG Rate and Level settings.

The following table lists five kinds of voice effects, and shows the appropriate FM parameters that must be programmed to enable the effect.

Effect	FM Parameter
Loudness	EG Bias of the Carrier(s)
Brightness	EG Bias of the Modulator(s)
Vibrato Depth	Pitch Modulation Sensitivity Pitch Modulation Depth LFO Speed
Tremolo Depth	Amplitude Modulation Sensitivity Amplitude Modulation Depth LFO Speed
Pitch (DX21/27/100)	Pitch EG

Now let's take a look at some specific applications.

## DX7 Tips

Let's choose an algorithm with more than 1 carrier, say Algorithm #5. Let's say operator pairs 1-2 and 3-4 are programmed to produce an electric piano voice, leaving operator pair 5-6 available to produce a brass voice. Therefore, if we were to play the DX7, we would hear electric piano and brass playing at the same time.

To allow the Breath Controller to vary the audio output of operator pair 5-6, follow these steps:

1. Set operator 5 Amplitude Modulation Sensitivity to 3.
2. Set Breath Control EG Bias ON.

This programming technique allows you to play an electric piano voice on your DX7, and by blowing into the BC1 Breath Controller you can accent it with a brass sound!

This technique can also be used with other types of sounds, to control them with a Mod Wheel, Foot Controller, or Aftertouch. Simply follow the steps above and enable the desired controller to vary the EG Bias of the operators you want to control.

### TX816 Tips

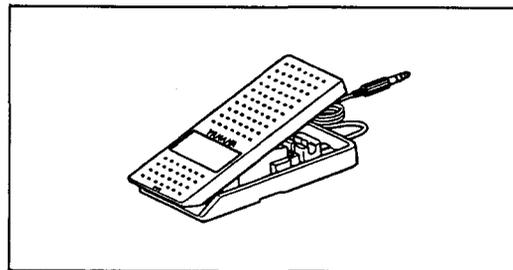
The factory voices for the TX816 incorporate some very interesting uses for the Mod Wheel, Foot Controller, and Breath Controller. Let's take a brief look at some ideas used in these voices.

Voice program 10 offers a tremendous variance in timbre, volume, and overall presence through the use of controllers. Modules 1 and 2 provide a percussive synth sound; the Mod Wheel is used to control its volume in the mix. Modules 3, 4, 5, and 6 have a filter sweep sound that is completely controlled by the Foot Controller. Modules 7 and 8 are a chorus synth sound whose volume is controlled by the Breath Controller. This program demonstrates one way to use the controllers across several modules in the TX816. It takes a little practice to use this many controllers comfortably in a performance, but the expressive freedom can be very powerful.

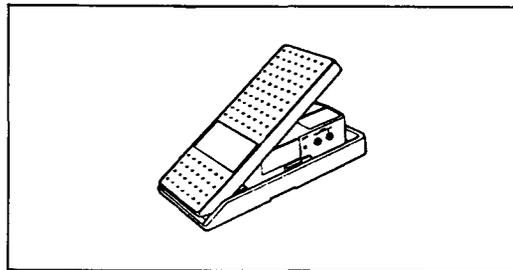
For a more detailed explanation of how other TX816 factory voices are set up, please refer to the TX816 FM Tone Generator System Performance Notes.

### KX88/76 Tips

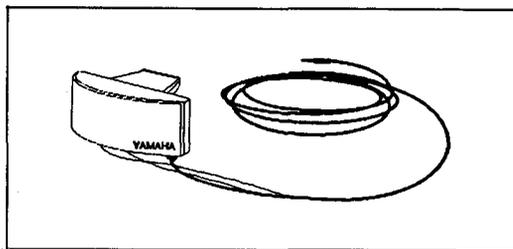
The KX88 and KX76 offer a whole world of possibilities for utilizing performance controllers. On the right side of the KX front panel is a controller Code Preset Table. These values represent functions that may be assigned to a specific controller. For example, a Foot Controller may be assigned to control MIDI Volume. It



FC7 Foot Controller.



FC9 Foot Controller.



BC1 Breath Controller.

could just as easily control modulation or MIDI Foot Control.

If you don't have a BC1 and want to try a voice that responds to MIDI Breath Control, assign a Foot Controller to send Breath Controller messages.

Besides the MIDI Channel messages (that include Potamento Time and Volume), the KX keyboards also offer a variety of MIDI Mode messages, MIDI Real Time commands, MIDI System Exclusive messages, and Internal System settings.

For more detailed information on how to assign functions to the KX controllers, refer to the October 1986 issue of *AfterTouch*.

### AfterTOE

Located on the FC7's bottom panel is a screw that allows you to adjust the AfterTOE spring-return function. This useful feature allows you to preset a pedal position. In other words, you determine a useful setting (angle) for the FC7. This setting can be accessed quickly and consistently in your performance by

*Continued on page 18*

pressing the pedal all the way down: It will spring back to the preset position. You still have full range of the pedal, and have the added convenience of a preset position that is somewhere between off and on.

Simply use a Phillips screwdriver to set the desired position of the SPRING POINT ADJ. Turning clockwise raises the toe position angle, while turning counterclockwise lowers the toe position angle. The maximum angle is about 10 degrees; minimum is 0 degrees.

## BC1 Sensitivity

There are several ways to adjust the sensitivity of your BC1 Breath Controller.

Start by placing a small piece of tape over the air hole located on the top of the BC1. Try the response with the hole completely covered. You can further adjust the sensitivity by poking a small hole in the tape.

Another way to adjust the sensitivity is to rotate the small plate located inside the bottom of the BC1. You will need a small jeweler's screwdriver to do this. This adjusts the BC1 pressure transducer's sensitivity, and has been preset at the factory.

Of the two methods just described, try the tape method first.

## Lock It Up

A small plate located on the bottom of the FC7, FC8, and FC9 allows you to lock two or more pedals together. This prevents them from sliding out of place during your performance. Simply take a Phillips screwdriver and remove the four screws on the bottom of the panel. This will also remove the plate. Flip the plate around so half of it hangs over the edge of the panel. Replace the screws that held it in place before and use the other two screws to secure the other pedal.

## MCS2 MIDI Control Station

Scenario #1: You've read through this article, and are saying, "Great examples, but my PF80 doesn't have a Breath Controller input." Well, you can still take advantage of these controller possibilities by using a Yamaha MCS2 MIDI Control Station.

The MCS2 allows any MIDI keyboard to become a MIDI master keyboard controller. For

example, you can add Breath Controller or Foot Controller messages to the MIDI output from a PF80 or CP70M Electric Grand!

The MCS2 has 12 controllers. The Pitch Wheel, Mod Wheel, and Breath Control are fixed. There are also 9 other controllers that are assignable. These include 2 Continuous Sliders, 2 Foot Controllers, 3 Push Switches, and 2 Footswitches.

The April 1986 issue of *AfterTouch* explains how to incorporate an MCS2 into a MIDI system.

## MEP4 MIDI Event Processor

Scenario #2: You are saying "Nice article, but I'm already doing that stuff. What else is new?" You are the kind of player who enjoys pushing their equipment. To explore new ways of using your controllers (and your MIDI system), there is the Yamaha MEP4, a powerful and highly flexible MIDI Event Processor.

The MEP4 allows you to modify MIDI data in many useful ways. Here are a few examples of how you might use an MEP4 to enhance your performance controller setup:

1. Make a controller more or less sensitive via MIDI. This involves adding or subtracting an offset amount to the controller's data byte.
2. Simultaneously send the controller's output to up to four different tone generators. Each tone generator could receive the same message at the same time, or you could send each message out at a slightly different time (up to 3000 milliseconds delay between the earliest and longest delay).
3. Send the controller's messages as is to one tone generator, but reverse it for a second tone generator. This would allow you to increase one synth's volume and decrease another synth's volume at the same time. This is similar to cross fading.
4. Limit the range of a controller, beyond which its MIDI data will be sent to a different tone generator.
5. Convert one type of Control message into another. For example, convert Breath Control into Pitch Bend.

The June 1986 issue of *AfterTouch* explains the basic operation of an MEP4 and offers several examples that incorporate an MEP4 into a MIDI system.

# Editor

Continued from page 3

contain a kind of informational flag that defines them as belonging to one of the 16 MIDI channels—in this way, every Note On sent from a MIDI instrument is given a channel assignment. It is this kind of flexibility that allows MIDI sequencers (such as the Yamaha QX21 and Roland MSQ-700) to record information that can contain as many as 16 different musical elements, even though they have fewer than sixteen locations in which to store that information.

The end result is digital information (traveling down one cable) that can tell a number of different instruments to play different music. Imagine a chain of instruments: The MIDI OUT from a sequencer is connected to the MIDI IN of instrument 1; the MIDI THRU of

instrument 1 is connected to the MIDI IN of instrument 2; the MIDI THRU of instrument 2 is connected to the MIDI IN of instrument 3; and the MIDI THRU of instrument 4. Each instrument is assigned to a particular MIDI channel, instrument 1 to channel 1, instrument 2 to channel 2, and so on. The sequencer sends information that is coded for these specific channels, and each instrument responds only to the information that is coded for its particular channel.

Instruments are told to respond only to certain information by assigning them to a particular *Mode* of operation (and, if appropriate, to a specific MIDI *channel*). For the story on MIDI Modes, tune in next month.

—TD

**LET US HEAR FROM YOU!** We want AfterTouch to be an information network for *all* users of Yamaha professional musical products, so please join in. We're looking for many different kinds of material.

Have you created an incredible patch for the DX7, the DX100, or any of the other members of the Yamaha FM digital synthesizer family? How about a program for the CX5M music computer or a great pattern for the RX11? Send in your patches, programs, and patterns. If we use your material, we'll give you full credit plus \$25.00 for each item used.

Have you discovered a trick that increases the musical flexibility of one of the Yamaha AfterTouch products? Send it in to our "FinalTouch" column. If we use your hot tip, you'll receive full credit plus a check for \$25.00.

Have you developed a new approach to one of the Yamaha AfterTouch instruments, or have you discovered an important secret regarding their use? Put it on paper and send it to us. Don't worry about your writing style—just get the information down. If we decide to use your material as a full article in AfterTouch, we'll write it up, put your name on it, and send you a check for \$100.00. (An AfterTouch article always covers at least one magazine page—which translates to at least four double-spaced pages of typescript.)

By the way, we cannot assume liability for the safe return of unused ideas, patches, or manuscripts. We will only be able to return unused material if you enclose a self-addressed, stamped envelope with your submission.

If you just have a question regarding the use of Yamaha professional musical products, send it along too, and we'll do our best to answer it in the pages of AfterTouch. (We regret that we won't be able to answer questions through the mail, but we will use all of your questions to guide us in our choice of future topics.)

Finally, if you just want to get something off your chest, or if you'd like to establish direct contact with other Yamaha AfterTouch product users, send in something to our letters column, "Touch Response." We'll do our best to print names, addresses, and phone numbers of all those who are interested in starting up regional users groups.

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# YCAMS Diary

*Continued from page 14*

fectly during our first rehearsal with chorus four days before opening.

Unfortunately, our cliff-hanging days were not over: One major bug remained. Milton's Box was designed to control the output of the QX1, but in its interface with the Macintosh it would not always start a new section on the first tap. Such behavior was impossible for us to live with, since on many selections the chorus and dancers had to start with the first note of the synthesized score. Every day we felt we were closer to a solution. Our dress rehearsal came and went with the problem persisting—it would start correctly on two out of three tries. Four hours before the production was to start, Milton's Box was open on the work bench with circuits exposed as we tried to find the cause, while I was considering booking an afternoon flight to Mexico. At six o'clock I checked in to find that a solution had not been found. Just as he was assembling the parts to close it up, I heard my son say, "Wait a minute, I just had an idea." Minutes later, we had rushed back to the concert hall and were hooked up to the system. Every start was a winner. We opened less than two hours later, and presented a very clean performance to an enthusiastic audience, followed by a successful run of four performances.

It must have been a strange sight for the

concert audience to see the conductor and myself coming down the aisle in full dress. After the bow, I seated myself in front of the conductor at a table on which was a Macintosh computer and a little black box. Behind me were the flashing red lights of the TX816 as it received the stream of MIDI data being output by my finger on the little white tap button. Through two enormous islands of speakers suspended from the ceiling, the powerful sounds of FM synthesis blended with the amplified voices of 80 singers to provide a physical sound experience even for patrons on the last row of the balcony.

The gear has been returned to my studio now, and I am deeply involved in a project to provide MIDI stations for use by our undergraduate music majors beginning in Autumn of 1986; the smallest of these stations will consist of a Macintosh computer, Mark Of The Unicorn's Performer and Professional Composer software, and Yamaha DX system keyboards. My next major creative effort will be a major composition using a sampling synthesizer to be added to our present battery. We are adding instruments on a semester basis. This is not the end of a MIDI adventure, but only the beginning of what I believe to be the most powerful revolution in the history of music.