AFTER TOUCH™

THE OFFICIAL PUBLICATION OF THE YAMAHA USERS GROUP

7 SYSTEM: QX7, TX7, DX7

NOVEMBER 1985

YAMAHA®

AFTERTOUCH

November 1985 Volume 1, Number 2

A product of GPI Editorial Services Tom Darter, Director P.O. Box 2338, Northridge, CA 91323-2338

AFTERTOUCH is published monthly. Third class postage paid at Long Prairie, MN and additional points of entry. **SUBSCRIPTIONS:** Free. Address subscription correspondence to AFTERTOUCH, P.O. Box 2338, Northridge, CA 91323-2338. **POSTMASTER:** Send form 3579 to P.O. Box 2338, Northridge, CA 91323-2338.

From The Editor

WELCOME TO THE SECOND issue of AFTERTOUCH. As we explained in the first issue, AFTERTOUCH is a new monthly publication designed especially for users of the Yamaha line of FM digital synthesizers, music computers, and related MIDI products. AFTERTOUCH will appear every month, and will be available free of charge—a regular informational service from Yamaha.

The aim of AFTERTOUCH is simple: To present information on the use of the X series line of products. There will be no advertising, and no sales pitches—just solid, hands-on information that will help you use Yamaha professional musical products to realize your artistic goals.

But we don't plan to stop with one-way communication. If you are reading this, then chances are that you already have some experience with X series products. We invite you to share your knowledge by sending it to AFTERTOUCH. If we use your article, hot tip, or patch, we will pay you for it, and will present it to your fellow musicians. They, in turn, may be able to combine your thoughts with theirs and come up with an even better idea for all of us to share.

Do you belong to or want to start a Users Group in your region? Send us a letter: Include your address and (if you wish) your phone number. We'll print it, and others in your area will be able to contact you to set up meetings, information swap meets, or other gatherings.

Send us questions too. Regular customer service questions should still be sent to Yamaha, but if you have a question on how to use an X series product, send it along to us, and we'll do our best to find the answer and share it with all of our readers.

The first issue of AFTERTOUCH has already reached thousands of musicians, and the responses are pouring in. We will start to share them with you next issue, in an expanded Questions column, in our first letters column ("Touch Response"), and in our first collection of hot tips ("Final Touch"). Until then, enjoy our second issue. See you next month!

—*TD*

AFTERTOUCH is a new monthly informational publication from Yamaha.

Receive AFTERTOUCH *Free* Every Month!

YOU HAVE RECEIVED THIS ISSUE of AFTERTOUCH because we know that you have purchased a Yamaha professional musical product, or that you frequent a store in which Yamaha products are sold. You can continue to receive AFTERTOUCH for an entire year, absolutely free, just by sending in the postcard that is bound into this issue.

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After you have signed the card and indicated your correct name and address, put a stamp on the postcard and mail it to us. 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. We just need the postcard to make sure that we have your correct address, and to make sure that you want to receive AFTERTOUCH every month.

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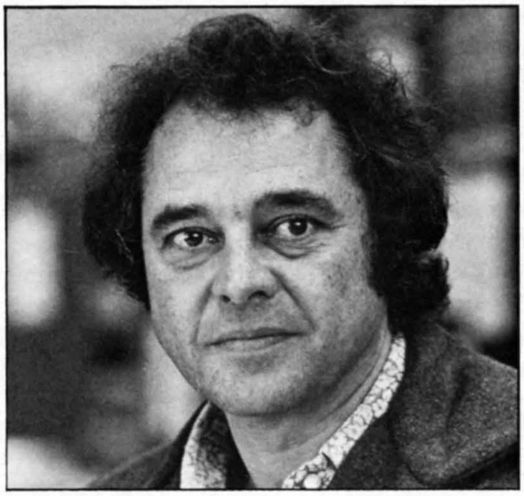
To receive AFTERTOUCH every month, absolutely free, just put your name and address on the enclosed card and mail it to us.

John Chowning

Part 1 Of An Exclusive Interview With The Father Of Digital FM Synthesis. By Tom Darter.

AS DIRECTOR OF THE Center for Computer Research and Musical Acoustics at Stanford University [CCRMA], John Chowning has long been an articulate and enthusiastic spokesman for music produced by electronic means. While still a graduate student in composition at Stanford in 1964, he became interested in electronic music. Since the school had no analog synthesis equipment but did have a large computer, he jumped directly into digital synthesis.



In the '70s, the results of his research in the field of digital FM synthesis were licensed to Yamaha, and the rest is history. As you will discover from this exclusive, two-part interview, Dr. Chowning's keen insights are important for any student of FM. In part 1, Chowning explains his early work with FM, and describes the convoluted pathway that connected his original theory of digital FM to its current pinnacle of commercial success—the Yamaha DX7 synthesizer.

* * * *

TD: *When did you first start working with digital FM [frequency modulation] seriously?*

JC: I guess there were two little chunks. The first step was in 1966-67, when I explored FM in the essential algorithm forms—parallel modulators, parallel carriers, and cascade. At the same time I was also working on spatial illusions. That was coming to a point of usability, so for a couple of years I concentrated on that, and didn't do much with FM.

Then in about 1970 I remembered some work that Jean-Claude Risset had done at Bell Labs, using a computer to analyze and resynthesize trumpet tones. One of the things that he realized in that work is that there is a definite correlation between the growth of intensity during the attack portion of a brass tone and the growth of the bandwidth of the signal. For the first few milliseconds, what energy is there is mostly around the fundamental; and quickly, as the intensity grows during the next 30 or 40 milliseconds, more and more harmonics appear at a successively higher volume. I thought about that, and I realized that I could do something similar with simple FM, just by using the intensity envelope as a modulation index.

That was the moment when I realized that the technique was really of some consequence, because with just two oscillators I was able to produce tones that had a richness and quality about them that was attractive to the ear—sounds which by other means were quite complicated to create. For example, Jean-Claude had to use 16 or 17 oscillators to create a similar effect using additive synthesis techniques.

TD: *What was your next step?*

JC: At that point, I really hooked into it and wrote the first paper. Max Mathews [of Bell Labs] was astonished that such rich tones could be synthesized so easily, and advised me on a rewrite to make the presentation a little more compact. The result was finally published in 1973 by the AES [Audio Engineering Society]. It has also been reprinted a couple of times in Computer Music Journal. That paper really settled it in my mind. After writing it, I felt that I really understood what was going on—how to predict it, how to use it in some ways.

TD: *How did Yamaha become involved?*

JC: Right after I crystallized the ideas in my mind, the Office of Technology Licensing at Stanford [OTL] thought there might be some commercial interest in the idea. The University contacted the obvious people: The major organ manufacturers in this country, and perhaps some synthesizer people, too. Representatives from a few manufacturers came out. One of the American organ companies expressed a fair amount of interest, and sent engineers a couple of times. Ultimately, their engineers decided that it just wasn't practical for them. Frankly, I don't think their engineers understood it—they were into analog technology, and had no idea what I was talking about.

Then the Office of Technology Licensing put a graduate student from the Business School on the case. He did a little research, and discovered that the largest manufacturer of musical instruments in the world was Yamaha. This was a bit of a surprise, since they did not then have a significant market in the U.S. at the time. The officer at Stanford's OTL wrote to Nippon Gakki in Hamamatsu, Japan. It happened they had one of their chief engineers visitng their American branch at the time [Yamaha International Corporation, or YIC, located in Buena Park, CA], so he came up to Stanford for the day. In ten minutes he understood; he knew exactly what I was talking about. I guess Yamaha had already been working in the digital domain, so he knew exactly what I was saying.

TD: *When did Yamaha actually take out the license on your concept of digital FM?*

JC: I think it was around 1975 when they actually took the license, but they started working with us before that. They put a few good people working on it right away, and the first result was the GS1, which was of course much more expensive than they wished it had been.

TD: *Why was that?*

JC: It was filled with IC [integrated circuit] chips. I think what was going on is that while they were developing ideas about the implementation of digital FM, they were also—quite independently—developing their own capability to manufacture VLSI [Very-Large-Scale Integration] chips. It was the convergence of these two independent projects that resulted in the first practical instrument, which was the DX7. The GS1 was probably one generation of chip technology older, so they had to use many more chips than they ended up using in the DX7—something like 50 to 2. Of course, that's not a one-to-one correspondence in power, but it's not too far off. I think Yamaha deserves a whole lot of credit for getting that VLSI implementation going in such an effective way.

They also added some very clever things in their implementation of the algorithms; things that were not obvious—not quite straightforward in the way one would usually work on a computer—in order to gain efficiency and speed. The consequence is that the bandwidth of the DX7 gives a really brilliant kind of sound. I guess there's something like a 57kHz sampling rate in the DAC [digital-to-analog converter]. The result is far better than we can get with equivalent density on our digital synthesizer here at Stanford. When we are running 96 oscillators, which is what the DX7 has, we have a maximum sampling rate of around 25kHz to 30kHz. That's only about 12kHz or 13kHz effective bandwidth. The DX7 is better than that, and I think it's quite noticeable.

TD: *So Yamaha created the first hardware implementations of your basic idea?*

JC: That's right. As far as I know, there were no digital hardware devices realized before Yamaha's first prototypes.

TD: *In your early digital FM experiments, back in 1966-67, was it impossible to use envelopes to determine modulation indexes?*

JC: No. I was using envelopes in that way, but I hadn't made the conceptual breakthrough. We had done bell tones: As the intensity falls away, so does the modulation index, so you go from complex inharmonic tones to essentially a damped sine at the threshhold. The breakthrough for me was the realization that there is always such a strong coupling of bandwidth and intensity in most sounds, and that it is extraordinarily easy to implement that effect using digital FM synthesis.

TD: *Did you develop a large vocabulary of digital FM algorithms in the early stages of your work?*

JC: No, I was working with the basic forms: Simple FM, involving an FM pair of one modulator and one carrier; parallel carriers, where one modulator branches off into several carriers; parallel modulators, where a number of modulators feed into one carrier; and cascade, where a number of modulators are stacked, and you have modulators modulating other modulators. These were the basic things I had tried. I realized that the idea was definitely extensible—not just some uniquely useful synthesis technique which would do bell sounds and nothing else. I was quite sure that it was extendable. The fact that you could alter the algorithm in all these different ways and have different kinds of power was obvious to me.

TD: *Did you define the basic FM algorithms for the DX7 and DX9?*

JC: That was pretty much their decision. I talked to them a lot in the early days about the importance of things like key scaling, which is I think fundamental to the power of the DX7: With one function you can change the bandwidth as you go up, just by scaling the function of pitch. This is particularly important in the digital realm, I knew, because of aliasing: When you're trying to produce frequencies that are at

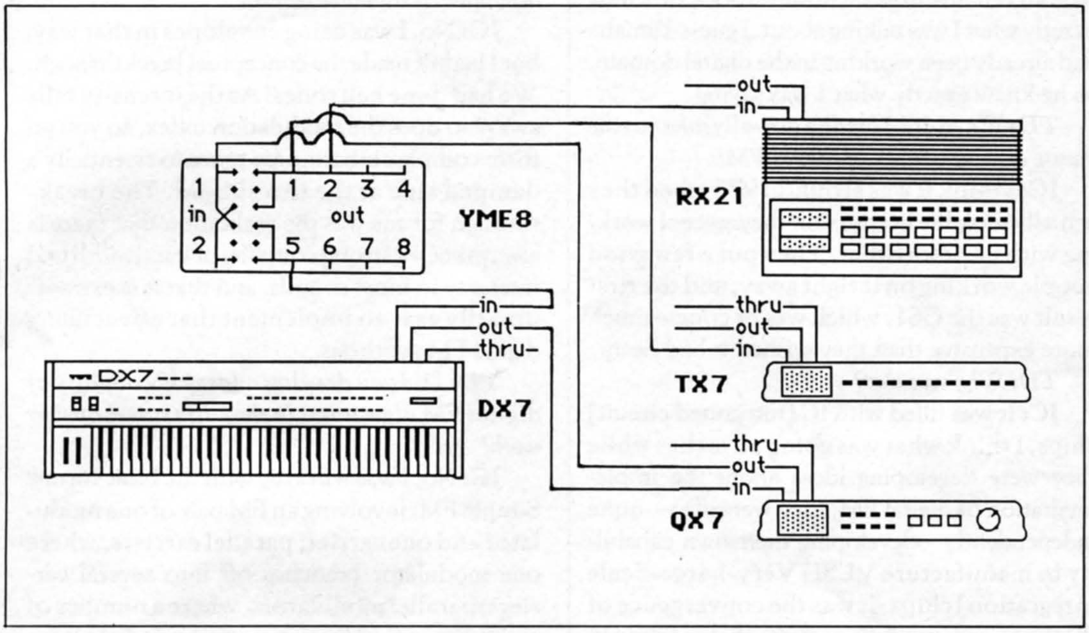
Continued on page 20

"With just two oscillators I was able to produce tones that had a richness and quality about them that was attractive to the ear."

7 System: QX7, TX7,

How To Use These Instruments To Create A Self-Contained Music System. By David Schoenbach & Tom Darter.

MIDI HAS BROUGHT about major changes in the ways electronic musical instruments are used to make music. Before MIDI (the Musical Instrument Digital Interface), most instruments were discrete machines, brought together only in live performance or via the medium of tape recording. With MIDI as a common interface language for electronic instruments, it has become more feasible for both designers and musicians to adopt a "systems" approach in their thinking.



Here are the basic MIDI connections for the 7 System, which includes a QX7 sequencer, a DX7 synthesizer, a TX7 tone generator, and an RX21 rhythm unit, plus a YME8 MIDI Expander box.

The Yamaha "7 System" is one result of this approach to design. Although each component of the system can function in a number of musical settings (separately or in various combinations), when brought together they form an integrated unit for making music.

Each component of the system is important. The QX7 digital sequence recorder is central, functioning as both a MIDI recorder and playback unit. The DX7 digital synthesizer is used as both a tone generator and an input keyboard for the sequencer. The TX7 digital tone generator provides a second sound source. And the RX21 digital rhythm programmer adds the percussion dimension to the system.

The units work together physically as well: The RX21, TX7, and QX7 are designed to stack on top of each other (with a little support in the back), and will therefore take up very little space next to your DX7. With the addition of a simple MIDI THRU-box such as the YME8, you will have a complete, integrated, expandable music-making system.

The basic setup is simple. The DX7 is functioning as the input device in the system, so connect its MIDI OUT to the MIDI IN of the QX7 sequencer. Connect the MIDI OUT of the QX7 to one of the MIDI INs of the YME8. Take two MIDI THRUs from the same side of the YME8 and connect them to the MIDI INs of the TX7 and RX21. Finally, connect a MIDI THRU from the other side of the YME8 to the MIDI IN of the DX7. (See the accompanying diagram.)

This completes the physical setup, but there is still one more important step. The "MIDI echo" function of the QX7 must be engaged. We will explain how to do this in just a minute. When this function is engaged, all data coming to the QX7's MIDI IN port will be sent to its MIDI OUT port. In other words, when MIDI echo is engaged, the MIDI OUT port on the QX7 merges MIDI OUT data with MIDI THRU data. This allows information from both the DX7 and the QX7 to control other instruments in the system. Without this function, switching from record to playback would involve a lot of plugging and unplugging of cables.

The YME8 makes it possible to work with the system without making *any* cable changes. The MIDI THRUs going to the TX7 and the RX21 should always be connected to the MIDI IN coming from the QX7, but the MIDI THRU going to the DX7 should only be connected during playback from the QX7.

DX7, RX21

Also, remember that it is possible to play the RX21 from the DX7's keyboard via MIDI, and that it is possible to record this drum performance into the QX7. (For details on how to use the RX21 this way, see the article beginning on page 15.) So, drum patterns may be programmed directly on the RX21 and synced with the rest of your music via MIDI, or they may be played using the DX7's keyboard and recorded directly into the digital memory of the QX7.

So there you have the basics of the system. Before we can move into a step-by-step explanation of how to create music using this setup, though, we need to spend some time describing the basic functions of the heart of the 7 System: The QX7.

The QX7 is a digital sequence recorder. That is, it stores digital information received via MIDI for later playback through one or more MIDI-controllable synthesizers, tone generators, or drum machnies. Information in the QX7 is stored as digital data representing a series of MIDI-transmitted events. These events may be notes on (with or without velocity information), notes off, controller change values (such as pitch bend), or program change values.

Most operations of the QX7 are achieved using one of the instrument's many "Job" functions. These are separated into four groups: A, B, C, and D. All of these Job functions are described in the QX7 owner's manual, and are outlined in the diagram printed on top of the instrument. You can step through Job function set A using the JOB STEP A/C button, and you can step through set B using the JOB STEP B/D button. Job function sets C and D are accessed while holding RESET and pressing the A/C or B/D buttons. Basic real-time recording is Job A-1.

MIDI echo (called ECHO BACK in the QX7 manual) is controlled via Job function C-6. Cycle to Job C-6 using the RESET button and the A/C button. Then turn echo on using the +1 button. Your system is now ready to go.

Real-time recording is simple on the QX7. After choosing the MIDI record channel (Job A-6), defining the time signature (Job A-2), and setting the knob to the appropriate tempo, simply return to Job A-1, then press the RECORD button followed by the START button. The QX7 gives you two bars of countdown, and the recording starts. When you are finished, press the STOP button, and the QX7 will cease recording at the end of the bar.

QX7 digital sequence recorder.

Before going any further, let's take a close look at the basic recording layout of the QX7, because the terminology can be confusing. First of all, there are two "tracks" on the QX7. These are simply memory locations for MIDI data, and operate very differently than the tracks of a tape recorder. Since a single MIDI "track" can contain information that encompasses 16 MIDI channels, it is quite possible for one "track" of the QX7 to control sixteen different instruments, each playing different music. (For more on MIDI channels, see the article on page 18.)

All recording in the QX7 goes onto TRACK 1. This is the only live recording track. TRACK 2 is the storage track, and information from a first recording pass must be moved to TRACK 2 if you wish to overdub. If you Record again on TRACK 1 before moving the first take to TRACK 2, it will be erased and replaced by the new recording.

So, in Record mode, MIDI information received is recorded onto TRACK 1. This data on TRACK 1 can be moved to TRACK 2 by means of EXCHANGE (Job B-1), which exchanges the data on TRACK 1 with the data on TRACK 2. This is used most often after the very first recording, to exchange the newly recorded material on TRACK 1 with the blank TRACK 2, prior to recording the first overdub.

To record the first overdub, pick a new MIDI record channel (if desired), set TRACK 2 for playback, and go into RECORD mode again. You will then record on TRACK 1 while listening to the material already in TRACK 2.

After you have material on both TRACK 1 and TRACK 2, there are a number of useful Job functions that allow you to combine the information in various ways.

TRACK DOWN (Job B-3) combines all data on TRACK 1 with the existing data on

7 System *Continued*

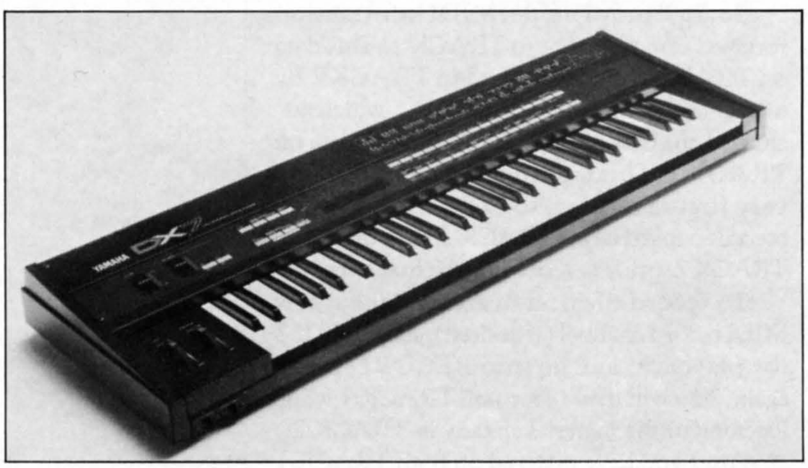
TRACK 2, and leaves TRACK 1 blank. Be careful with this function: after TRACK-DOWN, all information will reside in the TRACK 2 memory location, and data from the previous TRACK 1 will become inseparable from the previous TRACK 2 data.

CHAIN (Job B-2) copies TRACK 1 data to the end of TRACK 2, leaving the original TRACK 1 data intact. This is useful for recording a song in segments, or for repeating a segment.

Another way to move data from TRACK 1 to TRACK 2 is via INSERT (Job B-5), which copies all TRACK 1 data to the beginning of the current measure on TRACK 2, leaving the original data on TRACK 1 intact.

ERASE (Job B-4) and DELETE MEASURE (Job B-6) are also helpful editing tools. ERASE obliterates everything on TRACK 1 from (and including) the currently chosen measure. DELETE MEASURE removes the currently displayed measure from TRACK 1.

Remember that multiple channels of MIDI data can be stored on a single TRACK with MIDI channel integrity maintained for each. For example, an instrument part can be recorded via MIDI channel 1 on TRACK 1, and exchanged (Job B-1) to TRACK 2; then a second instrument part can be recorded on the now blank TRACK 1 via MIDI channel 2. If you are happy with both takes, you can track down (Job B-3) the new material to TRACK 2. This process can be repeated for up to 16 separate parts on 16 MIDI channels.



DX7 FM digital synthesizer.

One effective way to deal with an unsatisfactory part that has already been "mixed down" to TRACK 2 is to change the MIDI channel of the instrument and record a new performance on that MIDI channel. In the final playback, the unwanted data won't be heard if no instrument is assigned to that MIDI channel.

In addition to TRACK 1 and TRACK 2, there is a third data storage location in the QX7—the temporary buffer. Even though it is not a playable track, it can be a very useful editing tool. SAVE TEMPORARY BUFFER (Job D-2) swaps the contents of TRACK 1 and the temporary buffer. By the way, the QX7 uses the temporary buffer as part of its quantize function: When QUANTIZE (Job D-1) is engaged, the original, unquantized performance is stored in the temporary buffer. Therefore, don't use the QUANTIZE function if you have something in the temporary buffer that you want to keep.

Now that you have some idea of how the QX7 works, it's time to put the whole system together. Here is a step-by-step scenario, using the QX7 to store and control the performance of *all* instruments in the system.

Start by working on the drum part. Set the RX21 so that it can be played from the DX7's keyboard, and turn the DX7's volume down. Set the RX21 to receive on all MIDI channels, and set the QX7 to MIDI channel 2. (Remember that the DX7 will only send information on MIDI channel 1. This is not a problem in the 7 System configuration, however, since the QX7 will channelize the information from the DX7 internally during recording, according to its receive-channel setting. We are saving MIDI channel 1 as the record channel for the DX7, and will record its part last.)

To achieve maximum control, record the drum part one instrument at a time: Record the bass drum onto TRACK 1, EXCHANGE to TRACK 2, and add the snare part as an overdub. Then TRACK DOWN those two and add tom tom parts on successive overdubs. Since the RX21 is set to receive on all MIDI channels, it will respond to both the QX7 and the DX7 during this record/overdub process.

After the drum part is complete and mixed to TRACK 2, set the RX21 to MIDI channel 2, so it will play *only* the recorded part.

Now it's time to overdub the bass part. For recording, switch the QX7 to MIDI channel 3, set the TX7 to MIDI channel 1, find an appropriate sound, and begin recording. Using this configuration, the QX7 will record the performance from the DX7's keyboard onto MIDI channel 3, but you will be able to hear the part played by the TX7, which is responding to the MIDI channel 1 information coming from the DX7.

For playback, switch the TX7 to MIDI channel 3, to coincide with the recording in the QX7. After you are satisfied with the part, use TRACK DOWN to mix it onto TRACK 2. By the way, if your bass patch works well as a chord-rhythm patch in a higher register, you can also record a rhythm part onto TRACK 1 using the same MIDI channel.

Now for the melodies: Turn the volume up on the DX7, and find a sound you like. Switch the QX7 to MIDI channel 1. After you have recorded the part, set the DX7 to receive on MIDI channel 1, connect it to the QX7 via the YME8 switch, and listen to the playback. If you are satisfied, you can mix the part onto TRACK 2 along with the rest of your data.

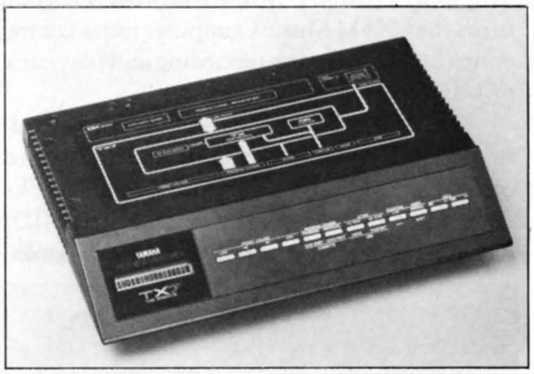
If you have other MIDI-equipped instruments, you can repeat this process, assigning each new instrument to its own MIDI channel. When you are done, you will have a multiple-channel recording, created via MIDI and stored for playback in your QX7.

When you begin to expand your horizons with the 7 System, you will discover that you can use the temporary buffer in the QX7 to good effect. Let's say that you want to put together a song in ABA form, with a few variations in the repeat of the A section. Here is a simple procedure using the temporary buffer that will allow you to record these sections separately.

To begin with, work up your first version of section A, using the approach outlined above. When you have all parts completed (drums, bass, rhythm, melody, countermelody, and so on), TRACK DOWN everything to TRACK 2. Then, using EXCHANGE (Job B-1) to move the whole thing to TRACK 1. From there, move your section A material to the temporary buffer using Job D-2.

Now that you have both TRACKS empty, and can record your B section, using the same basic recording procedure outlined above. When you are done, TRACK DOWN the entire section B to TRACK 2. Then recall section A to TRACK 1 using Job D-2 again. Insert your basic section A before section B by using INSERT (Job B-5).

Are you still with us? Good. Now, use EXCHANGE (Job B-1) again. Your complete A+B section will be moved to TRACK 1, and section A (still in TRACK 1 after INSERT) will be moved to TRACK 2. Next, use Job D-2 again to move your completed A+B section to the temporary buffer.



TX7 FM digital tone generator.

At this point, TRACK 1 will be empty, and you can overdub variations on the section A material that is now in TRACK 2. When finished with your variations, TRACK DOWN this final A section to TRACK 2. Then recall section A+B to TRACK 1 using Job D-2, and INSERT A+B into TRACK 2 before the final A section using Job B-5.

At this point, you will have a complete ABA song form, with variations in the repeat of the A section. This is just one example of the ways in which the temporary buffer can be used to help you manipulate MIDI information within the QX7. (Remember, if you try involved data manipulations like this, do not use the QUANTIZE function! The last thing you want to do is erase your A section from the temporary buffer by accident.)

RX21 digital rhythm programmer.

As you can see, the 7 System is a very flexible music-making tool, one that can expand along with your musical horizons. Enjoy your explorations in the world of the 7 System!

CX5M

An Introduction To The New YRM301 MIDI Recorder Program. By David Lourik.

ONE OF THE GREATEST things about computers is that they are general-purpose instruments. They can be transformed (via software) into any number of different things. The new YRM301 MIDI Recorder Program turns the CX5M Music Computer into a central control station for the recording and playback of MIDI sequences and songs.

THE MIDI Recorder program allows real-time recording of data from a MIDI keyboard onto one of 4 distinct tracks. These 4 tracks comprise one Bank of information. The MIDI Recorder contains four of these 4-track banks.

CX5M music computer.

Perhaps the most important thing to realize about the MIDI Recorder program is that the four tracks are simply memory locations, rather than physical tracks (as on a tape recorder). Information on a single track can contain discrete musical information corresponding to a number of different MIDI channels, and can therefore control a number of different MIDI instruments playing different parts. (For more on MIDI channels, see the article on page 18.)

Each of the 4 tracks can be assigned to a particular MIDI channel, or to Multi mode. For recording, the MIDI channel of the track to be recorded must match the MIDI channel on which the input keyboard is transmitting (unless the Track is assigned to Multi mode). For playback, any other MIDI channel may be selected. This capability allows you to use instruments that only transmit on MIDI channel 1 (such as the DX7) as your input keyboard, while still having access to the full range of 16 MIDI channels on playback.

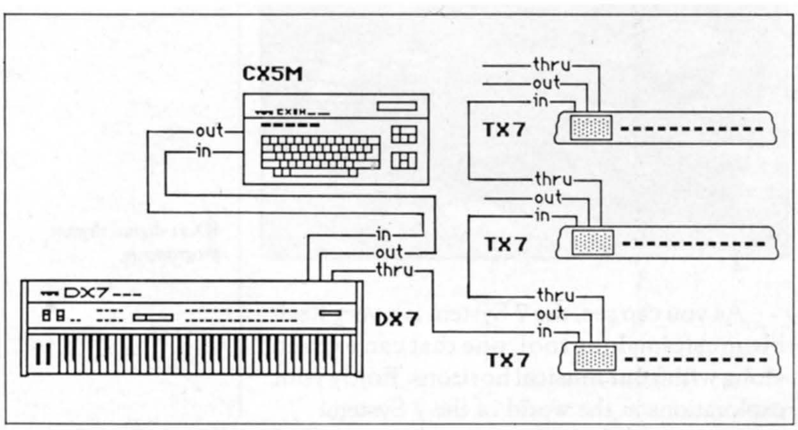
Using the setup shown in the accompanying diagram (with a DX7 and three TX7s), you would record all four tracks from the DX7 keyboard, and all recording would have to be on MIDI channel one. After recording, switch three of the tracks to MIDI channels 2, 3, and 4, respectively, and assign the three TX7's to receive on channels 2, 3, and 4. Each tone generator will only play data received on the MIDI channel to which it is assigned.

When a track is assigned to Multi mode (designated by an "M" in the MIDI channel sector of the main screen display), the Recorder will automatically record the MIDI channel number on which the music data is received. In this mode, the selected track will thus receive data on any MIDI channel, but you will *not* be able to change the MIDI channel selection of material that is recorded in this way.

Multi Mode is also used to combine previously-recorded tracks onto a single track, using the "MIX" function. Using the 4 tracks and Multi mode together allows you to keep precise control over your MIDI channel assignments, because you can make your final channel decisions just prior to using the MIX-down function.

For example, imagine that you have recorded three tracks of data (on tracks 1, 2, 3), using MIDI channels 1, 2, and 3. Since these three streams of information still reside on separate tracks, you can change the MIDI channel assignment for each one. Then, after making your final decisions on the MIDI channels, use the MIXdown function to combine all three tracks onto another track. The MIX function works by combining *two* tracks at a time. Using multiple MIX functions, you can combine a number of different tracks, and can MIXdown to any open track on any of the 4 Banks within the MIDI Recorder's memory.

Even though the tracks in the MIDI Recorder are not the same as tracks on a tape recorder, many of the program's functions are designed to operate the way a tape recorder does. For instance, there is an easy-to-use PUNCH IN/OUT feature that allows you to correct specific notes or passages in an already-recorded track. There is also an AUTO



One possible basic setup for using the YRM MIDI Recorder program with CX5M: This system uses the DX7 as both the input keyboard and one of the four tone generators. The remaining three tone generators, all TX7 modules, are connected in a standard MIDI IN/THRU configuration.

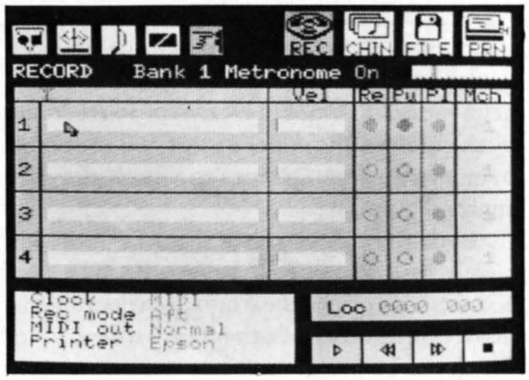
RECORD function, that allows you to program the Recorder to go in and out of Record mode at specific measure locations, so you can concentrate on the performance of the passage you want to correct, instead of having to operate both the computer and your instrument.

The MIDI Recorder gives you a wide range of musical options for your sequences. The Tempo settings can range from 40 to 200 quarter-notes per minute. Tempo is not remembered as part of the information in a recording, and must be set for recording and playback. This allows you to record a difficult passage at a slow tempo, and then adjust it to the proper tempo for playback.

Recordings made in real time can be given added rhythmic precision using the Quantize function. Music may also be recorded in Step-Time mode, for note-by-note accuracy.

In addition to all of this flexibility, the MIDI Recorder has a full Edit mode that lets you alter any individual note in your recording, in any of these five ways: 1) You can alter the pitch of the note, over the entire MIDI range, to correct a mistake or to create new melodies; 2) You can alter the level of the note (its key velocity) to add dynamics and expression to your recording; 3) You can move a note forwards or backwards in time, to correct timing errors to create subtle rhythms; 4) You can alter the length of a note; and 5) You can delete a note. With all of these options, you will find it easy to fine-tune your musical ideas.

The four memory Banks in the MIDI Recorder also give you a number of options for creating long compositions from your basic tracks using Chain mode. Chain functions allow you to create a playback sequence of banks and tracks. The "chain" consists of up to 12 parts, each of which can consist of a bank or selected tracks from a bank. In addition, each one of the 12 parts in the chain can be repeated up to 99 times, transposed up or down by up to 12 semitones, or have its tempo increased or decreased by up to 99 quarter-notes per minute (relative to the basic tempo you have chosen for the overall Chain playback). You can also alter the MIDI channel that each track transmits on for each segment of the chain, so the same recorded music can be performed by a variety of MIDI instruments. (This is not possible if the track was recorded or mixed down in Multi mode.) The entire chain can be played back automatically up to 9 times.

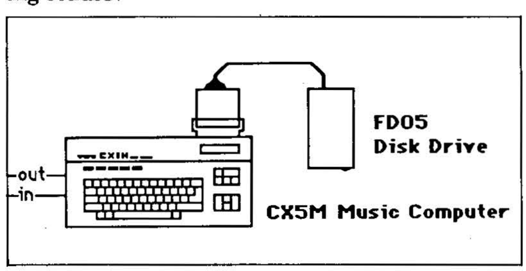


Main screen display of the YRM301 MIDI Recorder program, showing the System Parameters display in the lower left.

The MIDI Recorder program is very easy to operate. All of the program's main features can be accessed from the main screen display. To further simplify operation, the MIDI Recorder program is fully compatible with the new Yamaha Mouse, which plugs into the Joystick 1 port on the CX5M. This device makes it possible to move around quickly within the screen displays, and make most of your choices and decisions without using the computer keyboard at all.

The MIDI Recorder also offers you a number of choices for storage of your sequence recordings. In addition to the cassette storage offered with all CX5M programs, the MIDI Recorder is compatible with the new Yamaha FD05 Floppy Disk Drive. The drive must be connected to the back port of the computer, using the CA01 Single Cartridge Adapter and the FD051 Floppy Disk Drive Interface. (See the accompanying diagram.) Remember that no sequence information is final until it has been saved onto one of the CX5M's storage media. If the computer is turned off before the current sequence has been saved via one of the data storage options, the sequence will be lost. Make it a habit to store information often.

As you can see from the above introductory information, the YRM301 MIDI Recorder is a very flexible music-making tool, one that will turn your CX5M into a powerful MIDI recording studio.



To connect a disk drive to the CX5M, you must first plug a CA01 Single Cartridge Adapter into the computers rear slot; then the FD051 Floppy Disk Drive Interface is plugged into the cartridge adapter and connected to the FD05 Floppy Disk Drive.

KX Series

Program Your Keyboard Controller For Real-Time MIDI Control. By Jeffrey Gusman & David Lourik.

THE KX88 AND KX76 MIDI Keyboard Controllers are designed to be "master keyboards" in a synthesizer setup. Although neither the KX88 nor the KX76 produce sound by themselves, they offer a great deal of control over the tone generators to which they are attached.

Both the KX88 and the KX76 are completely assignable MIDI keyboards. The keyboard is only part of the story: Both instruments provide a number of other controllers, all of which can be programmed by the user to control any type of MIDI information.

Both keyboards provide inputs for two FC4-type footswitches, two FC7-type foot controllers, and one BC1 breath-controller. In addition, each keyboard provides 4 slider controls, 5 momentary switch controls, 2 toggle switch controls, 2 wheel controllers, and monophonic aftertouch control. Although all of these controls are given preset control assignments when the unit leaves the factory, every one of them may be programmed by the user. In short, the KX88 and KX76 controllers are completely programmable and assignable. Each of the controllers can be assigned to control a specific aspect of sound coming from an FM digital tone generator.

Both the KX88 and KX76 have three basic modes of operation: PLAY mode, CA (Controller Assign) mode, and PA (Parameter Assign) mode.

You will normally play the KX88 or KX76 in PLAY mode. When you use the various controllers in this mode, they will operate based on the code memory currently in operation.

All of the KX controllers have logical and useful preset assignments, but there may be situations where you will want an unusual assignment. All you have to do is set up the assignments you want, and then save them into one of the 16 memory locations in your keyboard controller.

Saving controller code assignments is easy. Press BANK A program select switch 15 [SAVE], then use the BANK B program select switches 1-16 to select the memory location. The selected number will blink in the lower readout, and when you press that same number again, all current settings will be stored in that memory location.

To recall the settings, go into CA mode and press BANK A program select switch 16 [LOAD]. Then use BANK B program select switches 1-16 to call up the desired memory. Return to PLAY mode, and your keyboard controller will function according to the memory settings you have just recalled.

The programming flexibility of the KX88 and KX76 gives you a great deal of control over your MIDI-equipped instruments. Their flexibility in performance goes far beyond this basic capability, though: Both the KX88 and KX76 MIDI keyboards are capable of controlling the numerous voicing parameters of the DX and TX tone generators.

Whenever a parameter value is changed on a DX7 using the data entry slider, the sound is disabled, and a new key must be played before the result of the parameter change can be heard. With the tone generators in the TX series, however, parameter changes can be heard in real-time.

This opens up some exciting possibilities for connections between TX tone generators and the KX88 or KX76: By assigning certain TX voicing parameters to certain controllers (using the PA and CA modes), you can create situations where the overall timbre of a patch can be changed in real time *as part of a performance.* In other words, the KX 88 and KX76 give you the ability to alter FM digital sounds dynamically in real-time, following the nuances you perform via the controllers you have assigned to the various parameter changes.

This entire process is made possible through the "User Definable" area of controller codes in the KX88 and KX76 keyboard controllers. The full range of controller codes is 00-FF [hex], a total of 256 different possibilities. Controller codes 00-3F [hex] are all predefined and preset within the KX88 and KX76. These codes and their definitions are printed on the front panel of the KX units. However, this accounts for only 64 of the possible controller codes. The remaining 192 controller codes [40-FF in hex] can be defined by the user.

Since all DX and TX voicing parameters are available for external control via MIDI "System Exclusive" messages, controller codes can be assigned to all of the DX/TX voicing parameters in the PA mode. These parameters can then be assigned to any one of the many KX controllers in the CA mode.

Remember that these "User Assignable" controller codes are *not* part of the 16 code memories in the KX units. The 16 code memories retain assignments of particular controllers to particular controller codes. The user-assignable controller codes each have *one* definition within the memory of the KX. Therefore, make a record whenever you define one of the user-definable controller codes, so that you can use it effectively when defining one of the 16 code memories.

Since there are so many possibilities, you may want to begin by simply experimenting with a number of assignments. Then you can set up your final group of user-assignable controller codes after you have determined your specific musical needs.

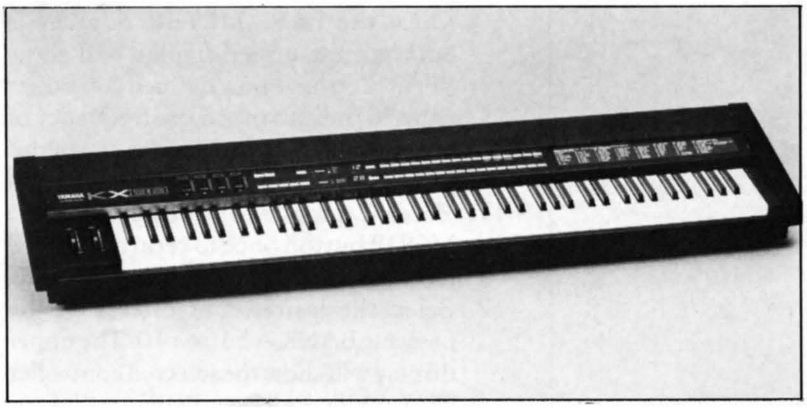
When selecting TX (or DX) voicing parameters to put under real-time control via one of the KX's controllers, it is very important to remember that the way a parameter change affects a voice depends on many factors, the most important of which is the algorithmic configuration of the patch in question. This should be taken into account when deciding on parameter assignments.

The owners manuals for the KX88 and KX76 include a number of examples of useful parameter assignments. Here are two others, complete with step-by-step instructions on how to enter them into your KX unit:

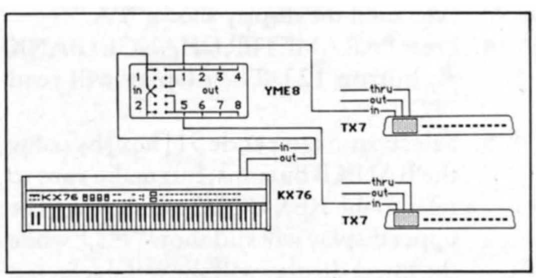
Assigning Coarse Frequency Parameters To Foot Controller 2

This allows control of the selected operator's pitch with a foot controller. If applied to a CARRIER operator, the result would be a very wide-ranging pitch bend, which would have limited musical use. When applied to a MODULATOR operator, however, the result of this control would be a wide-ranging change in overall tone color (depending on the algorithm). For this example, we will choose operator #6 as our subject. Use the following procedure:

1. Consult the MIDI DATA TABLE (page 28 in the KX88 manual, page 43 in the TX816 manual) to determine the GROUP number [00], SUB-GROUP number [0], and PARAMETER number [12 hex] for OP6 FREQUENCY.
2. Determine what parameter code number you want to assign to this parameter; for purposes of this example, let's choose 50 [hex].
3. Enter PA mode by pressing the MODE switch twice and holding it the second time until the display shows "PA."
4. Press PARAMETER CHANGE [BANK A, button 12]. The display will read "PC."
5. Select parameter code 50 [hex] by using the BANK B buttons, but make sure to refer to the HEX CODE numbering. The upper display will still show "PC," while the lower display will show the selected parameter code, "50."
6. Once the parameter code is entered, the KX unit will ask you to define the limit of the parameter change; the upper display will show "LM." Set the LIMIT to 0-31 using BANK B button 4 (see page 11 of the KX88 owners manual).
7. The upper display will now show "G," asking for the GROUP number. Enter "00" using the BANK B buttons. Remember to refer to the HEX CODE numbering.
8. Once the GROUP number is entered, the upper display will show "SG," asking for the SUB GROUP number. Enter "0" using the BANK B buttons. Remember to refer to the HEX CODE numbering.
9. Once the SUB-GROUP number is entered, the upper display will show "P," asking for the PARAMETER number. Enter "12" using the BANK B buttons. Remember to refer to the HEX CODE numbering.



KX88 MIDI keyboard controller.



In this configuration using a YME8 MIDI Expander box, the KX76 can control both of the TX7 tone generators, either separately or together.

10. Once the PARAMETER number is entered, the upper display will show "PA." You have now defined controller code 50 [hex] to the coarse frequency of operator #6. Now it is time to assign this parameter to a particular controller.
11. Enter CA mode as follows: Press the MODE button once to return to PLAY mode, and once more to enter CA mode.
12. Select the desired controller [FC2] by pressing BANK A button 10. The upper display will show the selected controller [F2], while the lower display will show the controller code previously assigned to that controller.
13. Assign the new parameter code number 50 [hex] to FC2 by using the BANK B buttons. Remember to refer to the HEX CODE numbering.
14. Return to PLAY mode by pressing the MODE button, and try out your new parameter/controller assignment.

Assigning Operator Feedback To The Breath-Controller

The feedback loop is a part of every TX and DX algorithm. Since feedback increases the complexity of the operator waveform to which it is applied, it often has a strong effect on the overall timbral density of the sound. The breath controller is an obvious input mechanism for this effect. Use the following procedure:

1. Consult the MIDI DATA TABLE (page 28 in the KX88 manual, page 43 in the TX816 manual) to determine the GROUP number [00], SUB-GROUP number [1], and PARAMETER number [07 hex] for FEEDBACK.
2. Determine what parameter code number you want to assign to this parameter; for purposes of this example, let's choose 51 [hex].
3. Enter PA mode by pressing the MODE switch twice and holding it the second time until the display shows "PA."
4. Press PARAMETER CHANGE [BANK A, button 12]. The display will read "PC."
5. Select parameter code 51 [hex] by using the BANK B buttons, but make sure to refer to the HEX CODE numbering. The upper display will still show "PC," while the lower display will show the selected parameter code, "51."
6. Once the parameter code is entered, the KX unit will ask you to define the limit of the parameter change; the upper display will show "LM." Set the LIMIT to 0-7 using BANK B button 2 (see page 11 of the KX88 owners manual).
7. The upper display will now show "G," asking for the GROUP number. Enter "00" using the BANK B buttons. Remember to refer to the HEX CODE numbering.
8. Once the GROUP number is entered, the upper display will show "SG," asking for the SUB GROUP number. Enter "1" using the BANK B buttons. Remember to refer to the HEX CODE numbering.
9. Once the SUB-GROUP number is entered, the upper display will show "P," asking for the PARAMETER number. Enter "07" using the BANK B buttons. Remember to refer to the HEX CODE numbering.
10. Once the PARAMETER number is entered, the upper display will show "PA." You have now defined controller code 51 [hex] to the coarse frequency of operator #6. Now it is time to assign this parameter to a particular controller.
11. Enter CA mode as follows: Press the MODE button once to return to PLAY mode, and once more to enter CA mode.
12. Select the desired controller [BC] by pressing BANK A button 3. The upper display will show the selected controller [BC], while the lower display will show the controller code previously assigned to that controller.
13. Assign the new parameter code number 51 [hex] to BC by using the BANK B buttons. Remember to refer to the HEX CODE numbering.
14. Return to PLAY mode by pressing the MODE button, and try out your new parameter/controller assignment.

Now that you understand how to program the KX MIDI keyboards to control real-time parameter changes, you should be able to apply the procedure outlined above to create your own set of controls over real-time parameter changes. Explore a number of different possibilities, until you find the ones that work best for you.

RX Series

How To Play The RX Rhythm Controllers With A Keyboard Via MIDI. By Tom Darter.

SINCE ALL OF THE RX digital rhythm programmers are equipped with MIDI, they offer musicians a number of interesting options. Through MIDI connections to other instruments, the overall capabilities of the RX series can be expanded far beyond those available in each basic unit.

One of the most exciting possibilities in this direction gives musicians the ability to play the various drum sounds in the RX series instruments from a MIDI-equipped keyboard, such as the DX7 or KX88.

Notes are designated by numbers in MIDI code. The overall note range is 128 notes (0 to 127), far larger than the range of a piano. The standard key numbers on a 5-octave synthesizer such as the DX7 are 36 to 96.

Each of the RX series units contains a routine whereby each of the drum sounds will respond to a certain MIDI key number. When the corresponding key is played on a MIDI keyboard, the drum assigned to that key number will sound.

Perhaps the biggest advantage of this setup is that the RX units respond to velocity information sent via MIDI. So, if you control the drum sounds from a velocity-sensitive MIDI keyboard, you can play each sound with a wide variety of volume inflections. All of this is possible through MIDI, even though the RX series units aren't touch-sensitive by themselves.

All three Yamaha drum machines have preassigned key numbers for the drum sounds they contain. The RX11 and RX15 allow you to change these key assignments, while the RX21's key assignments are fixed. The chart on page 17 shows how MIDI key numbers are assigned to the drum sounds of the RX series when they leave the factory.

The basic setup for taking advantage of these key assignments is simple: Just connect the MIDI OUT of your velocity-sensitive keyboard to the MIDI IN of your RX unit. From there on, each one of the machines has its own routine. Let's look at them one at a time:

With The RX21

After turning the RX21 on, press the black MIDI control button. The display will read:

CLOCK: INTERNAL

Press the MIDI button again, and you will see:

RECEIVE CH = 01

Make sure that the RX21 is set to the same MIDI channel as your keyboard.

After setting the MIDI channel, press the MIDI button one more time. The display will show:

CH INFO AVAIL

With this display on, the RX21 will respond to key information from your keyboard.

RX21 digital rhythm programmer.

Switching to another section of the MIDI button's menu will disable the "CH INFO AVAIL" setting, and the RX21 will no longer respond to key information from your keyboard. Likewise, calling up any of the other functions from the black control keys, such as pattern PLAY or song PLAY, will disable the MIDI channel connection.

You can, however, use the TEMPO, LEVEL, ACCENT, and instrument keys without interrupting the MIDI connection to the keyboard. This is important, because you may need to adjust these controls to take full advantage of the volume control supplied by the touch-sensitivity of the keyboard.

Like many digital rhythm units, the RX21 does not have touch-sensitive drum keys. By itself, the machine offers only two volume levels for each drum sound—basic volume and accent volume. The overall volume range in the RX21 is 0-31, with the accent level being added to the basic level. Therefore, if you program the TOM to have a basic level of 23, setting the accent level to 08 will extend the accent level to the maximum volume of 31 (23 plus 8). Accent volume only occurs when you hold down the ACCENT key before striking one of the drum keys.

In order to take advantage of the full range of volume offered by touch-sensitivity from the keyboard, you should set the basic level to cover the full range of volume you desire for each drum sound, because the touch-sensitivity only operates within this basic range. (The accent level is added only when the ACCENT key is depressed.)

Finally, remember that the RX21's internal programming responds only to patterns played on its front-panel drum keys: It will not record drum strokes played via MIDI into its internal PATTERN memory. This does not mean that the RX21 can only be used in live performance while connected to a MIDI keyboard—the keystrokes from the keyboard can be recorded into a MIDI sequencer, and on playback those keystrokes will drive the drum sounds in the RX21, complete with full velocity control.

With The RX15

After turning the unit on, hold down the FUNCTION button and press the MIDI IN button (while still holding FUNCTION). the display will show:

RECEIVE AVAIL

If by any chance the display gives this response:

RECEIVE UNAVAIL

then press the -1/NO button, and the message will change to "RECEIVE AVAIL." Pressing the -1/NO button repeatedly will toggle between the two settings.

RX15 digital rhythm programmer.

After making sure that "RECEIVE AVAIL" is showing on the display, press either the +1/YES button or the MIDI IN button. You will now see:

OMNI ON

If instead, the display says "OMNI OFF," use the -1/NO button to toggle to the "OMNI ON" position. The RX15 will only respond to external keyboard control when in OMNI mode.

At this point, you will be able to play the RX15's drum sounds from your keyboard, according to the factory preset key assignments. The RX15 also allows you to define your own key assignments for each drum sound, as follows:

1. Follow the above procedure to set "RECEIVE AVAIL" and "OMNI ON."
2. With "OMNI ON" showing in the display, press the one of the instrument keys. If you press, for instance, the RIDE key, you will see the following: "RIDE NOTE = 62."
3. You may now adjust the key assignment of the RIDE sound using the DATA ENTRY slider. The overall range for each drum sound is 36-99.
4. To assign a key number to another drum sound, simply press the instrument key and adjust the value with the DATA ENTRY slider. When finished with your key assignments, return to PATTERN or SONG mode by pressing the MIDI IN button again. The RX15 is now ready to be played from an external keyboard or sequencer, following the key assignments you have just defined.

Just like the RX21, the RX15 offers only two basic volume levels when played from its front panel, basic level and accent level. These levels are additive, and can be programmed separately for each instrument, using the INST LEVEL key, the ACCENT LEVEL key, and the DATA ENTRY slider. The overall range is 0-31. If you want to take full advantage of the nuances of volume control provided by your velocity-sensitive keyboard, you may want to program INST LEVEL for each drum sound to the maximum desired range, since the velocity sensitivity will only operate within that basic range. (Accent level is only engaged while the ACCENT key is held down.)

Remember that you cannot program the RX15's internal memory from an external keyboard or sequencer—the internal memory is only set to recognize and store keystrokes from the unit's front panel. In order to save material performed using an external keyboard, you need to use a MIDI sequencer. With a sequencer, though, you will be able to record and playback the full range of volume control available through MIDI.

With The RX11

The setup for the RX11 is very similar to that of the RX15, with one major exception: You do not have to put the RX11 in OMNI mode in order to control it from an external keyboard or sequencer. You can select one specific MIDI channel, and control the unit's drum sounds via that single channel.

Start by setting up the basic operation: Turn the instrument on. Then hold the FUNCTION button and press the MIDI IN button (while still holding FUNCTION). The display should read:

CH INFO AVAIL

If, instead, you see "CH INFO UNAVAIL," toggle to "CH INFO AVAIL" using the -1/NO button. Then set that choice by pressing either the MIDI IN button or the +1/YES button.

At this point, you will see the following:

OMNI ON

If you want to specify a single MIDI channel, press the -1/NO button, and you will see this:

OMNI OFF

Now set that choice with either the MIDI IN or +1/YES button.

You are now ready to set the MIDI channel. The display will read:

RECEIVE CH = 01

Choose the channel you want using the DATA ENTRY slider, then exit the routine by pressing the MIDI IN button one last time.

You are now ready to play your RX11 from an external keyboard, provided that it is set to send information on the channel the RX11 is waiting to receive on. Begin playing, using the factory preset key assignments (as shown in the chart on page 17).

You may also program your own key assignments for each of the RX11's drum sounds, following the same method explained above for the RX15. From either the "OMNI" or "RECEIVE CH" display within the MIDI IN function routine, simply press any of the instrument keys, and the current key assignment for that drum sound will be displayed. You may then program the key assignment using the DATA ENTRY slider, within the note range 36-99.

As with the other RX series instruments, the RX11 only has two volume levels per instrument when programmed from the front panel. It does respond to velocity-sensitivity, however, within the full range set by the INST LEVEL control. The ACCENT level is only accessed when the ACCENT key is held down.

Also, the RX11's internal programmer only responds to keystrokes from its front panel. To record percussion performances created via a MIDI keyboard, connect a MIDI sequencer to your setup.

RX11 digital rhythm programmer.

These key assignments are the MIDI key numbers assigned to the RX drums sounds when the instruments are shipped from the factory. The assignments can be changed in the RX11 and RX15, while those in the RX21 are fixed.

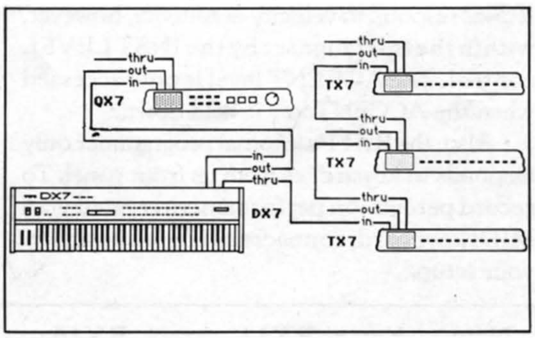
Note	Key #	RX11	RX15	RX21
G# 1	44	BD2		
A 1	45	BD1	BD	BD
(A# 1)				
B 1	47	TOM4		
C 2	48	TOM3	TOM3	TOM3
C# 2	49	SD2		
D 2	50	TOM2	TOM2	TOM2
D# 2	51	RIMSHOT	RIMSHOT	
E 2	52	SD1	SD	SD
F 2	53	TOM1	TOM1	TOM1
F# 2	54	CLAPS	CLAPS	CLAPS
G 2	55	COWBELL	COWBELL	
G# 2	56	SHAKER	SHAKER	
A 2	57	HH CLOSED	HH CLOSED	HH CLOSED
(A# 2)				
B 2	59	HH OPEN	HH OPEN	HH OPEN
C 3	60	CRASH	CRASH	CRASH
(C# 3)				
D 3	62	RIDE	RIDE	

MIDI

MIDI Channels: All 16 Can Operate Along One Cable. By Tom Darter.

ALTHOUGH MIDI IS by no means magic, it is capable of some very subtle sleight-of-hand which will help you make magic with your music.

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 pressed on instrument 1 can actually produce a sound from both instrument 1 and instrument 2. In addition, most current MIDI instruments will also transmit the velocity with which the key was pressed, 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.



In this basic record/playback setup, the QX7 can control all four tone generators (the DX7 and the three TX7s). By using four different MIDI channels, each tone generator can be made to perform a different musical part.

Of course, even this simple information from instrument 1 (and other kinds of information like it) will only have an effect on instrument 2 if it has been set up to receive the information coming from instrument 1. This is where the sleight-of-hand comes in: Even though most MIDI information travels along one single MIDI cable, the information itself is divided into different "channels"; in addition, receiving instruments operate in different operational "modes," each of which makes the instrument deal with incoming information in certain specific ways. This month we'll talk about how channels operate in MIDI, and next month we'll explain the four MIDI modes.

MIDI information travels along a single cable because MIDI is a *serial* interface. That 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" is in quotes here because MIDI channels are not physical channels at all. Although they can separate musical information 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 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 QX7 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 information. (In both instruments, these locations are called "Tracks," but they do not operate like tape recorder tracks—rather, they are tracks of digital information in MIDI code.)

The end result? 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.

And how are these instruments told to respond only to certain information? By assigning them to a particular MODE of operation and, if appropriate, a specific MIDI channel. For the complete story on MIDI modes, tune in next month.

Questions

DX Users Group, Plus "Tracks" And "Channels" On The QX7.

In a few months, I hope to form a regional DX Users Group by contacting interested musicians through AFTERTOUCH. In the meantime, are there any groups already in existence that I can contact?

We have heard from Al Duester, who is forming a national group with the name "The DX User." Duester explains the group's purpose as follows:

"The main idea behind the group is that a few hundred amateurs pooling their talents can still come up with a few thousand great voices. Besides voices, we'll be trading tips, techniques, software, hardware projects, and whatever else the membership can come up with. A newsletter will be published on an irregular basis with voice patches available first on paper, then on a variety of disks if membership warrants it."

If you are interested in finding out how the group will function and how to join, send three 22-cent stamps to: The DX User, P.O. Box 209, Woods Hole, MA 02543.

The QX7 sequencer has been described to me as a two-channel digital recorder, but I've also been told that it operates on 16 channels. What gives?

Terminology is the problem. The QX7 is a digital recorder with two *tracks*, but it processes information on all 16 MIDI *channels*.

There are two basic memory locations within the QX7 on which information can be recorded. These are the two "tracks," A and B. Unlike tracks on a tape recorder, though, these "tracks" contain streams of MIDI data (rather than sound information stored on tape). Essentially, they are nothing more than memory locations: Track A is for recording MIDI data, and track B is for storing and compiling MIDI data. (There is also a third memory location, the temporary buffer, which is useful for shuffling information back and forth within the QX7.)

Since the QX7's two "tracks" consist of streams of MIDI information, they can easily record data that encompasses all 16 MIDI channels. Therefore, it is possible for information on one "track" to control a number of different instruments, each operating on a different MIDI channel, each playing different music. In other words, one QX7 "track" can consist of many tracks of music, since each MIDI channel is the logical equivalent of a tape-recorder track.

(For more on how MIDI channels operate, see this month's "MIDI" article on page 18; and for more on the operation of the QX7, see the "7 System" article on page 6.)

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John Chowning

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Next month, in Part 2 of this exclusive interview, Dr. Chowning will discuss his recent work with the DX7, and will outline ways in which the DX instruments can be used as teaching tools in the field of acoustics.

or above the half-sampling rate, they can reflect down in unfortunate ways. With key scaling, it is easy to reduce the signal to essentially a sinusoid at the highest notes, which is ideal for dealing with the problem of aliasing.

As for the design of the algorithms, some of the choices on the DX7 were really surprising to me. They all do use the four basic forms I worked with, but the implementation is different. On our system at Stanford we would have done it a slightly different way. We would have coupled two simpler units together to achieve more or less the same thing. And they've done it all in terms of six operators.

TD: *Are six operators enough?*

JC: Many people have asked me that question. I think it will be a long time before the possibilities of six operators are exhausted. Given the additional complexity of adding more operators, it becomes harder and harder to envision the acoustic result. Six may not be quite enough, but it is certainly richer terrain than anyone's going to get tired of in the short term.

TD: *The interesting thing about the six operator question is that, unless you want more than four operators cascaded in a stack, you can get more than six operators by having two instruments and programming them as one.*

JC: True. And frankly, I don't think there's much use in more than four in a stack. It's awfully hard to envision. With a linear increase in the number of operators, there is a geometric increase in spectral complexity. So going from one carrier and one modulator to one carrier and two modulators, it's not just twice as complex—it can be many times more complex. And going from two to three modulators, it almost becomes factorial. With three modulators in a cascade, there is an incredible increase in timbral complexity: With a significant amount of output from any of those operators in the cascade, you can very quickly approach some sort of noise, because the density of the spectrum becomes so great. It also depends a bit on the ratios of frequencies.

TD: *What I'm hearing, which is a very important thing for you to say, is that people don't yet realize what it is they've got under their control with six operators. Yet here they are asking for more operators—the numbers game, like having more voices in memory. They haven't stopped to look at what they already have.*

JC: I think the key to understanding the instrument involves a whole lot of work on basic controls like key scaling, modulation, and velocity sensitivity, all with a simple FM pair—just two operators. Once a simple FM pair is understood, it's a lot easier to make use of the various combinations.