BRUCE BARTLETT

Recording Techniques

SYNCHRONIZING A DRUM MACHINE TO A SYNTHESIZER

• In our July/August issue, I explained how to connect a synthesizer to a computer MIDI interface to make a simple MIDI studio. The next step is to add a drum machine.

Suppose you've recorded a drum pattern using the drum machine's internal sequencer (it's easier to do this than recording the pattern on several tracks of an external sequencer). Also suppose you've recorded a synthesizer melody with an external sequencer. How do you synchronize the drum patterns in the drum machine with the synthesizer melody in the sequencer? In other words, how do you get the drum machine and synth to play in sync, when both have different patterns recorded in different memories?

To synchronize the machines, you use a single MIDI clock (timing reference) that sets a common tempo for all the equipment. Before setting up a system to do this, first we need to understand what the MIDI clock is.

WHAT IS THE MIDI CLOCK?

The MIDI clock is a series of bytes in the MIDI data stream that conveys timing information. It is analogous to a conductor's baton movements, which keep all the performers in sync at the same tempo. The clock bytes are added to the MIDI performance information in the MIDI signal. The clock signal is 24, 48, or 96 pulses per quarter note (PPQ). That is, for every quarter note of the performance, 24 or more clock pulses (bytes) are sent in the MIDI data stream.

A sequencer or drum machine can do the following with the clock pulses:

1. Send clock pulses from its MIDI OUT connector.

2. Receive clock pulses at its MIDI IN connector.

3. Echo (repeat) incoming clock pulses through the MIDI THRU connector.

If a drum machine sends clock pulses, the drum machine sets the tempo and other devices follow it. If a drum machine receives clock pulses from a sequencer, the sequencer sets the tempo and the drum machine follows it.

To send clock pulses from a sequencer or drum machine, you set the device to "Internal clock" mode. To receive clock pulses, you set it to "External clock" or "MIDI clock" mode. Transmitting a clock pulse through the MIDI THRU connector is automatic. If your drum machine has only a MIDI OUT connector, you enable "Echo MIDI in" so that the incoming pulses are echoed or repeated at the MIDI OUT connector.

Now that you understand the MIDI clock, you're ready to use it to synchronize a drum machine with a synthesizer. Let's say that each has a separate recorded performance stored in its own memory. The audio outputs of the drum machine and synth are connected to a mixer, which you monitor. There are at least three ways to synchronize the recorded drum performance with the recorded synth performance:

1. Use the drum machine's clock to drive the sequencer, which in turn drives the synthesizer in sync with the drum machine.

2. Use the sequencer's clock to drive both the drum machine and the synthesizer. The drum machine's internally recorded patterns play in sync with the synthesizer's sequencer-recorded melody.

3. Record the drum-machine pattern on one track of the sequencer; record the synth melody on another track of the sequencer. During playback, the sequencer clock will drive both the drum machine and synthesizer.

Let's look at each method in detail.

METHOD 1: MAKE THE DRUM MACHINE CONTROL THE SEQUENCER

Please see *Figure 1* for this setup. The connections to a sequencer are either to a stand-alone unit, or to a MIDI computer interface plugged into a computer running a sequencer program. You would proceed as follows:

1. Record a drum pattern with the drum machine's internal sequencer.

2. Record a synth melody or chords with an external computer/sequencer.

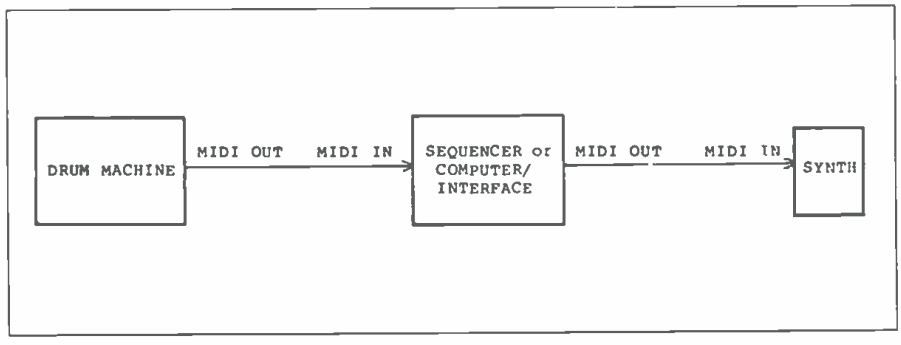
3. Connect the drum machine MIDI OUT to the sequencer MIDI IN.

4. Connect the sequencer MIDI OUT to the synthesizer MIDI IN.

5. Set the drum machine to ENABLE CLOCK OUT (or equivalent).

6. Set the sequencer to EXTERNAL CLOCK or MIDI CLOCK.

Figure 1 Equipment connections for making the drum machine control the sequencer.



7. Press the "play" key on the computer/sequencer.

8. Press the "play" key on the drum machine.

As the drum machine plays its internally recorded patterns, its clock pulses drive the sequencer to play the synth melody at the same tempo.

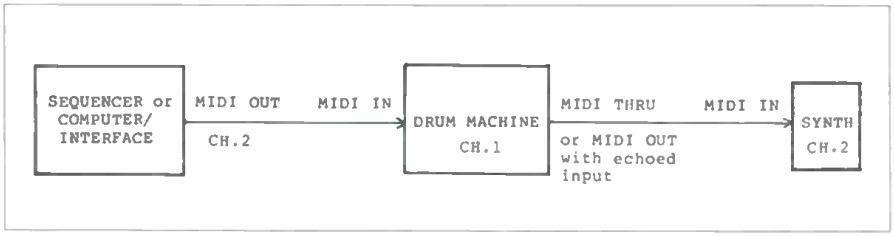


Figure 2. Equipment connections to make the sequencer drive the drum machine and the synthesizer.

METHOD 2: MAKE THE SEQUENCER PLAY THE DRUM MACHINE AND SYNTH

Please refer to *Figure 2* for this setup. You would proceed as follows:

1. Record a drum pattern with the drum machine's internal sequencer.

2. Record a synth melody or chords with an external computer/sequencer.

3. Connect the sequencer MIDI OUT to the drum machine MIDI IN.

4. Connect the drum machine MIDI THRU to the synth MIDI IN. Alternatively, set the drum machine to echo the MIDI IN signal to the MIDI OUT connector, and connect the drum machine MIDI OUT to the synth MIDI IN.

5. Set the drum machine to receive an EXTERNAL CLOCK or MIDI CLOCK signal.

6. Set the sequencer to INTERNAL CLOCK and MIDI DRUM.

7. Set the drum machine to MIDI channel 1. Set the sequencer synth track and the synthesizer to MIDI channel 2. In this way, the sequencer's recorded performance will play only the synthesizer. Alternatively, keep everything on MIDI channel 1, but set the drum machine so that it will NOT respond to MIDI data.

8. Press the "play" key on the computer/sequencer.

As the sequencer plays its recorded synth melody, the sequencer's clock pulses drive the drum machine and synthesizer at the same tempo. The drum machine plays its internally recorded patterns, while the synth plays the sequencer track.

METHOD 3: RECORD THE DRUM PATTERNS INTO THE SEQUENCER

Please refer to *Figure 3A* for this setup. You would proceed as follows:

1. Record a drum pattern with the drum machine's internal sequencer.

2. Connect the drum machine MIDI OUT to the sequencer MIDI IN.

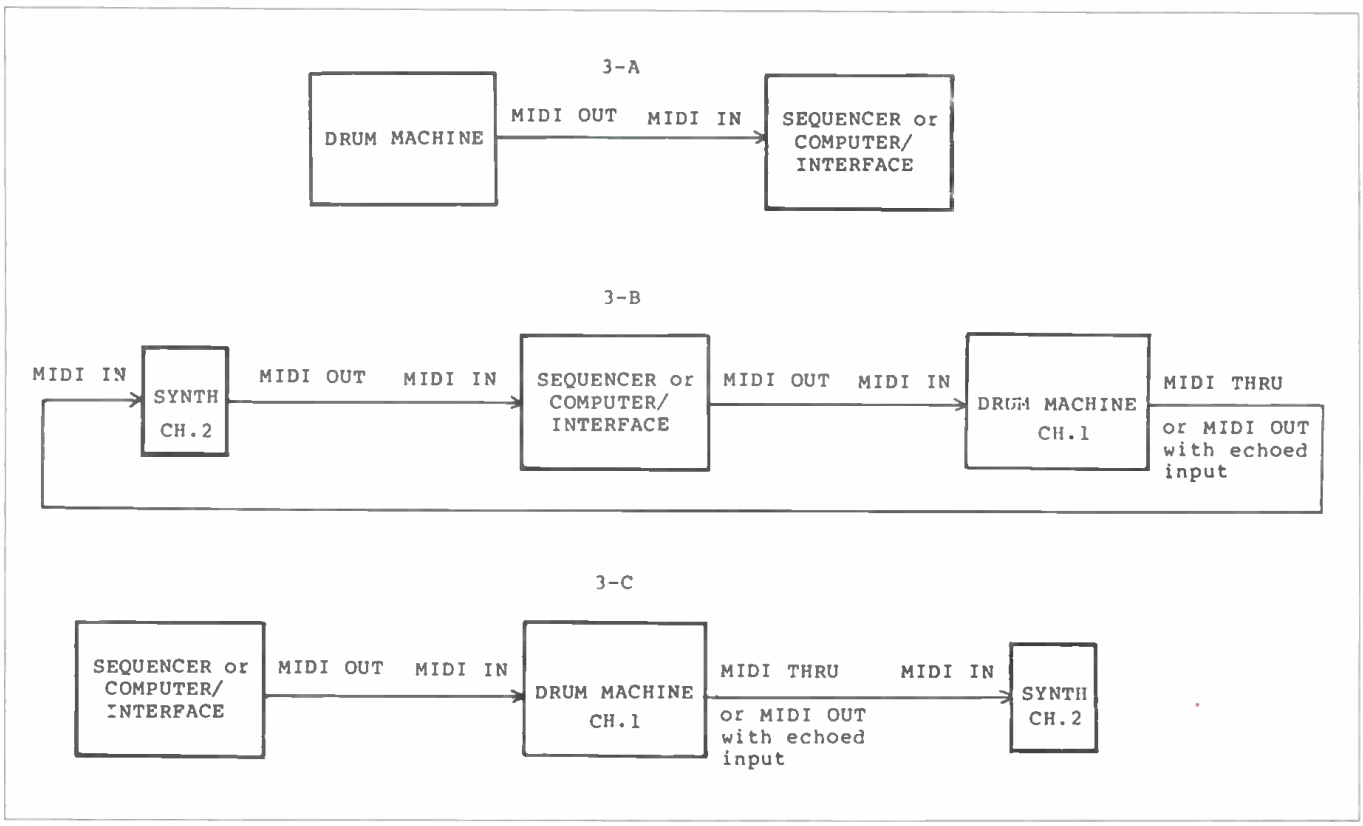
3. Set the drum machine to ENABLE CLOCK OUT (or equivalent).

Also set the drum machine to enable MIDI data out, or to send MIDI data.

4. Set the sequencer to EXTERNAL CLOCK or MIDI CLOCK mode, and record track 1.

5. Hit the "play" key on the drum machine. The sequencer will record the drum pattern on track 1.

Figure 3. Equipment connections for recording the drum patterns into the sequencer on track 1 (3A), overdubbing the synthesizer into the sequencer on track 2 (3B), and playing both tracks into the drum machine and synthesizer (3C).



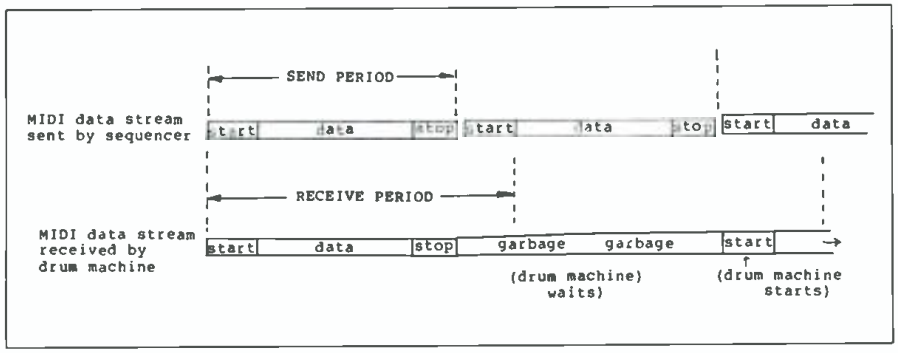


Figure 4. The effect of mismatched baud rates.

6. Now you're ready to add the synthesizer track. Connect the sequencer MIDI OUT to the drum machine MIDI IN (as in *Figure 3B*).

7. Connect the synthesizer MIDI OUT to the sequencer MIDI IN.

8. Set the sequencer to INTERNAL CLOCK.

9. Start recording on track 2 with the sequencer. You'll hear the drum machine playing the pattern recorded on track 1.

10. While listening to the drum machine, play along on the synthesizer and record it on track 2 of the sequencer.

11. For playback, connect the sequencer MIDI OUT to the drum machine MIDI IN (as in *Figure 3C*).

12. Connect the drum machine MIDI THRU to the synth MIDI IN. Alternatively, enable the drum machine to echo the MIDI IN signal at its MIDI OUT connector, and connect the drum machine MIDI OUT to the synth MIDI IN.

13. Set sequencer track 1 to MIDI channel 1; set sequencer track 2 to MIDI channel 2.

14. Set the drum machine to receive MIDI signals on channel 1. Set the synth to receive MIDI signals on channel 2.

15. Press the "play" key on the computer/sequencer.

As the sequencer plays tracks 1 and 2 on channels 1 and 2, its clock pulses drive the drum machine and synth at the same tempo.

Synchronization problems might occur with Methods 1 and 2. If the baud rate of the computer is faster than that of the drum machine, the drum machine might gradually lag behind the sequencer playback tempo. Here's why:

In most drum machines and synthesizers, the computer clock frequency yields a correct MIDI baud rate of exactly 31,250 bits per second. But in the Commodore 64 and Apple II series computers, the computer clock frequency is slightly higher, so these computers send MIDI data at 31,960 baud—slightly faster than the standard MIDI baud rate. However, the drum machine and synth are designed to receive MIDI data at exactly 31,250 bits per second. Herein lies the problem.

Each MIDI byte has 10 bits: a start bit, an 8-bit word, and a stop bit. Since the computer is sending MIDI bytes slightly faster than the drum machine is receiving them, the drum machine eventually misses a start bit (*Figure 4*). Instead, it just sees garbage, and waits until it sees the next start bit to continue playing. This "waiting" causes the drum machine to gradually lag behind the sequencer tempo. That is, the drum machine starts in sync with the sequencer, but since the drum machine is playing slightly slower, it gradually lags behind or plays late.

Some synths can accommodate incorrect baud rates better than others. If the synth can follow the sequencer's incorrect baud rate, but the drum machine lags behind the sequencer's baud rate, eventually the drum pattern will lag behind the synth melody.

There are several solutions to this problem:

- Obtain a MIDI computer interface with a built-in crystal oscillator. The baud rate will be determined by that crystal rather than by the computer's crystal. Many recent interfaces have a crystal oscillator built in.
- Use a computer other than Apple II series or Commodore 64.
- Add a crystal oscillator and divider to an existing MIDI computer interface to get 31,250 baud.
- Use Method 3 described earlier: record a short drum pattern into a sequencer, then play along with it on your synth while recording the synth on another sequencer track. Since the drum pattern is short, long-term time-lag problems don't happen.

EFFECTS OF TRANSPOSING

Suppose you have recorded a synth track and a drum-machine track with a single sequencer. If you transpose a song section (change its key), the sequencer will play different keyboard keys to transpose the melody. Unfortunately, the sequencer will also play different drum-machine pads. Instead of hearing, say, a kick drum, you'll hear a cowbell. To prevent this, transpose only the synth track—not the entire sequence which contains both drum and synth tracks. Append together various sequences, each sequence having a synth track with different keys (pitches).

EFFECT OF TEMPO CHANGES

If you change the tempo of a sequence, both the drum machine and synth will follow the change, and stay in sync. No problem.

If the sequencer is playing at 96 PPQ, but the drum machine operates only at 24 PPQ, the drum patterns will play four times too fast. Be sure that the sequencer and drum machine are set to the same PPQ rate.

A REAL-WORLD EXAMPLE

The first time I tried synching a drum machine to a synthesizer, I used an Alesis drum machine, Casio CZ-1000 synthesizer, Passport MIDI interface, and a Commodore 64 computer running a Syntech Studio 1 sequencer program.

To begin the process of songwriting, I recorded the intro by tapping in a four-bar solo on the drum machine.

I started with kick and snare, then added hi hat, toms, and cymbals. Then I recorded another simple four-bar drum pattern to be used throughout the song. Now there were two drum patterns in the drum machine's internal sequencer.

Next, I recorded synthesizer chords into the computer/ sequencer while listening to the sequencer's click track. When I was finished, the sequencer contained the synth performance.

Now I was ready to sync the two sequences: drums and synthesizer. I tried method one, driving the

sequencer and synth from the drum machine. Although they started together when I hit "play" on the drum machine, the drums eventually lagged behind the synthesizer. Unknown to me, the slight difference in baud rate between the Commodore 64 and the Alesis drum machine caused the problem.

Next I tried method two, driving the drum machine and synth from the sequencer. The same problem occurred.

Finally I tried method three, which worked. I recorded the drum intro into the sequencer as sequence A, track 1. Then I recorded the four-bar simple drum pattern as sequence B, track 1. While listening to the sequence-B drum track, I played four bars of synthesizer chords, and recorded them on track 2.

THE RIGHT TIME

Now it was time to put the song together. I copied sequence B several times and appended it onto itself, calling each copy "sequence C," "sequence D," etc. For each of these sequences, I transposed the synth track to a different key. This resulted in chord changes. Finally, I cut and pasted the various sequences (chord changes) together, plus the intro, to form a song.

To make sure each track played the correct instrument, I set track 1 and the drum machine to MIDI channel 1, and set track 2 and the synth to MIDI channel 2. I plugged the sequencer MIDI OUT to the drum machine's MIDI IN, and plugged the drum machine's MIDI OUT (with input echoed) to the synth's MIDI IN. Finally, I hit "play" on the sequencer, and a tightly synchronized song came out.

I recorded the drum machine and synth audio outputs onto three tracks of a multi-track tape recorder (two tracks for the stereo drum machine). Then I overdubbed a synthesizer melody, and mixed down the four tracks with effects to stereo. There's another way to do this: Record a sync tone on an outside track of a multitrack recorder, and drive the drum machine and synth chord sequence from the tape-sync signal. Then you can record the audio outputs of the drum machine and synth directly onto 2-track for better clarity.

It might have been easier to make the drum machine play its patterns, play along "live" on the synth, and record an audio mix of the two instruments. But at least I learned how to make two non-compatible machines play together. This achievement was technical mastery, more than musical mastery. The pleasure of creating a song this way was intellectual, rather than physical or emotional. Whether or not the mechanical assembly of a song can be called "song writing" is debatable, but some sort of music did come out of the playback speakers!

CONCLUSION

By following the suggestions in this article, you should be able to synchronize a drum machine with a synthesizer. These principles can be extended to more tracks and more sound generators as you expand your MIDI studio. Be aware of computer incompatibility problems and work around them. You'll be rewarded with a well-synchronized musical performance.

ACKNOWLEDGEMENT

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