THE MIDI OPTION

May 27, 1986

CONTENTS OF THIS MANUAL

This manual contains information on the use of the Synclavier (R) MIDI option.

INTRODUCTION TO MIDI

MIDI (Musical Instrument Digital Interface) makes it possible to
control many different electronic instruments from a single MIDI
keyboard or sequencer. With it, you can send digital signals from a
master device to synthesizers, sequencers, rhythm machines and other
types of audio processing equipment.

Because MIDI specifications define hardware and software standards
used throughout the industry, musicians can use their favorite
keyboard to perform or record sound textures from a variety of
instruments.

The MIDI option allows the Synclavier (R) to control or be controlled
by other MIDI instruments.

MIDI Equipment
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There are many kinds of instruments and processors available today
which use MIDI implementation in various ways. Among these are:

- MIDI keyboards and keyboard controllers, guitars, percussion
  pads, and pitch-to-MIDI converters, all of which produce control
  and expression signals;

- MIDI sequencers which record these signalsl;

- MIDI-controlled sampling units which reproduce live sounds
  digitally;

- MIDI synthesizers which produce sounds using various types of
  synthesis.

Often more than one type of MIDI-controlled equipment is contained in
one unit. Keyboards and synthesizers are a good example of this
combination: the keyboard produces control and expression signals
and the synthesizer produces sounds. Another example is the
programmable drum machine, which can contain both sampling unit and
synthesizer; it always contains some type of sequencer.

The Synclavier (R) combines four of MIDI instruments in one unit:
- keyboard,
- synthesizer,
- sampler,
- sequencer.

MIDI Ports

There are three kinds of MIDI ports on MIDI devices:

The MIDI OUT port

   The MIDI OUT port is used by a MIDI keyboard or a MIDI
   sequencer to send messages to the MIDI IN ports of other MIDI
   equipment.

The MIDI IN port

   The MIDI IN port receives information from the MIDI OUT or
   MIDI THRU ports of other MIDI devices.

The MIDI THRU port

   The information sent from the MIDI THRU port is an exact copy
   of the information received at the MIDI IN port. It is used
   to pass information to MIDI IN ports of additional MIDI
   devices. This is called "daisy-chaining". The instrument
   equipped with the MIDI THRU port does not add information to
   the THRU signal when notes are played or controllers are
   moved.

Each MIDI OUT port has 16 channels. That is, messages can be sent
out of one MIDI OUT port on any one or all of 16 separate channels.
Each receiving device can have its MIDI IN port set to respond to any
one or all of these channels.

MIDI devices may have different MIDI ports. For example:

   ● A MIDI keyboard usually has one MIDI OUT port from which its
     signals are sent to a synthesizer or sequencer.

   ● A MIDI synthesizer has at least one MIDI IN port to receive
     signals and one MIDI THRU port from which to pass them on to
     other devices.

   ● Sequencers and keyboard controllers typically have MIDI IN and
     MIDI THRU ports as well as multiple MIDI OUT ports. The
     Synclavier (R) has up to eight MIDI IN ports, up to eight MIDI
     THRU ports, and from 4 to 32 MIDI OUT ports.

MIDI Signals

Signals are sent out of the MIDI OUT ports at a rate of 31.5 kHz or 31,250 bits per second. Thus, more than 3000 10-bit MIDI messages are transmitted per second. A chord performed on the master keyboard is sent out as individual notes, a few milliseconds apart. The MIDI transmission rate makes the ear perceive the notes as simultaneous.

The MIDI signal rate is too slow, however, to allow transmission of more than about 10 notes at once from one MIDI OUT port without perceptible delays. On a sequencer this problem can be relieved by using additional MIDI OUT ports.

There is also a limit as to how many MIDI devices can be connected in a chain (using MIDI THRU to MIDI IN). Cumulative distortion may appear with more than four MIDI devices on one chain. A MIDI THRU box can be used to provide parallel MIDI outputs to avoid this problem. The Synclavier (R) provides multiple MIDI OUT ports so that it is seldom necessary to connect more than one or two devices in this way.

MIDI Messages

There are two types of MIDI messages that can be sent from one MIDI
device to another:

- Channel messages
- System messages

Channel Messages

When a musician plays a note on a MIDI keyboard, a Note-On
message is sent through the MIDI OUT port on the channel
assigned to the keyboard. Other instruments in the network
set to receive that channel (or to all of the channels)
respond to the Note-On message by sounding that note.

A Note-On message contains information on the note number,
and the velocity of the keystroke. If the receiving
instrument is not equipped with the velocity sensitivity
feature, then it responds to the Note-On message only and
ignore the additional information.

While the player is holding the key, any changes in key
pressure are transmitted. How the receiving instrument
responds to these changes depends on what pressure
information the sending instrument transmits (individual or
channel pressure) and what pressure information (if any) the
receiving instrument recognizes.

When the player releases the key, a Note-Off message for that
note is sent and the instruments on that channel or those set
to receive all channels respond accordingly.

When a MIDI instrument receives a message through its MIDI IN
port, it first determines whether the message is on a channel
it is set to respond to. If it is, it plays the note; if
not, it does not play. In either case it passes the message
on through its MIDI THRU port to the next instrument in the
network.

System Messages

There are three types of System messages; System Real-Time,
System Common and System-Exclusive. System Real-Time and
System Common messages are used primarily to synchronize
sequencers and drum machines. System Real-Time messages are
also used to implement the program change feature described
below.

System Exclusive messages are the codes each manufacturer
defines to implement functions on its own components. System
Exclusive messages can control such things as timbre
parameters, sequence and timbre data dumps, and external MIDI
effects and mixers.

Real-Time Effects

When using the Synclavier (R) as the controlling keyboard, you can send eight types of Synclavier (R) expression through the MIDI OUT ports. Similarly, real-time effects performed on other keyboards can be recorded into the Synclavier (R) memory recorder. Real-time effects changes are controlled in the MIDI network by MIDI Controllers. The following chart shows the MIDI Controllers and their corresponding Synclavier (R) expression input devices:

MIDI CONTROLLER	SYNCLAVIER (R) EXPRESSION INPUT
Key Velocity	Key Velocity
Channel Pressure	No direct equivalent although input is recorded in memory recorder
Individual Key Pressure	Individual Key Pressure
Pitch Wheel	Pitch Wheel
Modulation Wheel	Mod Wheel
Breath Controller	Breath Controller
Modulation Pedal	Pedal2
Sustain Switch	Sustain
Portamento Switch	Portamento

Velocity information based on Synclavier (R) sensitivity and response settings is sent with MIDI. Velocity signals received from MIDI sources are responded to by the Synclavier (R) in relation to the sensitivity setting only.

Channel pressure, used by some types of MIDI keyboard devices, is a control signal based on the total pressure of keys pressed on the keyboard at one time. Individual pressure, used on the Synclavier (R), is a separate control signal based on the pressure on each individual key.

Although the Synclavier (R) produces only individual key pressure signals, it is capable of recording and transmitting either. If there are devices in your network that respond to individual key pressure, set this item on the MIDI Display to INDIV for the keyboard or track sending to those devices.

If you have recorded a sequence on the Synclavier (R) from another device that sends out channel pressure, this information is recorded with the sequence. When these tracks are subsequently used to control the same or similarly equipped devices, setting the PRESSURE item on the MIDI Display to CHAN for those tracks directs the Synclavier (R) to send that information.

Additional MIDI controllers will be available in the future.

Program Change

The MIDI program change message transmits timbre change information anywhere in a sequence. The Synclavier (R) records and transmits program change signals, but it does not perform them. If, for example, a timbre change is made on a MIDI synthesizer during recording on the Synclavier (R), the time and the tone (timbre) memory number are recorded. When the sequence is played back, the Synclavier (R) transmits this information. The timbre being used before the program change is not sent, and therefore not recorded by the memory recorder. To record the original timbre setting, you must select the timbre while the memory recorder is recording.

MIDI Routing and Synchronization

Using the MIDI option you can

- assign outgoing signals to MIDI OUT ports and channels. You can assign two keyboard timbres (split keyboard) as well as all tracks of the memory recorder.

- select a channel for receiving MIDI through the MIDI IN port. You can select any of the 16 MIDI channels or receive on all channels.

- synchronize to other units by selecting MIDI synchronization. You can choose one of two MIDI sync inputs and send MIDI sync from one or all MIDI OUT ports.

If you are synchronizing the Synclavier (R) to other MIDI devices, you need to activate MIDI synchronization.

There are two methods for making MIDI assignments:

1. the MIDI button and control knob on the keyboard unit;

2. MIDI Display on the terminal.

All settings can be made from the terminal MIDI Display. You use the spacebar to step through the settings of the selected parameter, and may enter numbers directly.

The only MIDI parameters accessed using the MIDI button and control knob are incoming MIDI synchronization and MIDI OUT ports and channels.

Controlling MIDI from the Keyboard

The MIDI button (the unlabeled button, fifth panel, bottom row,
fourth from left) is used to assign a MIDI OUT port and MIDI channel
for the keyboard timbre. It is also used in conjunction with the EXT
SYNC MODE button to set synchronization to MIDI IN.
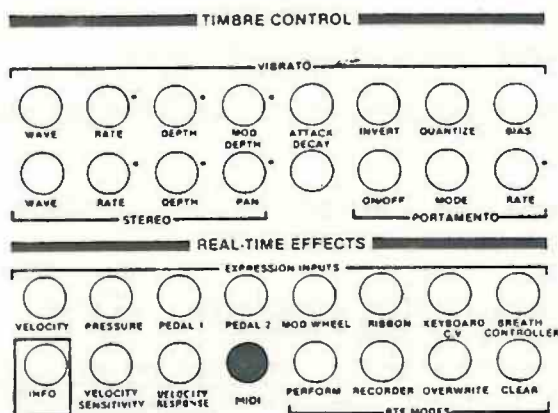
Setting a MIDI OUT port for the keyboard timbre

When you first press the MIDI button, the display window
shows

   "MIDI: Output Off."

This means that the MIDI output for the keyboard timbre is
turned off. Press the button repeatedly to step through all
the possible settings for MIDI OUT ports and channels; or
dial a setting with the control knob.

For example, when you press the MIDI button a second time,
the display window shows

   MIDI: O [1] C [1]

This setting means that Channel 1 of the first MIDI OUT port
is selected for the keyboard timbre. As you press MIDI
repeatedly, you step through all the possible settings
(MIDI: O [1] C [2], MIDI: O [1] C [3], etc.) If you have one
MIDI module installed in your system, the cycle returns to
MIDI:OUTPUT OFF after MIDI: O [4] C [16].

Once you have assigned the MIDI output and channel for the
keyboard timbre, any sequence recorded with that timbre and
then saved retains these MIDI assignments.

Assigning sequence tracks MIDI OUT ports

The MIDI button and control knob assign the MIDI OUT port and channel to the keyboard timbre only. To send a sequence from the memory recorder through the MIDI system, you must assign a port and channel for each track recorded. You can do this by using the SKT and SMT buttons to bring the timbre of each track to the keyboard as follows:

1. Press SKT and the track number button to bring the timbre of the desired track to the keyboard.

2. Press the MIDI button and make the desired output and channel settings.

3. Press SMT, the track number button and SKT to place the routed timbre back onto its track.

MIDI parameters are actually timbre parameters. If you change a MIDI parameter on a keyboard timbre and try to record on a previously recorded track, the timbres will not match. Use step 3 above to place the changed timbre on the selected track.

When you save a sequence, you also save the MIDI routings for the keyboard and each memory recorder track in use.

Setting the MIDI synchronization input

The Synclavier (R) can be changed from internal synchronization to MIDI input synchronization from the button panel. Setting MIDI synchronization output to a particular MIDI OUT port must be done from the MIDI Display.

To set synchronization to MIDI input:

1. Press EXT SYNC MODE and hold. The display window shows

    Internal Sync

2. Press MIDI (5th panel, bottom, 4th from the left). The display window changes to

    MIDI IN Sync

The MIDI AUX Input

    With a 2X8 MIDI unit, you may select an auxiliary input for
    receiving MIDI sync signals. With a 2X8 unit installed, the
    SYNC IN parameter displays a third selection:

        SYNC IN: AUX

    When AUX is selected, sync signals received at the AUX input
    on the first MIDI module are used for external
    synchronization.

+---+
| |
| Regardless of the number of modules installed, only the MIDI IN |
| and AUX ports of MIDI Module 1 are used for sync input. The |
| MIDI IN port of MIDI Module 1 is the ONLY active MIDI IN port. |
| |
| No other MIDI IN or AUX inputs are active. |
+---+

Controlling MIDI from the Terminal

You use the MIDI Display to set

- MIDI input channels;
- MIDI OUT ports and channels;
- MIDI synchronization input and output.

The MIDI Display is activated from the MAIN MENU.

```
┌────────────────────── MIDI DISPLAY ──────────────────────┐
│  1. Move cursor using arrow keys.  Enter values or <SPACE> to step. │
│  2. Press <ENTER> when done with this screen.             │
└───────────────────────────────────────────────────────────┘
```

NUMBER OF AVAILABLE MIDI OUTPUTS: 4   SYNC IN: OFF   SYNC OUT: OFF
                                          INPUT CHANNEL: ALL

KEYBOARD TIMBRE	MIDI OUT	MIDI CHAN	SEND PRES
SNARE	1	1	

SPLIT KEYBOARD TIMBRE	MIDI OUT	MIDI CHAN	SEND PRES
NO SPLIT KEYBOARD			

T#	INSTRUMENT NAME	MIDI OUT	MIDI CHAN	SEND PRES
1	RHODES	1	2	
2	BRIGHT GUITAR	1	3	
3	BASS GUITAR	1	4	
4	SPLIT HAMMOND	1	5	
5	SYNTH PAD #1	1	6	
6	VOICES #1	1	7	
7	VOICES #2	1	8	
8	TRUMPET #1	1	9	

T#	INSTRUMENT NAME	MIDI OUT	MIDI CHAN	SEND PRES
9				
10				
11				
12				
13				
14				
15				
16				

The screen is divided into three parts.

- Across the top of the screen are the basic instructions for using the display.

- Below the instruction box to the left, the NUMBER OF AVAILABLE MIDI OUTPUTS tells you the number of MIDI Outputs available to you in your Synclavier (R) Digital Music System. To the right of this are the default settings for synchronization input and output and the MIDI Input Channel.

- The bottom half of the screen contains keyboard and track MIDI output routings.

Synchronization Input and Output

Both synchronization settings are set to OFF whenever a new timbre is recalled to the keyboard.

Set SYNC IN to INPUT if a synchronization signal is coming from another device. You may also receive MIDI sync through the AUX input if equipped with a 2X8 MIDI unit. In this setting, the Synclavier (R) memory recorder does not start until an outside sychronization signal is received.

Set SYNC OUT to the desired MIDI OUT port if the Synclavier (R) is sending a synchronization signal to other devices.

Synchronization settings are not saved with the sequence.

MIDI Input Channels

When you first enter the system, the MIDI Input is set to ALL. This means that the Synclavier (R) responds to input on any of the 16 MIDI IN channels. To select an individual channel, move the cursor to Input Channel and press the space bar to step through the 16 possible channels. Or type in the number of the channel you want to select and press RETURN.

Input settings are not saved with the sequence.

MIDI Outputs and Channels

This part of the display controls the outputs and channels
for the keyboard timbre, the other timbre of the split
keyboard (if using one) and the sixteen tracks of the memory
recorder.

- The MIDI OUT column determines the MIDI OUT port through
  which MIDI information is transmitted. The default
  setting is OFF.

- The MIDI CHAN column determines which MIDI channel for
  the designated MIDI OUT port is be used when
  transmitting. By default, this field is left blank,
  since the MIDI output is off.

- The SEND PRES column determines whether or not pressure
  information is to be transmitted to the designated port
  and channel and if so which type of pressure (individual
  or channel—see above). The default setting is null.

To change any of these settings, move the cursor to the appropriate
field using the arrow keys, and press the space bar to step through
the range of values. Or type in the new value from the terminal
keyboard and press RETURN.

Track MIDI OUT routings are saved with a sequence; Synchronization
and Input channel settings are not.

Saving MIDI parameters

You cannot save MIDI settings when you save a timbre. MIDI settings
are only saved with sequences.

When you save a sequence,

- all Track output settings (port, channel, and pressure) are
  saved with the sequence.

- synchronization settings are not saved with the sequence.

- input settings are not saved with the sequence.

PERFORMING AND RECORDING WITH MIDI

With the MIDI option, there is no real difference between performing or recording using the Synclavier (R) keyboard and performing or recording using another MIDI keyboard.

The most common situations in which MIDI is used to link the Synclavier (R) to other sound devices are:

- operation of devices such as synthesizers and sampling devices from the Synclavier (R);

- operation of the Synclavier (R) from a MIDI keyboard;

- synchronizing the Synclavier (R) memory recorder with other sequencers for recording and playback;

- transferring sequences between another sequencer and the Synclavier (R) memory recorder.

The examples on the following pages illustrate some of the possibilities from each of these situations.

When you set up a MIDI network you use 5-pin DIN connectors. Most instruments have connectors labelled IN, OUT, and THRU.

```
+------------------------------------------------------------------+
|                                                                  |
|   WARNING:  These connectors are fragile and can be damaged by   |
|   careless use.                                                  |
|                                                                  |
+------------------------------------------------------------------+
```

Controlling other Instruments with MIDI

Using the MIDI output ports you can control any MIDI-equipped instrument with the Synclavier (R).

1. Connect the MIDI IN port of your MIDI keyboard to the MIDI OUT port of the Synclavier (R).
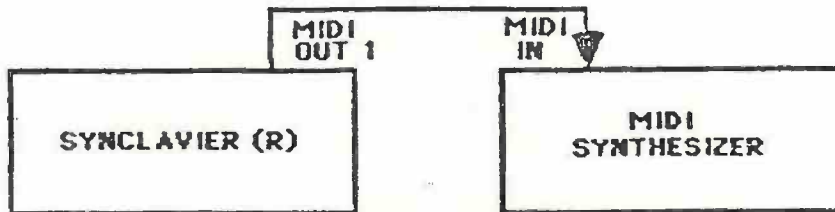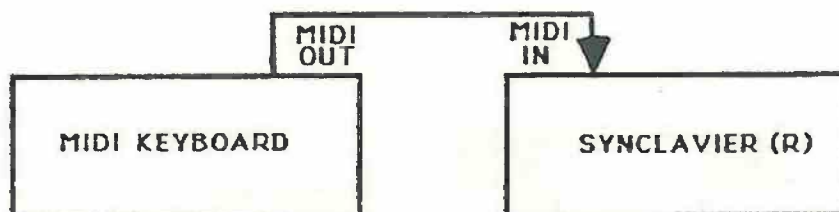

2. If you want to hear both the Synclavier (R) and the MIDI synthesizer, be sure that both are connected to your sound system. If you want to hear only the MIDI synthesizer, turn down the Synclavier (R) at the mixer, lower the keyboard volume using the TRACK VOLUME button, or recall a "null" timbre to the Synclavier (R) keyboard. Any timbre under the name EMPTY TIMBRE on the Timbre Directory is a null timbre, as is a timbre on an empty track in the memory recorder. To recall a null timbre:

   a. Press SKT.
   b. Press a numbered button under TRACK SELECT for an empty track.

3. Press the MIDI button twice to turn on MIDI OUT 1, CHANNEL 1.

4. Play on the Synclavier (R) keyboard. Your MIDI synthesizer is triggered.

You can record your MIDI synthesizer into the Synclavier (R) digital memory recorder by pressing RECORD.

Controlling the Synclavier (R) with MIDI

1. Connect the MIDI OUT port of your MIDI keyboard to the MIDI IN
    port of the Synclavier (R).

```
            MIDI              MIDI
            OUT               IN
     ┌─────────────────┐  ┌─────────────────┐
     │                 │  │                 │
     │  MIDI KEYBOARD  │  │  SYNCLAVIER (R) │
     │                 │  │                 │
     └─────────────────┘  └─────────────────┘
```
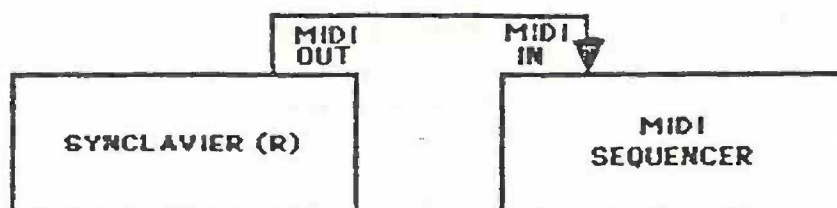
2. Recall the desired timbre to the Synclavier (R) keyboard.

3. Play on the MIDI keyboard. You hear the Synclavier (R) timbre.

4. Patch velocity, mod wheel, or other real-time effects as desired.
    The pitch wheel from the MIDI keyboard is always active.

    If you want to record your performance into the memory recorder,
    press RECORD on the Synclavier (R).

Recording Synclavier (R) Parts on Other Sequencers

To record from the Synclavier (R) to a MIDI sequencer, follow these instructions:

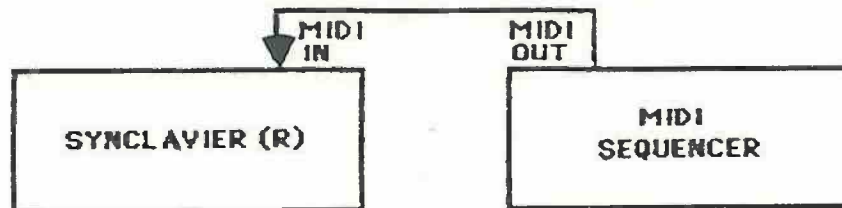1. Connect the Synclavier (R) MIDI OUT 1 to the sequencer MIDI IN.

2. Recall a timbre to the Synclavier (R) keyboard.

3. Set up real-time effects on the Synclavier (R) as desired.

4. Assign the Synclavier (R) keyboard to MIDI OUT 1 and CHAN 1 using the terminal MIDI Display or by pressing the MIDI button on the button panel twice.

5. Set the Pressure Send Parameter if the timbre uses a key pressure setting.

6. Set up the sequencer to record MIDI Channel 1 according to its instructions.

7. Start recording on the sequencer.

8. Play on the Synclavier (R).

Playing back a Sequence from a MIDI Sequencer

To play a sequence from a MIDI sequencer which controls the Synclavier (R), follow these instructions:

1. Connect the sequencer MIDI OUT 1 to the Synclavier (R) MIDI IN.

2. Recall a timbre to the Synclavier (R) keyboard.

3. Set up the sequencer to play according to its instructions.

4. Route the recorded sequencer track to the correct sequencer MIDI OUT port.

5. Start the sequencer.

Additional devices can be driven from the MIDI sequencer by connecting them to a MIDI THRU on the Synclavier (R), or by connecting them to other MIDI OUT ports on the sequencer.
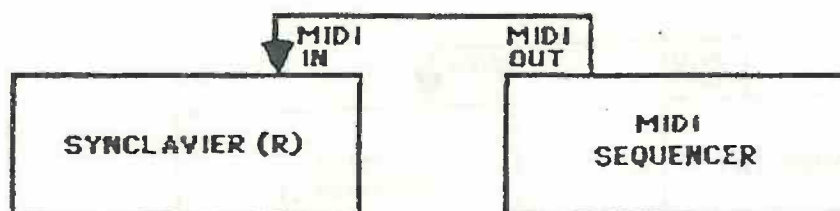
Transferring Sequences

You can transfer a sequence from a MIDI sequencer to the Synclavier (R) and vice versa. However, if the sequence to be transferred has more than one track and you want to keep each track separate, it is necessary to transfer them one at a time.

```
+-------------------------------------------------------------------+
|                             WARNING                               |
|                             -------                               |
|                                                                   |
|  Do not use the Music Notation or Recorder Displays while         |
|  transferring sequences.  Timing errors may result.               |
|                                                                   |
+-------------------------------------------------------------------+
```

Transferring from a MIDI sequencer to the Synclavier (R)

1. Connect the sequencer MIDI OUT to the Synclavier (R) MIDI IN.

```
        ┌MIDI          MIDI
        ▼ IN           OUT
┌───────────────┐   ┌───────────────────┐
│               │   │                   │
│               │   │      MIDI         │
│ SYNCLAVIER (R)│   │   SEQUENCER       │
│               │   │                   │
│               │   │                   │
└───────────────┘   └───────────────────┘
```

2. Recall the desired timbre to the Synclavier (R) keyboard.

3. If a previous track has been recorded with the same timbre, solo the track to be recorded.

4. Set the sequencer to send a MIDI sync signal.

5. Set the Synclavier (R) for MIDI INPUT synchronization. You do this by setting SYNC IN to INPUT on the MIDI Display or by holding the EXT SYNC MODE button while pressing the MIDI button on the button panel. The keyboard display window shows

   MIDI IN Sync

6. Set up the sequencer to play the desired track through a selected MIDI OUT port.

7. Set the Synclavier (R) click rate to match the tempo on the sequencer.

8. Press RECORD on the Synclavier (R). The memory recorder does not start, as it is waiting for a MIDI Clock signal.

9. Start the sequencer.

10. Repeat Steps 3 - 10 for each track.

Transferring from the Synclavier (R) to a MIDI sequencer

1. Connect the Synclavier (R) MIDI OUT 1 to the sequencer MIDI IN.
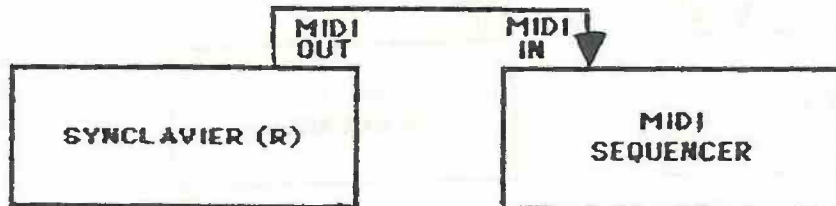
2. Record or recall a sequence to the memory recorder.

3. Set the tempo on the sequencer to match the Synclavier (R) click rate.

4. Set the Synclavier (R) for MIDI INPUT synchronization as above. Be sure that the sequencer MIDI OUT port you are using sends MIDI sync.

5. Assign the memory recorder track(s) to be transferred to a MIDI OUT port and channel.

6. Use the MIDI Display to set the pressure information type (INDIV or CHAN) if pressure signals are to be sent.

7. Set the sequencer to record according to its instructions.

8. Press START on the Synclavier (R). The sequence does not begin to play until receiving a start signal from the sequencer.

9. Start the sequencer.

10. Repeat Steps 5 - 9 for each track to be transferred.

You can set up a MIDI network using many keyboards, synthesizers, and sequencers. The following diagrams illustrate two possible networks.
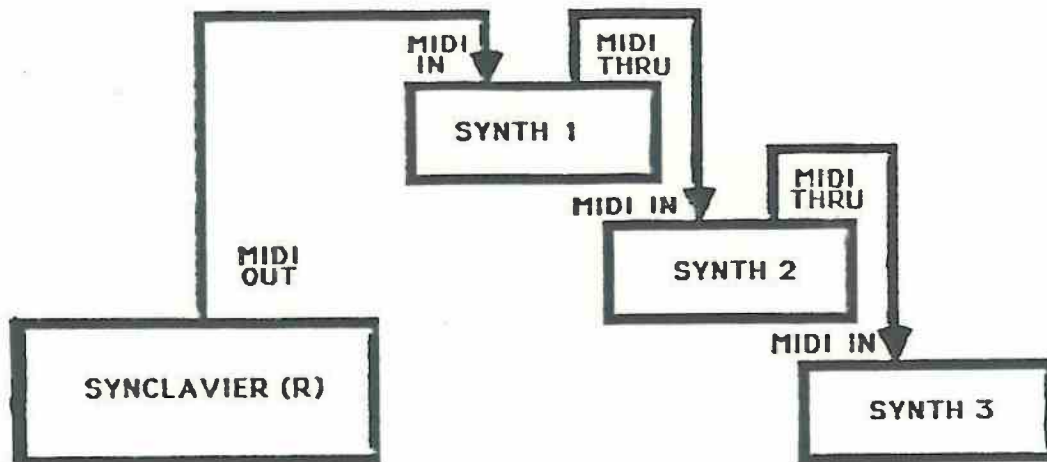
Other ways of connecting MIDI devices are outlined in the manuals for other MIDI devices and in MIDI 1.0 Detailed Specification Document from the International MIDI Association, 11857 Hartsook St., North Hollywood CA 91607, telephone (818) 505-8964.

SYNCLAVIER (R) MIDI IMPLEMENTATION CHART

[SYNCLAVIER DIGITAL MUSIC SYSTEM]   Date: 1 February 1986
Synclavier MIDI Option   MIDI Implementation Chart   Version: 1.0

Function...	Transmitted	Received	Remarks
Basic Default Channel Changed	1 - 16 * 1 - 16 *	all channels 1 - 16	

Mode   Default
       Messages
       Altered
	1
	x
	**************
		1
		1,2,3
		x	

Note Number : True voice	24 - 108 **************	0 - 127	
Velocity Note ON Note OFF	o 9nH, v=1-127 o 9nH, v=0	o ** o **	
After Key's Touch Ch's	o * o *	o ** o **	
Pitch Bender	o	o **	7 bit resolution

1
          2
          4
Control
         64
Change   65
	o
	o
	o
	
	o
	o
		o **
		o **
		o **
		
		o **
		o **
			Modulation Wheel
			Breath Control
			Pedal 2
			
			Sustain foot sw
			Portamento ft sw
			
			NOTE: More
			controllers in
			future

Program Change : True #	o **************	o **	Synclavier (R) does not perform program changes
System Exclusive	x	x	
System : Song Pos : Song Sel Common : Tune	o x x	o x x	Transmits and receives song positions to sequence start
System : Clock Real-Time : Commands	o o	o o	
Aux :Local ON/OFF :All Notes OFF Mes- :Active Sense sages :Reset	x o x x	x o x x	
Notes	* Information stored with sequence ** Information recorded by Memory Recorder		

Mode 1 : OMNI ON, POLY   Mode 2 : OMNI ON, MONO   o : Yes
Mode 3 : OMNI OFF, POLY   Mode 4 : OMNI OFF, MONO   x : No

NOTE: The Synclavier (R) MIDI software is currently under development. Several features provided for by the MIDI specifications have not yet been implemented in the Real-Time Performance software. Specifically, certain System Real-Time and System Common features, have not been implemented. No System Exclusive features have been implemented.