

## 7-0 INTRODUCTION

The Musical Instrument Digital Interface (MIDI) is a system which, for the first time, allows computer-based instruments from various manufacturers to be basically compatible. This is a great benefit to the owner, whose equipment is thereby protected from obsolescence. As MIDI-compatible equipment is introduced one will be able to freely choose keyboards, sequencers, and rhythm units with confidence that they will work together as one programmable system.

First this section explains how to basically use the MIDI control options available on the Prophet-T8. Then it discusses the specific data formats in more detail. Interested programmers should also consult "The Complete SCI MIDI," which can be ordered through our Customer Service Department.

## 7-1 BASIC OPERATION

Assuming two Prophet-T8s are interconnected, "Synth A" refers to the "master" Prophet-T8, whose MIDI OUT is connected to the MIDI IN of "Synth B," the "slave" - T8.

1. Switch power off on all equipment to be interconnected.
2. Connect Synth A MIDI OUT to Synth B MIDI IN jack.
3. Switch power on. After TUNE, notes played on Synth A will be played simultaneously on Synth B, with velocity.
4. To enable Synth B to change programs under remote control from Synth A, on Synth B hold RECORD and press PROGRAM SELECT 1. Now program changes selected on Synth A will simultaneously select the same program number on Synth B.
5. To reprogram Synth B with a specific program from Synth A, select the desired Synth A program, either left or right. Then (on Synth A) hold RECORD and press PROGRAM SELECT 2. Synth B will reprogram the same memory location with this program.
6. To enable Synth B to follow the wheels on Synth A, on Synth B hold RECORD and press PROGRAM SELECT 4. Now Synth B's wheel value will be a sum of the local wheel and that of Synth A.
7. Receiving of program changes and wheels over MIDI must be enabled (if desired) each time power is switched on.
8. Whenever TUNE is pressed on Synth A, Synth B will also TUNE.

## 7-2 INITIALIZATION AND MODES

The simplest application is to tie two Prophet-T8s together, gaining the sonic power of multiple simultaneous programs. MIDI OUT on the "master" is connected to MIDI IN on the "slave" (Figure 7-0). If it is desired to use either keyboard to control the other, a second cable can be added (Figure 7-1). Each then becomes a master and slave. The -T8s are smart enough to distinguish information which arises from their keyboard from that which comes in through the MIDI. Each will send what is played on its keyboard or by its sequencer only. They do not "echo" the MIDI IN information over MIDI OUT. This prevents an infinite loop from forming from the slight delays this all takes.

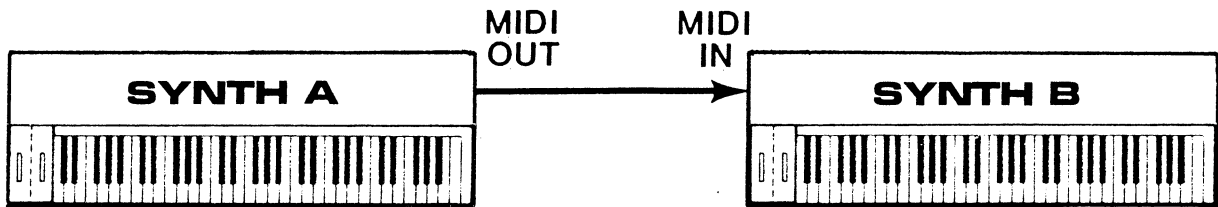


Figure 7-0  
SIMPLE CONTROL

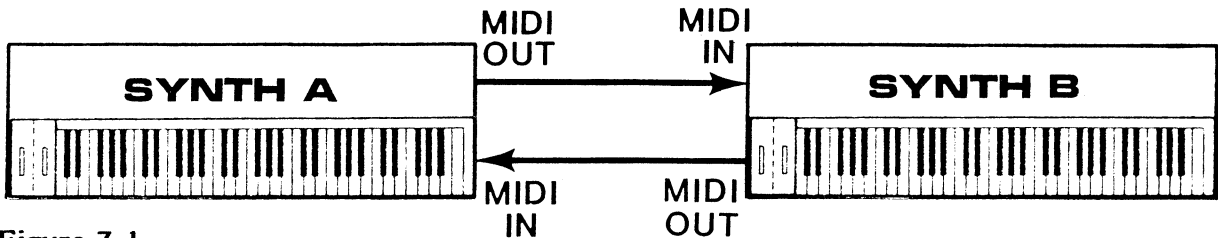


Figure 7-1  
DUAL CONTROL

Returning to the simple installation for explanatory purposes, we will assume that both synths are Prophet-T8s. This will allow the convenient description of the -T8 as both a MIDI transmitter and receiver. When power is first turned on, both instruments TUNE, then initialize to Omni mode. Omni mode is the most general level of MIDI operation. T8 Omni data is always transmitted over MIDI Channel 1. As an Omni receiver the -T8 responds to data received on any channel (1 - 16). The notes are then handled according to the internal assignment system. Having Omni as the default mode allows the Prophet-T8 to drive any other synth, even if Synth B doesn't have velocity or pressure. However, in Omni mode pressure information is ignored.

The Prophet-T8 is also capable of Poly and Mono MIDI modes. Poly mode allows addressing each separate synthesizer, sequencer, or rhythm unit over a separate Channel. If Synth B were to receive a Poly mode select command, BxH-FFH, it would listen for keyboard data encoded only on Channel 1. In Poly mode, the -T8 also ignores received pressure data. But any number of notes can be sent, to which the -T8 will respond according to its normal voice assignment.

Mono mode is the most powerful level of MIDI operation, allowing individual channeling of each synthesizer voice. Channeling each voice allows transfer of the changing pressure data for each key. Both interconnected machines must be in mono mode to work.

The -T8 may be changed to Mono mode by holding RECORD and pressing PROGRAM SELECT 6. This also causes transmission of the Mono mode select code, BxH-FEH over MIDI. When Synth B (also a -T8) receives this command it configures its eight voices to receive on Channels 1 through 8 in Mono mode. It will receive Note On/Off, Velocity, and Pressure data with the voice already assigned.

To change the -T8 into Omni mode again, hold RECORD and press PROGRAM SELECT 5. This also causes transmission of the Omni mode select code, BxH-FDH over MIDI. When Synth B receives this command, it will return to Omni mode.

### 7-3 KEYBOARD INFORMATION

Once the mode has been selected, keyboard data can be communicated. Suppose Middle C on Synth A is struck. This is a Note On event, transmitted to Synth B as a three-byte message where the first byte codes the command and channel numbers, the second byte is the key number, and the third byte is the key on/off velocity. For example: 90H-3CH-40H.

90H    9H= Note On status  
          0H= Channel 1. Range: 0-7H (Channels 1-8)

3CH    = key number 60(C2). Range: 33(A0) - 108(C6)

40H    = velocity 64, average. Range: 01H-7FH (1-127)

Because its MSB is set (1), Synth B sees the first byte as a status byte. This flag tells the receiver to decode this byte as a command, and prepare for the key number and velocity data bytes which follow.

When the instruction has been completely received, Synth B plays Middle C and will hold it until a matching Note Off command is received. If in Mono mode, the channel pressure is transmitted and received, while the note is on, with a two-byte code, for example D0H-5EH:

D0H    DH= Mono mode Channel pressure status  
          0H= Channel 1.

5EH    = current channel pressure 95. Range: 0-127

Note that this code is repeated whenever there is an incremental difference in pressure in that channel.

Finally, the Note Off command in this case might be 80H-3CH-4AH, where

80H    8H= Note Off status  
          0H= Channel 1. Range: 0-7H (Channels 1-8)

3CH    = key number 60(C2). Range: 33(A0) - 108(C6)

4AH    = release velocity 74, slightly quick. Range: 01H-7FH (1-127)

As multiple notes are turned on, Synth B, if in Omni or Poly modes, will assign its voices just as if the notes were coming from its keyboard. In fact its keyboard can be played normally. It will simply play along with the MIDI input, and "steal" voices if more than four or eight notes (depending on the mode) are played.

If in Mono mode, the notes will be played on the voices determined by the status codes, which will match the voices used on Synth A.

The -T8 will recognize codes which enable or disable the -T8's keyboard. On power-up, the keyboard is of course enabled. Then after it receives BxH-FCH-00H only MIDI data will play the synth. Playing the keyboard will however send keyboard MIDI OUT, enabling external processing of the keyboard data, which can then be sent back to the synth via MIDI. "Local keyboard control" is restored when the BxH-FCH-FFH code is received.

#### **7-4 TUNE**

For remotely activating TUNE, the Prophet-T8 uses code F6H. It transmits this when TUNE is pressed, and goes into TUNE when this byte is received.

#### **7-5 PROGRAM SELECT**

On power-up, the Prophet-T8s select program R11 for themselves. For simplicity, when they are simply interconnected, master and slave program selections are not linked. Instead, one independently selects programs on Synths A and B.

To enable Synth B to follow Synth A program changes, hold down RECORD (on Synth B), then press PROGRAM SELECT 1.

Whenever the Synth A program is changed, it will transmit the new program number to Synth B in two bytes. The status byte again defines the command and channel numbers, while the second byte contains the program number. For example, C0H-42H.

C0H CH= Program Change status  
0H= Channel 1

42H = Right program 13. Range: 0-63 Left, 64-127 Right

When Synth B receives this code, it switches (if enabled) to R13 and plays in whatever sound is stored there.

To disable MIDI program changes, again hold RECORD and press 1.

#### **7-6 PROGRAM DUMP**

The master -T8 can dump programs to the slave, reprogramming the same location by another coded switch function. For example, if program L33 is selected on Synth A, hold RECORD and hit PROGRAM SELECT 2. The slave's program L33 will be replaced with Synth A's program. This will happen regardless of the state of either instrument (Preset, Manual, Edit, etc.). Also note that the actual stored program value is sent, even if it has been edited. This means that edited programs must be recorded before they can be sent.

The program dump occurs within the System Exclusive data format. In this example, the code would be F0H-01H-03H-12H-data-F7H:

F0H System Exclusive status  
01H SCI's Manufacturer's ID number  
03H Defines program dump (Prophet-T8).  
12H Program number L33. Range 00-63 (left programs) and 64-127 (right).  
data 32 bytes of program data, formatted according to Table 7-1 (next page).  
Sent as 64 4-bit nibbles, right justified, LS nibble sent first.

The -T8 will also respond to requests for specific program data, although the request cannot be sent from the -T8. The program dump request takes the form:

F0H System Exclusive status  
01H SCI's Manufacturer's ID number  
00H Defines program dump request  
12H Program number L33.

When this is received, the -T8 will transmit the requested program in the format of Table 1, again regardless of the state of the instrument.

If the receiver sees an incorrect ID number, it will ignore the dump request.

## 7-7 TEMPERMENT

The tempering of the -T8's keyboard can be changed only by MIDI command. Each of the twelve notes of the octave can be modified from its normal equal-tempered position in the scale by sending a sixteen bit two's complement number over MIDI. A value of 0000H sets the note to normal temperment. Each bit has a value of 1/128th of a semitone (0.78 cents), so bit 7 has a value of 1 semitone. Therefore, 0080H would raise the note by one semitone (thereby making it equal to its upper equal-tempered neighbor), FF80H would lower it by one semitone, FFFFH would lower the value by .78 cent, etc.

Please note that offsets are not corrected for VCO scaling error, therefore any offset greater than one semitone will have reduced accuracy, depending on how well the VCOs have been scaled (which is a routine service procedure) and what frequency range is being used.

The sixteen bit number is sent in four nibbles, the least significant nibble of the least significant byte being sent first, the most significant nibble of the most significant byte last.

For example, let's lower E from its normal-equal tempered value of 400 cents to a pure just interval of 5/4 related to C, or 386.28 cents. This is an offset of -13.72 cents, or about -18 LSBs ( $13.72 \times 100/128=17.6$ ). Using hexadecimal arithmetic, we subtract 12H (equal to 18 decimal) from 10000H, which gives a value of 0FFEEH.

To identify the chromatic note, the following table is used:

<u>Note</u>	<u>Hexadecimal</u>
C	00
C#	01
D	02
D#	03
E	04
F	05
F#	06
G	07
G#	08
A	09
A#	0A
B	0B

The data is sent using the system exclusive format:

F0H	system exclusive status
01H	SCI's manufacturer's ID number
07H	defines temperament data
04H	the note "E"
0EH	least significant nibble, least significant byte
0EH	most significant nibble, least significant byte
0FH	least significant nibble, most significant byte
0FH	most significant nibble, most significant byte

Updates to temperament data will have no effect on the notes which are currently on. The new temperament will only take effect when a new Note On is received (from MIDI, local keyboard, or sequencer) for that note.

**Table 7-0  
PROPHET-T8 PROGRAM BIT MAP**

	Switch Bit (7)	Control Bit (6)	Aux Bit (5)	Pot Bits (0-4, 0-5, or 0-6)
Byte 0	PR LFO FREQ	x		FILT RES (0-5)
Byte 1	PR LFO AMT	S7		MIX NOISE (0-5)
Byte 2	PR AMP	S6		MIX OSC B (0-5)
Byte 3	PR FILT	S5		MIX OSC A (0-5)
Byte 4	PR PW			P-MOD OSC B (0-6)
Byte 5	PR FREQ B			PRESS AMT (0-6)
Byte 6	PR FREQ A	S4	x	LFO FREQ (0-4)
Byte 7	ENA WHEEL			P-MOD FILT ENV (0-6)
Byte 8	P-MOD FILT	S3		OSC A FREQ (0-5)
Byte 9	P-MOD PW A			OSC A PW (0-6)
Byte A	P-MOD FR A			LFO-MOD INIT AMT (0-6)
Byte B	OSC A TRI	S2		OSC B FREQ (0-5)
Byte C	OSC A SAW			OSC B PW (0-6)
Byte D	OSC A SYNC			OSC B FINE (0-6)
Byte E	LFO FILT			FILT CTF (0-6)
Byte F	LFO PW			FILT KBD AMT (0-6)
Byte 10	LFO FREQ B	S1	x	FILT REL (0-4)
Byte 11	LFO FREQ A			FILT SUS (0-6)
Byte 12	LFO SQUARE	S0	x	FILT DEC (0-4)
Byte 13	LFO TRI	x	x	FILT ATK (0-4)
Byte 14	LFO SAW			FILT ENV AMT (0-6)
Byte 15	OSC A PULSE	P3		REL ENV RATE (0-5)
Byte 16	OSC B SAW	P2		FILT ENV PEAK (0-5)
Byte 17	OSC B KBD	P1		AMP ENV PEAK (0-5)
Byte 18	OSC B LO	P0		ATK/DEC ENV RATE (0-5)
Byte 19	OSC B PULSE	L5	x	AMP REL (0-4)
Byte 1A	OSC B TRI			AMP SUS (0-6)
Byte 1B	ADR	L4	x	AMP DEC (0-4)
Byte 1C	DOUBLE	L3	x	AMP ATK (0-4)
Byte 1D	SPLIT	L2	x	GLIDE (0-4)
Byte 1E	SINGLE	L1	x	2ND FILT RELEASE (0-4)
Byte 1F	UNISON	L0	x	2ND AMP RELEASE (0-4)

x=not used  
S0-S7= Split key number  
P0-P3= PROG VOLUME  
L0-L5= Link program number