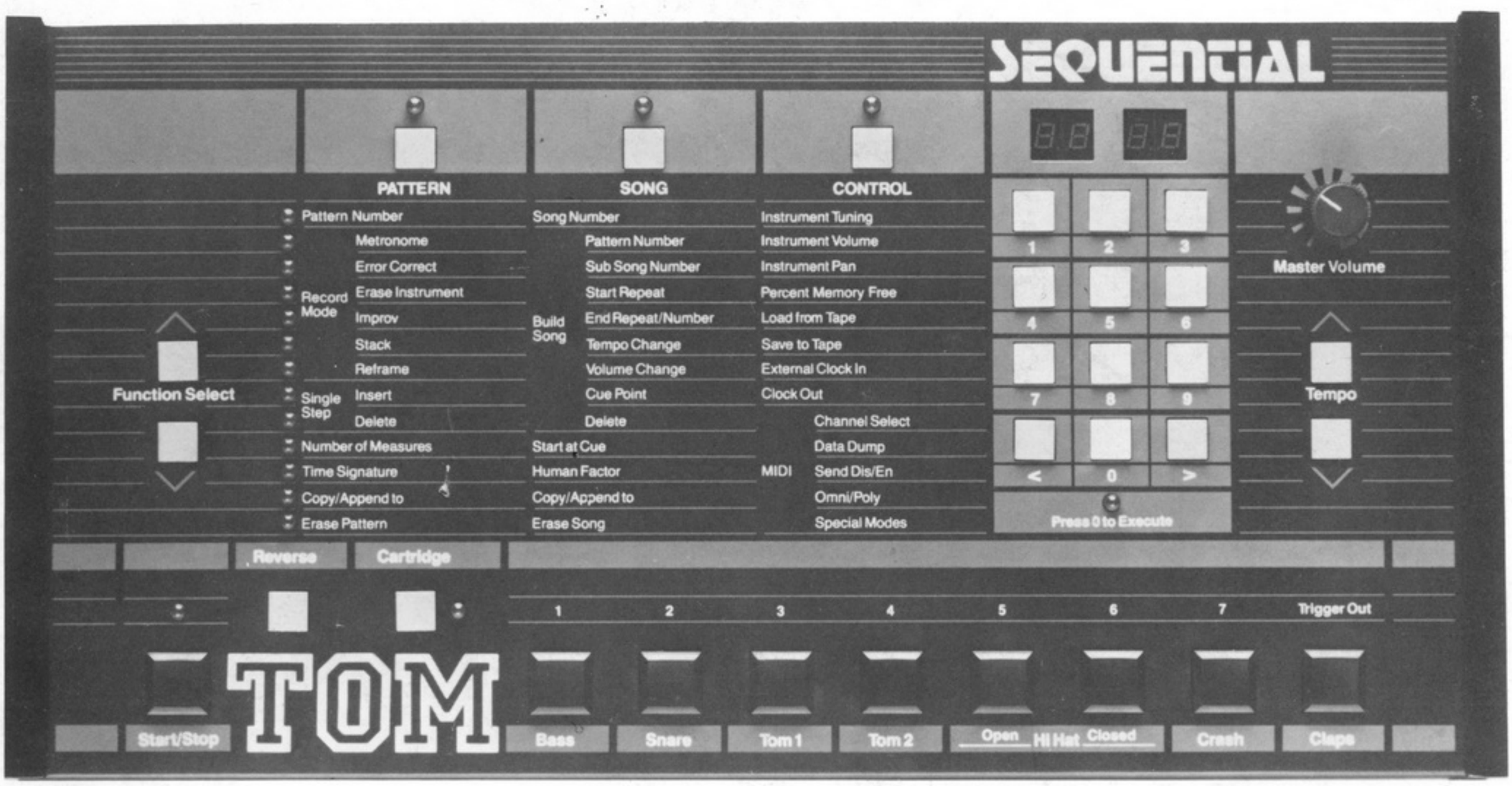


TOM

MIDIGUIDE

SEQUENTIAL

SEQUENTIAL
Publications Department

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March, 1985

MODEL 420
TOM
DIGITAL DRUM MACHINE

MIDIGUIDE

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MODEL 420
TOM
DIGITAL DRUM MACHINE

MIDIGUIDE

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Table of Contents

	page
1 OVERVIEW	1
MIDI Basics	1
MIDI Channels	2
MIDI Modes	2
Mode 1	2
Mode 3	2
Mode 4	2
2 BASIC APPLICATIONS	3
Synchronizing MIDI Sequencers and Drum Machines	3
Operation of Two Model 420s	4
Clocking Another TOM	4
Loading Patterns and Songs from 420 to 420	6
Operation with the Multi-Trak	6
Clocking the MULTI-TRAK	6
Playing the TOM with MIDI Keyboards	8
Playing the Instrument Keys	8
Tuning Keys	9
Special Keys	9
Controlling Instrument Tunings with Pitch Wheel	10
3 ADVANCED APPLICATIONS	11
Initial Conditions/MIDI OPTIONS/Special Keys	11
Option 1: Tuning Key Assignment	12
Control from Five-Octave Keyboard	12
Control from Four-Octave Keyboard	12
Option 2: MIDI Velocity Enable/Disable	13
Option 3: Instrument Key Mute	13
Option 4: Pattern and Song Selection Receive	13
Option 5: Event Receive Enable/Disable	13
Option 6: Transmit Enable/Disable	14
Option 7: MOD Wheel Assignment	14
Option 8: Special Keys Enable/Disable	14
Mode 4 Operation	15
Tuning Keys	15
Special and "Flange" Keys	15
4 MIDI IMPLEMENTATION	17
Transmitted Data	17
Recognized Receive Data	19
Table 1: MIDI Instrument Key Assignment	22
Table 2: Mode 4 MIDI Channel Assignment	22
Table 3: Tuning Key Assignment	23
Table 4: Special Key Assignment	24

SECTION 1

OVERVIEW

This MIDIGUIDE provides more detailed information than is contained in the TOM Operation Manual (CM420).

The two most important applications for the TOM's MIDI are 1) for synchronizing external sequencers, and 2) for creating patterns using MIDI-equipped keyboards, eliminating the need to "overdub" different volumes and tunings.

The TOM's instrument volumes and tunings may be programmed from MIDI-equipped keyboards using the PITCH and MOD wheels, or with a new "pitch key" system.

MIDI Basics

MIDI is a flexible system which allows several pieces of equipment to communicate with very simple connections. The sort of things the equipment talk about? When to start playing a song or pattern, how fast to play it, which one, and so on. To coordinate operations between equipment, MIDI messages are sent. There are many common messages which are understood by most MIDI equipment, such as note events (allowing synthesizers to simultaneously play the same notes), or start and stop messages which control the playback of sequences or drum patterns.

For special applications, "system exclusive" messages may be sent which only are accepted by equpment of a specified manufacturer. (For example, compacted pattern data from a Model 420 can be sent to another manufacturer's instrument, but is not accepted because the message carries the Sequential ID code.)

MIDI Channels

If several pieces of equipment are connected, you have to be careful how you say things, or some equipment may interpret it incorrectly. For example, a drum machine and a synthesizer may both receive the same patttern (or program) select message, if you want only the drum machine to respond, you must "address" that drum machine only. In order to accomplish this, some MIDI messages are labeled with a

number indicating a MIDI Channel. If an instrument's channel matches the message label, the instrument knows the message should be accepted.

To adjust the TOM's basic channel:

Press **CONTROL.**

Select **Channel Number.**
The right display shows the current Basic Channel number.

Enter the desired channel two-digit number (01-16) on the ten-key pad, or adjust the displayed channel number with INC and DEC.

MIDI Modes

In some cases, you may not want the instrument to be so selective about which messages it accepts, so most instruments have MIDI "modes" which determine how it responds to MIDI messages. These modes are numbered 1, 3, and 4. (In fact there is a Mode 2 but it is rarely used, and on most Sequential instruments, this is a disallowed state.)

All four MIDI modes are the result of combining two of three other MIDI options; Omni, Poly, and Mono. Omni mode is either on or off, and either Mono or Poly mode may be selected. Descriptions of these modes are provided in the COMPLETE SCI MIDI (MIDI-3).

To adjust the TOM's MIDI Mode:

Press **CONTROL.**

Select **Mode.**
The right display shows the current MIDI Mode.

Adjust the displayed Mode number with **INC** and **DEC.**

Mode 1

When the Model 420 is in Mode 1 (Omni on/Poly on), it accepts MIDI commands transmitted on any of the sixteen channels. The Model 420 transmits messages on the basic channel.

Mode 3

When the Model 420 is in Mode 3 (Omni off/Poly on), it does not accept MIDI commands carrying any channel number other than the basic channel. The Model 420 transmits messages on the basic channel.

Mode 4

When the Model 420 is in Mode 4 (Omni off/Mono on), it accepts and transmits MIDI messages on all sixteen channels. Each of the 420's instrument sounds are assigned a MIDI channel, so the channel on which a message is received determines which instrument sound will be played.

SECTION 2

BASIC APPLICATIONS

When the Model 420 is connected with other MIDI equipment, the two main types of data which it sends are 1) event messages indicating which instrument sound is played, and 2) timing messages which tell other instruments when to start and stop playback, and provide timing clocks to ensure synchronized playback between instruments. The following examples show the differences between several common operations.

CAUTION: For all connections, use MIDI-specification cables (such as the Sequential Model 838). Five-pin DIN connectors used for audio applications may not be reliable when handling MIDI data (which consists of pulses well outside the audio frequency range).

Synchronizing MIDI Sequencers and Drum Machines

Before MIDI, drum machines normally provided 5-V clock outputs which could control the playback of sequencers or other drum machines. Although this system was, and still is, very simple, there were often problems with differences in clock rates, and voltages, and output conditions. MIDI clarifies many of these problems by providing specific messages which are always interpreted in the same manner by all MIDI equipment.

When patterns are played or recorded on the TOM, a series of messages are sent out over MIDI.

1. Pattern or Song number.
   When a pattern or song is selected on the TOM, the numbers are sent out. It is possible to disable these messages (see Option 6) but for the time being, assume that they are enabled.

2. Start.
   When you start a pattern or song, a message is sent over MIDI, telling the other equipment to begin playback at the same time.

3. MIDI Clocks.
   As the Model 420 plays patterns or songs, MIDI Timing Clock messages are transmitted at a rate of 24 ppq (pulses per quarter-note). If receiving equipment recognizes MIDI Timing Clocks, they can be used to control playback speed following the MIDI Start message.

4. Stop.
   When the TOM's pattern or song is stopped, this message tells other equipment to stop at the same time.

5. Continue.
   If the TOM's pattern or song continues, rather than starts playback, this message is sent to all connected equipment so that playback resumes from where it was stopped, rather than from the beginning of the pattern (or sequence).

Using these specific messages improves the communication between the TOM and whatever equipment it clocks, and reduces the number of control operations required to make them work together.

OPERATION OF TWO MODEL 420s

CAUTION: Before connecting any equipment, make sure power is switched off.

Clocking Another TOM

Connect the master's MIDI OUT to the slave's MIDI IN.

Enable the slave's MIDI clock input:

Press **CONTROL** on the slave.

Select **External Clock In** with the **Function Select** switches.
The left display reads "Ci" (for Clock In). The right display shows the current status of the slave's external clock input ("OF," "nn," "24," "48," or "96").

Adjust the displayed status with **INC** and **DEC** until "nn" (MIDI) is displayed.

The "master" 420 controls both itself and the slave. When the Model 420 is shipped from the factory, all MIDI messages are enabled to be transmitted. The following operations assume no changes have been made to the TOM's MIDI options. The TOM's MIDI clock output, unlike other MIDI messages or the 5-V clock output (see the TOM OPERATION MANUAL), is always enabled.

Pattern Functions:

On the master, press **PATTERN.**

Enter the desired pattern number.
The slave's display shows the same pattern number is selected.

On the master, press **Start/Stop.**
Pattern playback begins on both 420s.

To stop pattern playback, press **Start/Stop.**
Playback also stops on the slave.

To continue playback on both 420s, on the master, hold **PATTERN,** then press **Start/Stop.**
Pattern playback resumes on both 420s from the point at which they were both stopped.

To adjust playback speed of both 420s, use the master's **Tempo** switches.
Both 420s follow the tempo changes.

To stop pattern playback, press **Start/Stop.**

Note: Although the same pattern number is selected on both instruments, the patterns themselves may be different on each 420.

Song Functions:

On the master, press **SONG.**

Enter the desired song number.
The same song number is selected on the slave.

To start song playback, on the master, press **Start/Stop.**
Song playback on both 420s begins simultaneously.

Note: Although the song on the slave may contain an initial tempo, the slave's internal clock is currently disabled, so playback speed is controlled by the master.

To stop song playback, press **Start/Stop.**
Playback also stops on the slave.

To continue playback on both 420s, on the master, hold **SONG,** then press **Start/Stop.**
Song playback resumes on both 420s from the point at which they were both stopped.

Note: Although the same song numbers are selected on both instruments, the songs themselves--as well as the patterns they select--may be different on each 420. To load songs and patterns from one 420 into another, see below.

Loading Patterns and Songs from 420 to 420

CAUTION: The following operation erases the current memory of the slave. If necessary, before proceeding, save the slave's memory to tape, or if using the Sequential Model 64 or Model 242 (MIDI cartridges for the Commodore 64 computer) with the Model 900A Dumptraks, save the slave's memory to diskette.

On the master, press **CONTROL.**

On the master, select **Data Dump.**
The **Execute** LED flashes.

To initiate the data dump, press **0.**
Execute remains lit while the master loads all pattern and song data to the slave. When the load is completed, the slave's memory will contain all the pattern and song data contained in the master.

Operation with the MULTI-TRAK

The Sequential Model 615 MULTI-TRAK is a new velocity-sensitive six-voice synthesizer which features a built-in sequencer. The following operations with the MULTI-TRAK demonstrate how to clock MIDI sequencers and how to control the TOM from MIDI keyboards.

CAUTION: Before connecting any equipment, make sure power is switched off.

Clocking the MULTI-TRAK

The Sequential Model 615 MULTI-TRAK's built-in sequencer can be clocked either from the Model 420's **Clock Out** (see the TOM OPERATION MANUAL, CM420), or with MIDI clocks.

Connect the 420's MIDI OUT to the MULTI-TRAK's MIDI IN.
To enable the MULTI-TRAK's MIDI clock input, turn Speed all the way down.

The 420 controls the operation of both the MULTI-TRAK and itself. When the Model 420 is shipped from the factory, all MIDI messages are enabled to be transmitted. The following operations assume no changes have been made to the TOM's MIDI options. The TOM's MIDI clock output, unlike other MIDI messages or the 5-V clock output (see the TOM OPERATION MANUAL), is always enabled.

Pattern Functions:

On the 420, press **PATTERN.**

Enter the desired pattern number.
The MULTI-TRAK's display shows the same program number is selected.

On the 420, press **Start/Stop.**
Pattern playback on the 420, and sequence playback on the MULTI-TRAK begin simultaneously.

To stop playback, press **Start/Stop.**
Playback stops on both instruments.

To continue playback on both instruments, on the 420, hold **PATTERN,** then press **Start/Stop.**
Pattern playback resumes on both instruments from the point at which they were both stopped.

To adjust playback speed of both instruments, use the 420's **Tempo** switches.
Both instruments follow the tempo changes.

To stop pattern playback, press **Start/Stop.**

Song Functions:

On the master, press **SONG.**

Enter the desired song number.
If the song number is between 00 and 03, the same sequence number is selected on the MULTI-TRAK.

To start song playback, on the master, press **Start/Stop.**
Song playback on the 420, and sequence playback on the MULTI-TRAK begin simultaneously.

Note: Although the song on the MULTI-TRAK may contain an initial tempo the slave's internal clock is currently disabled, so playback speed is controlled by the master.

To stop song playback, press **Start/Stop.**
Playback also stops on the MULTI-TRAK.

To continue playback on both instruments, on the 420, hold **SONG,** then press **Start/Stop.**
Song and sequence playback resume on both instruments from the point at which they were both stopped.

Playing the TOM with MIDI Keyboards

The TOM can select from eight or fifteen instrument sounds to play at any time, but as there are only eight instrument switches on the TOM's front panel, and as each instrument event can contain one of thirty-two tunings, eight volumes, three pan "positions," and be played forwards or reversed, recording patterns which take full advantage of these features may require many operations for each event. As a convenient alternative, a MIDI keyboard may be used as an extension to the TOM's front panel controls, to increase the number of instrument controls which can be adjusted spontaneously while recording.

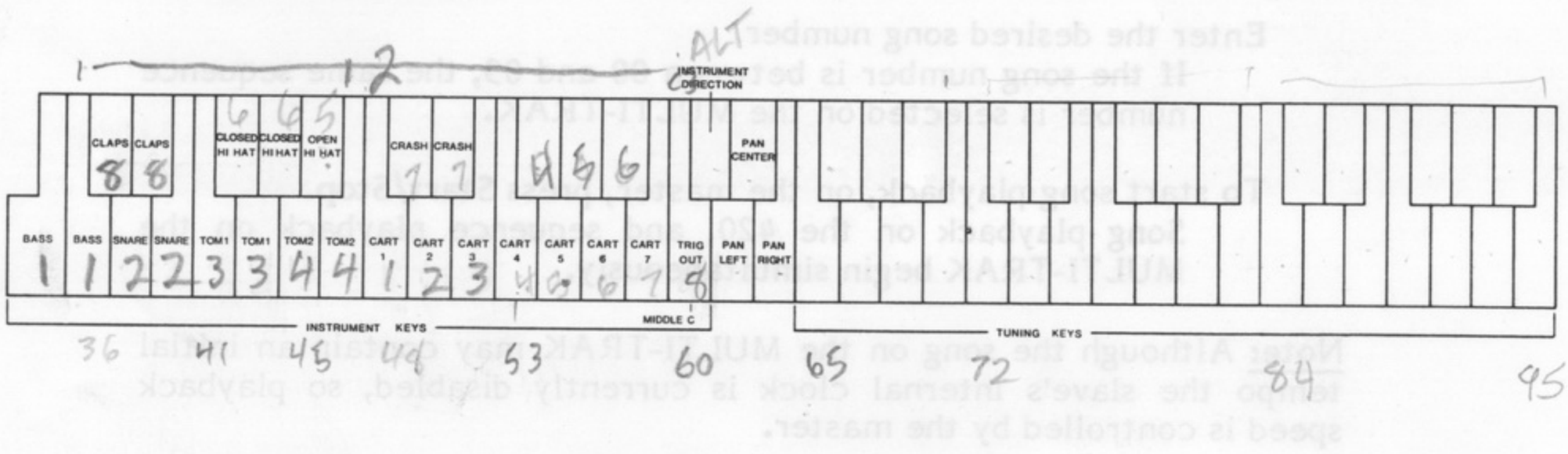
The following basic operations may be used for playing the TOM live, or for recording patterns. The Sequential MULTI-TRAK is used in these examples, although other velocity-sensitive keyboards could also be used. For instructions on how to control the TOM's instrument tunings and other controls, see ADVANCED APPLICATIONS.

Playing the Instrument Keys

Connect the keyboard's MIDI OUT to the TOM's MIDI IN.

When the Model 420 is shipped from the factory, it is set up for operation with five-octave MIDI keyboards. The following operations assume the 420's MIDI options have not been altered.

The 420's instruments are assigned to the lower octaves of the MIDI keyboard as follows:



Instrument, Tuning, and "Special" Key Assignment

Play the instrument keys on the keyboard.

The instruments are played with the current instrument control (tuning, pan, etc.).

If the 420 does not respond, see Option 3, and Option 5.

If the MIDI keyboard is velocity-sensitive, the instrument volumes are controlled by the key velocity.

Tuning Keys

The TOM recognizes thiry-two "tuning keys" which, in conjunction with the instrument keys, control the tunings of each of the TOM's instruments.

To control instrument tunings with the instrument keys:

Hold down one instrument key.

Play the tuning keys.

The instrument plays at the tuning corresponding to the tuning key played.

If the keyboard is velocity-sensitive, the dynamics of the TOM's instruments are controlled by the touch of each tuning key.

The TOM's thirty-two instrument tunings can be distributed over the top octaves of MIDI keyboards in several configurations with the TOM's MIDI "options." (For details on the MIDI options, see ADVANCED APPLICATIONS.)

You can also hold any combination of four instrument keys (maximum) while playing the tuning keys. Or, if the TOM is in "stack mode" (see the TOM Operation Manual, CM420), then it is possible to hold down one instrument key, then play four tuning keys simultaneously.

Note: When the TOM is in MIDI Modes 1 or 3, the instrument and tuning keys are distributed as shown in the figure on the previous page. When in Mode 4, the tuning keys are distributed over the lower octaves of the keyboard, and instruments are instead selected by the keyboard's MIDI channel.

Special Keys

The TOM's instrument direction and panning can be controlled with four "special" keys. In Modes 1 and 3, the special keys are located as shown in the figure on the previous page.

Pressing the "instrument direction" key ($C\#_2$) has the same effect as pressing the **Reverse** switch on the TOM's front panel.

To control instrument panning with the special keys:

Hold down the desired instrument key.

To pan the selected instrument, play the desired "special" key (D_2, $D\#_2$, or E_2).

Note: When the TOM is in Mode 4, the special keys are located one octave higher than in Modes 1 and 3 ($C\#_3$-E_3).

Controlling Instrument Tunings with the PITCH Wheel

A method for adjusting instrument tunings in real-time, is to move your keyboard's PITCH wheel (if equipped with one) while holding one of the instrument keys in the keyboard's lower octaves (see above).

If necessary, enable your keyboard's wheels over MIDI (see your Sequential instrument's MIDIGUIDE or operation manual).

Play the instrument keys on your keyboard.

Move the PITCH Wheel.
A tuning value of 0-31 appears in the 420's left display, corresponding to the PITCH wheel position.

Play and hold some instrument keys.
The tunings of all instrument keys played and held are now set to the value which appears in the 420's left display.

Release all held instrument keys.
The display no longer shows the tuning. Any instruments played (other than those played in the previous step) still play at their original tuning.

After the PITCH wheel is moved, the 420 assigns the new tuning to all instrument keys played so long as they are all held.

SECTION 3

ADVANCED APPLICATIONS

To make the Model 420 suitable for operation in as many situations as possible, many of its MIDI functions are adjustable. Rather than have these MIDI "options" default to a specific state on power-up, they are remembered when power is switched off. This way, if your applications differ from the initial settings, you need not adjust the MIDI options each time power is switched on.

When the Model 420 is shipped from the factory, its MIDI options are adjusted as follows:

Function	**Setting**
MIDI Mode	1
Basic Channel	1
Tuning Keys	Five-octave keyboard
MOD Wheel	Instrument Pan
Velocity	Enabled
Instrument Key Mute	Off
Pattern/Song # Receive	Enabled
Event Receive	Enabled
Event Transmit	Enabled
Special Keys	Enabled

Many of the operations on the following pages require the factory option settings to be altered.

<u>To adjust the MIDI options:</u>

To select MIDI Options:

Press **CONTROL.**

Select **Options** with **Function Select** switches.

The left display reads "1." This indicates Option #1 is selected. The right display shows the current option status.

Adjust selected MIDI option setting as necessary.

Each option is described on the following pages.

To select other MIDI options, use **INC** and **DEC.**

The left display shows the selected MIDI option number.

OPTION 1: TUNING KEY ASSIGNMENT

The TOM's thirty-two tuning keys can be distributed over MIDI keyboards in several configurations. Option 1 has three possible settings, each corresponding to a different tuning key assignment. These tuning key assignments are only effective when the TOM is in MIDI Modes 1 or 3.

Select Option 1.

The right display shows the current status of Option 1 (1-3).

Control from Five-Octave Keyboard

With Option 1 selected, press **0** until the right display reads "1."

The 420's 32 instrument tunings are distributed over the top octaves of the MIDI keyboard.

Tunings are controlled in the same way as described in Section 2.

Control from Four-Octave Keyboards

With Option 1 selected, press **0** until the right displays "1."

The 420's twenty lowest tunings are distributed over the top octaves of the MIDI keyboard (F_2 to C_4).

Tunings are controlled in the same way as described in Section 2.

or

With Option 1 selected, press **0** until the right displays "2."

The 420's twenty highest tunings are distributed over the top octaves of the MIDI keyboard (F_2 to C_4).

Tunings are controlled in the same way as described in Section 2.

or

With Option 1 selected, press **0** until the right displays "3."

The 420's even-numbered tunings (00, 02, 04....30) are distributed over the top octaves of the MIDI keyboard (F_2 to C_4).

This way the user can play the entire range of tunings, but only every other tuning.

Tunings are controlled in the same way as described in Section 2.

OPTION 2: MIDI VELOCITY DISABLE/ENABLE

When Option 2 is on, MIDI keyboards control instrument volumes with key velocity. When Option 2 is off, the TOM ignores MIDI velocity. Instead, instrument volumes may be controlled by the MOD wheel (depending on the status of Option 7). This is useful when playing the TOM from non-velocity-sensitive MIDI keyboards.

Select Option 2.
The right display shows the current status ("on" or "OF").

To switch Option 2 on/off, press **0**.

OPTION 3: INSTRUMENT KEY MUTE

When Option 3 is on, MIDI keyboards can play the TOM's instruments with the assigned instrument keys. When Option 3 is off, instruments can only be played by using the instrument keys in conjunction with the tuning keys (see Option 1, on previous page).

Select Option 3.
The right display shows the current status ("on" or "OF").

To switch Option 3 on/off, press **0**.

OPTION 4: PATTERN AND SONG SELECTION RECEIVE

When Option 4 is on, the TOM recognizes program and song selections as pattern and song selection (respectively). When Option 4 is off, these selections are disabled.

Select Option 4.
The right display shows the current status ("on" or "OF").

To switch Option 4 on/off, press **0**.

OPTION 5: EVENT RECEIVE

When Option 5 is on, all enabled MIDI messages are accepted (unless not recognized). When Option 5 is off, all received MIDI messages are disabled.

Select Option 5.
The right display shows the current status ("on" or "OF").

To switch Option 5 on/off, press **0**.

OPTION 6: EVENT TRANSMIT

When Option 6 is on, all enabled MIDI messages are transmitted. When Option 6 is off, all MIDI messages are disabled, except MIDI timing clocks.

Select Option 6.
The right display shows the current status ("on" or "OF").

To switch Option 6 on/off, press **0**.

OPTION 7: MOD WHEEL ASSIGNMENT

When Option 7 is on, MOD wheel changes received over MIDI control the TOM's instrument panning. Whe Option 7 is off, MOD wheel changes affect instrument volumes (unless velocity is enabled over MIDI, see Option 2).

Select Option 7.
The right display shows the current status ("on" or "OF").

To switch Option 7 on/off, press **0**.

OPTION 8: SPECIAL KEYS INPUT

When Option 8 is on, all "special" keys (instrument direction, pan left, pan center, pan right, and the four "flange" keys) are enabled over MIDI. When Option 8 is off, the special keys are disabled.

Select Option 8.
The right display shows the current status ("on" or "OF").

To switch Option 8 on/off, press **0**.

MODE 4 OPERATION

To put the TOM into Mode 4:

Press **CONTROL.**

Select **MIDI Mode** with the **Function Select** switches.
The current MIDI mode is shown in the right display.

Adjust the displayed mode to 4 with **INC** and **DEC.**

Tuning Keys

When the TOM is in Mode 4, each instrument sound is assigned to one MIDI channel. Instrument tunings are then distributed over the lower octaves of the MIDI keyboard (C_0-$F\#_2$).

To select the desired instrument:

Press **CONTROL.**

Select **MIDI Channel** with the **Function Select** switches.
The right display shows the current channel number.

Adjust the displayed channel number with **INC** and **DEC.**
For instrument MIDI channel assignment, see Table 3-1.

This configuration is particluarly useful when the TOM is used for playing MIDI synthesizers. The synthesizer's notes can be programmed as instrument tunings (limited to a thirty-two note range), then on playback, up to sixteen synthesizers can play independent lines by setting them to different MIDI channels.

Note: The TOM transmits a "Note Off" immediately following each "Note On," so the duration of all notes is the same, and depends entirely on the synthesizer's release.

Special and "Flange" Keys

The instrument direction key is located at $C\#_3$, and the "panning" keys are D_3-E_3. Operation of the "special keys" is the same as in Modes 1 and 3.

Four "flange" keys are located at F_3, G_3, A_3, and B_3 in Mode 4. These determine how many times instruments are "stacked" when played.

To use the "flange" keys:

Select **Stack,** then switch it on.

Play F_3 on the MIDI keyboard.

Play the tuning keys (C_0-F#$_2$).
The instrument plays as usual.

Play G_3 on the MIDI keyboard.

Play the tuning keys.
The instrument is stacked on itself, causing a flanging effect.

For heavier flanging, stack instruments twice, or three times, by playing A_3 or B_3 (respectively), then playing the tuning keys.

SECTION 4

MIDI IMPLEMENTATION
March, 1985

Unless otherwise specified, status/data bytes are given in hex and binary, while numbers in descriptions are in decimal.

TRANSMITTED DATA

Status	Second	Third	Fourth	Fifth
Note On (only sent when "Event Transmit" is on.)				
9NH	P	40H	K	V
1001 nnnn	0ppp pppp	0100 0000	0kkk kkkk	ovvv vvvv
	Pitch Key On			
		"Dummy" velocity byte.		
			Drum Key On	
				Drum key velocity. V=01H-7FH, depending on programmed volume only (accent and song volume changes are ignored).

Sixth	Seventh	Eighth	Ninth
K	0H	P	0H
0kkk kkkk	0000 0000	0ppp pppp	0000 0000
Drum key Off (key On with velocity=0)			
	Zero velocity		
		Pitch Key Off (Key On with velocity=0)	
			Zero velocity.

All Note Ons are followed immediately with a Note Off (V=0), with no new status byte, i.e., nine bytes sent for each note played.

Program (Pattern) Change

CNH	P
1100 nnnn	0ppp pppp
	P=00-99

Song Select

F3H	S
1111 0011	0sss ssss

When song is selected, that song number is sent.
S=00H-63H (0-99 decimal)

TRANSMITTED DATA

Status	Second	Third	Fourth	Fifth	Sixth

Start
FAH
1111 1010
When playback of any song or pattern starts, this is sent immediately before the first Timing Clock.

Continue
FBH
1111 1011
Sent when playback of pattern or song continues from the point at which it was stopped.

Timing Clock
F8H
1111 1000
During playback of any song or pattern, this is sent at 24 per-quarter-note rate.

Pattern Marker

F0H	01H	7FH	F7H
1111 0000	0000 0001	0111 1111	1111 0111
(SYS EX	SCI ID	PM	EOX)

Sent after the last clock of a drum pattern.

Stop
FCH
1111 1100
Sent whenever a song or pattern is stopped.

Program Dump.

F0H	01H	0EH	D	F7H
1111 0000	0000 0001	1110	Data	1111 0111
(SYS EX	SCI ID	420 ID		EOX)

Data is formatted as four-bit nibbles, right justified, LS nibble sent first.

RECOGNIZED RECEIVED DATA

Status	Second	Third	Fourth	Fifth	Sixth

Note On (no tuning information)

9NH	K	V
1001 nnnn	0kkk kkkk	0vvv vvvv

N is the channel number. This is ignored if Omni On mode, and checked for match with channel number in Omni Off mode.

For key assignment, see Tables 1, 3, and 4.

V (Velocity)=01H-7FH.

Note On (includes tuning information)

9NH	P	40H	K	V
1001 nnnn	0ppp pppp	0100 0000	0kkk kkkk	0vvv vvvv

Pitch Key On.

For key key assignment, see Tables 1, 3, and 4.

"Dummy" velocity byte.

Key On.

Drum key velocity.

Sixth	Seventh	Eighth	Ninth
K	0	P	0
0kkk kkkk	0000 0000	0ppp pppp	0000 0000

Key Off (key On with velocity=0)

Zero velocity

Key Off (Key On with velocity=0)

Zero velocity.

Note Off

9NH	K	00H
1001 nnnn	0kkk kkkk	0000 0000

Zero velocity.

Note Off

8NH	K	V
1000 nnnn	0kkk kkkk	0vvv vvvv

RECOGNIZED RECEIVED DATA

Status	Second	Third	Fourth	Fifth

Omni Mode On

FNH	7DH	00H	
1111 nnnn	0111 1101	0000 0000	

When received, Mode 1 (Omni On/Mono Off) is selected.

Omni Mode Off

FNH	7CH	00H	
1111 nnnn	0111 1100	0000 0000	

When received, Mode 3 (Omni Off/Mono Off) is selected.

Mono Mode On (Poly Mode Off - All Notes Off)

BNH	7EH	M	
1011 nnnn	0111 1110	0vvv vvvv	
		M is ignored	

Poly Mode On (Mono Mode Off - All Notes Off)

BNH	7FH	00H	
1011 nnnn	0111 1111	0000 0000	

Song Select

F3H	S		
1111 0011	0sss ssss		
	S=00H-62H.		

Switches to song mode and selects song # (must be 00H-62H). Also must already be in either song stop or pattern stop modes.

Program Select

CNH	P		
1100 nnnn	0ppp pppp		
	P=Program Number (00-99)		

Ignored while the 420 is in Record Mode.

Start

FAH
1111 1010
Only if in song mode, starts playback from start of current song. Selects MIDI playback clock.

Timing Clock

F8H
1111 1000
Recognized whenever in playback of a song or pattern, and MIDI clock is selected (either by front panel or by Start status.)

RECOGNIZED RECEIVED DATA

Status	Second	Third	Fourth	Fifth

Continue
FBH
1111 1011
Resumes playback from the point where playback was stopped with a MIDI "Stop." If playback was stopped from the TOM' RUN/STOP switch (or footswitch), Continue causes playback to start from the beginning.

Stop
FCH
1111 1100
Stops song playback. MIDI clock inputs are ignored.

Program Dump Request

F0H	01H	00H	F7H
1111 0000	0000 0001	0000 0000	1111 0111
(SYS EX	SCI ID	REQUEST ID	EOX)

This initiates a complete program dump of song and pattern data.

Program Dump Receive

F0H	01H	0EH	D	F7H
1111 0000	0000 0001	0000 1110	data	1111 0111
(SYS EX	SCI ID	420 ID		EOX)

Data is formatted as four-bit nibbles, right justified, LS nibble sent first.

MOD Wheel Change

BNH	01H	M
1011 nnnn	0000 0001	000m mmmm

Successive MOD wheel changes can be received without repeating the status byte.

PITCH Wheel Change

ENH	Vls	Vms
1110 nnnn	0vvv vvvv	0vvv vvvv
	LS byte	
		MS byte

Successive PITCH wheel changes can be received without repeating the status byte.

TABLE 1
MIDI Instrument Key Assignment (Modes 1 and 3)

Key	Key Number	Instrument
B, C_0	23H, 24H	Bass Drum
$C\#_0$, $D\#_0$	25H, 27H	Claps
D_0, E_0	26H, 28H	Snare
F_0, G_0	29H, 2BH	Tom 1
$F\#_0$, $G\#_0$	2AH, 2CH	Closed Hi-Hat
A_0, B_0	2DH, 2FH	Tom 2
$A\#_0$	2EH	Open Hi-Hat
C_1	30H	Cartridge 1
$C\#_1$, $D\#_1$	31H, 33H	Crash Cymbal
D_1	32H	Cartridge 2
E_1	34H	Cartridge 3
F_1	35H	Cartridge 4
G_1	37H	Cartridge 5
A_1	39H	Cartridge 6
B_1	3AH	Cartridge 7
C_2	3CH	Trigger Out

TABLE 2
Mode 4 MIDI Channel Assignment

MIDI Channel	Instrument
1	Bass
2	Snare
3	Tom 1
4	Tom 2
5	Open Hi-Hat
6	Closed Hi-Hat
7	Crash Cymbal
8	Claps
9	Cartridge 1
10	Cartridge 2
11	Cartridge 3
12	Cartridge 4
13	Cartridge 5
14	Cartridge 6
15	Cartridge 7
16	Trigger Out

TABLE 3
Tuning Key Assignment

Tuning Value	Key — Option 1 Value (Modes 1 and 3) 1	2	3	Mode 4
00	F_2	$C\#_4$	F_2	C_0
01	$F\#_2$	D_4	N/A	$C\#_0$
02	G_2	$D\#_4$	$F\#_2$	D_0
03	$G\#_2$	E_4	N/A	$D\#_0$
04	A_2	F_4	G_2	E_0
05	$A\#_2$	$F\#_4$	N/A	F_0
06	B_2	G_4	$G\#_2$	$F\#_0$
07	C_3	$G\#_4$	N/A	G_0
08	$C\#_3$	A_4	A_2	$G\#_0$
09	D_3	$A\#_4$	N/A	A_0
10	$D\#_3$	B_4	$A\#_2$	$A\#_0$
11	E_3	C_5	N/A	B_0
12	F_3	F_2	B_2	C_1
13	$F\#_3$	$F\#_2$	N/A	$C\#_1$
14	G_3	G_2	C_3	D_1
15	$G\#_3$	$G\#_2$	N/A	$D\#_1$
16	A_3	A_2	$C\#_3$	E_1
17	$A\#_3$	$A\#_2$	N/A	F_1
18	B_3	B_2	D_3	$F\#_1$
19	C_4	C_3	N/A	G_1
20	$C\#_4$	$C\#_3$	$D\#_3$	$G\#_1$
21	D_4	D_3	N/A	A_1
22	$D\#_4$	$D\#_3$	E_3	$A\#_1$
23	E_4	E_3	N/A	B_1
24	F_4	F_3	F_3	C_2
25	$F\#_4$	$F\#_3$	N/A	$C\#_2$
26	G_4	G_3	$F\#_3$	D_2
27	$G\#_4$	$G\#_3$	N/A	$D\#_2$
28	A_4	A_3	G_3	E_2
29	$A\#_4$	$A\#_3$	N/A	F_2
30	B_4	B_3	$G\#_3$	$F\#_2$
31	C_5	C_4	A_3-C_5	G_2

TABLE 4
Special Key Assignment

Special Key	Key	
	Modes 1 and 3	Mode 4
Direction	C#$_2$	C#$_3$
Pan Left	D$_2$	D$_3$
Pan Center	D#$_2$	D#$_3$
Pan Right	E$_2$	E$_3$
Flange 1	N/A	F$_3$
Flange 2	N/A	G$_3$
Flange 3	N/A	A$_3$
Flange 4	N/A	B$_3$