MIDIScope™
Version 1.5

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Version 1.5 Preface

Version 1.5 adds MultiFinder compatability. Version 1.4 of MIDIScope™ includes some new features, some internal improvements and numerous bug fixes. Additions, since version 1.1, include a transmit buffer and the ability to edit data in the trace buffer.

Original Introduction

The Kurzweil MIDIScope™ is a serious data capture and analysis tool for the Macintosh. Unlike some programs which simply display the raw MIDI data, the MIDIScope offers the following unique features:

- A programmable filter to select incoming messages by class and channel.
- A real-time display of key velocities, pressure or control values with peak, average and histogram modes.
- A trace buffer with symbolic message display.
- A programmable data matcher for triggering the trace buffer.

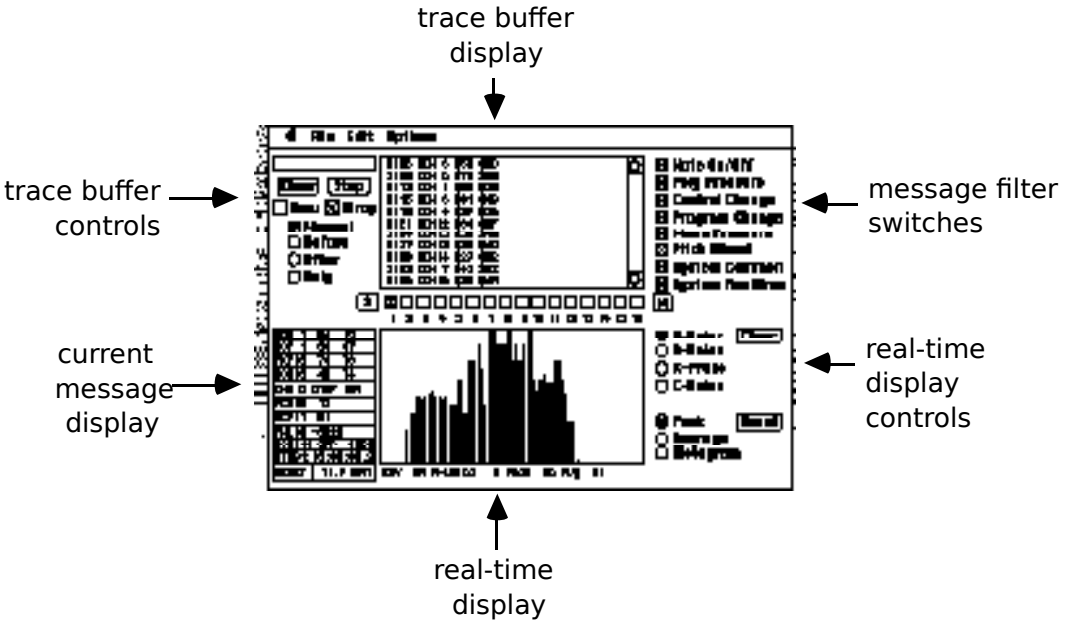
Distribution

This program has been placed into the Public Domain by Kurzweil Music Systems, Inc. As such, it may be distributed freely as long as (a) this documentation and the attached registration form are included in the distribution and (b) any identification and copyright notices contained within the application file itself are unaltered. **This software is not for sale!**

Getting Started

To use MIDIScope, you need a Macintosh, a suitable MIDI interface and a source of MIDI data. If you don't have a MIDI Interface, or if you don't want to bother with setting one up, select **Demo** from the **Options** menu. This generates a continuous stream of random MIDI messages which allow you to explore the various modes and options of the program without having to worry about providing a source of MIDI data.

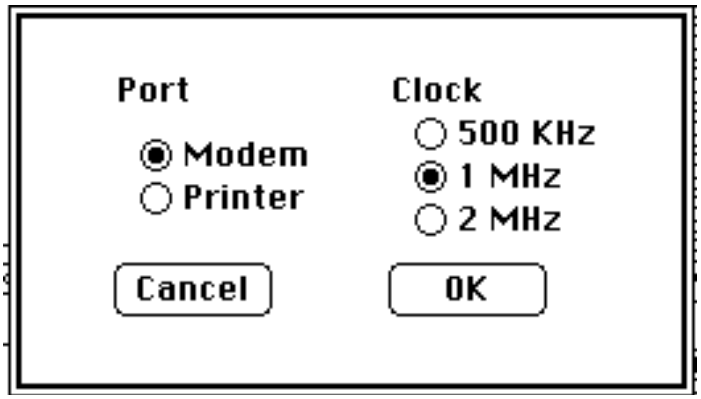
Connect the interface to the modem port (preferably) or printer port, connect a keyboard (or other source of MIDI data) to the input of the interface and launch MIDIScope. After a few seconds, the MIDIScope control panel will take shape:



Note: the MIDIScope™ window is configured to occupy the entire screen on a standard Macintosh. It's a real window, though; the title bar is hidden beneath the menu bar. If your display area is larger than the screen, MIDIScope™ automatically moves the window down and to the right to let you get at the title and drag it to a convenient location.

When running under MultiFinder, the window disappears when MIDIScope is not active.

First, select **Interface...** from the **Options** menu and use the radio buttons in the dialog box to choose the correct port and clock rate for your interface:



Next, set your MIDI keyboard to play on channel 1 (or use the row of check boxes in the center of the display to select the channel on which your keyboard is sending).

Now, play something on your keyboard. In the large rectangle in the lower center of the screen (the **Real Time Display**), you will see a black bar appear as you press each key. The height of this bar shows the attack velocity of the Note On message. When you release the key, the black bar will vanish but a gray bar will remain. This gray bar shows the maximum velocity for that particular key. (If your keyboard isn't velocity sensitive, all the bars will be the same height.)

Press the radio button labeled **Avg** in lower right corner of the screen. The gray bars on the display will change to show the average velocity value for each key. You can clear the peak or average data by pressing the **Reset** button. Incidentally, this data is separate for each display mode; i.e., you don't lose the peak readings if you switch to average, and vice versa.

Just below the display rectangle is an information line which displays the last values recorded by the real-time display. You can also use this line to read any value in the display. Just point inside the display rectangle (the cursor will change to a cross-hair) and press the mouse button. As you drag within the display, the information line will track the horizontal position of the mouse, showing the associated data values.

Peak and **Avg** modes display the attack velocity by individual key number. To see an analysis of velocities as a whole, press the button labeled **V-Hist**. Now the display shows one bar for each attack velocity (1 thru 127, since zero velocity means note off); the height of each bar represents the frequency of the attack velocities (i.e., the number of times a particular value has been received). If you play loudly (assuming your keyboard is touch sensitive) the bars to right will get taller as more high key velocities are recorded. Conversely, if you play softly, the bars to the left (low key velocities) will get taller. The heights of the bars are scaled so that the tallest one is always the full height of the display area.

V-Hist mode is useful to determine the range of velocities that a particular keyboard is producing. For example, if you plug in a DX-7 and play for awhile, you won't see any velocities above 118.

So far we have only looked at attack velocities. To see control values, switch back to **Peak** or **Avg**

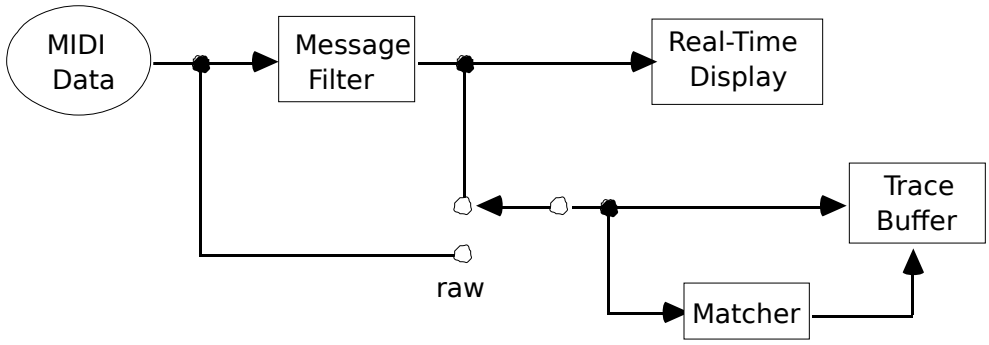
mode and press the radio button labeled **C-Value** (in the lower right corner of the screen). Move the pitch wheel, mod wheel or any other controls on your keyboard and the black bars will appear, tracking the values of these controls.

In the other large rectangle in the upper center of the screen (known as the **Trace Buffer Display**), you will see lines of numbers appear as the MIDI messages are received. The first number in each line is the index (in decimal) of the first byte in the line; the remaining numbers are the bytes of the MIDI messages shown in hexadecimal. Pull down the **Options** menu and select **Symbolic Display**. The MIDI messages will now be shown symbolically; each status byte (i.e., the first byte of the message) is shown as **NON** (for Note ON) or **NOF** (for Note OFf) followed by the MIDI channel number (1 thru 16) and the key numbers (the second byte of each message) are displayed as a key letter (C thru B with optional #) and octave number (in MIDI, key #60 is C4 a.k.a Middle C). The third byte (the attack or release velocity) is still displayed in hex. If you'd like to see it in decimal, select **Decimal Numbers** from the **Options** menu.

The scroll bar at the right of the buffer display is inactive while the buffer is recording. To be able to scroll back thru the recorded data, press the **Stop** button in the upper left corner of the screen (it's label will immediately change to **Start**). The scroll bar will become active. To record more MIDI data, press **Start** (the label will change back to **Stop**).

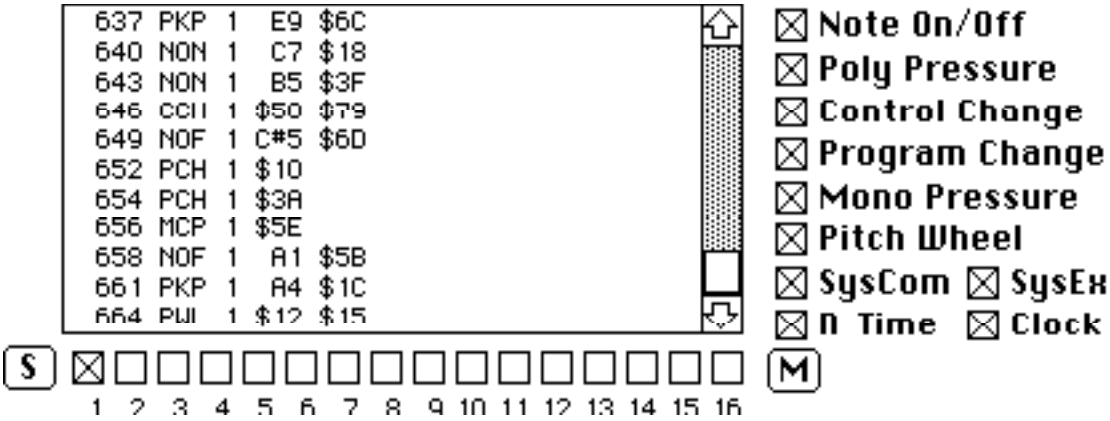
You can save recorded data using the **Save Trace ...** or **Save Trace As Text...** items in the **File** menu. The former saves the trace as raw MIDI data (which can subsequently be loaded back into the buffer using the **Load Trace...** menu item) while the latter saves the trace as a TEXT file (suitable for manipulation by your favorite editor).

MIDIScope™ Organization



The MIDIScope is organized into four major sections. Incoming data passes thru the **Message Filter**, which may be programmed to select messages by type and channel. Output from the filter is displayed immediately by the **Real Time Display**. In addition, the **Trace Buffer** records either raw or filtered data. The trace may be controlled manually, or by the programmable **Data Matcher**.

The Message Filter



The message filter allows you to select the messages that will be shown on the real-time display and recorded in the trace buffer. Messages may be filtered by type and (for voice messages) by channel number.

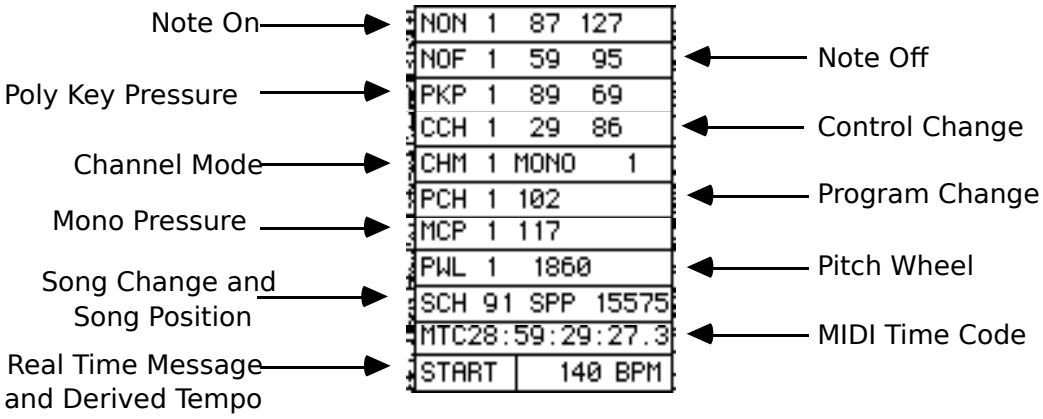
The column of check boxes to the right of the trace buffer display controls filtering by message type. A checked box means that the filter is passing that particular type of message. Just below this column is a small button which may be labeled **S** (for single) or **M** (for multi). Pressing this button toggles the mask mode for the message type filter. When the button is labeled **M**, any combination of boxes (and thus message types) may be selected. When the button is labeled **S**, only one message type may be selected at any time.

Below the trace buffer display is a row of check boxes which control filtering by channel number. To the left of this row is a second **S/M** button, which toggles the mask mode for the message channel filter. As with the message type filter, this button allows selection of either a single channel or any combination of channels.

The main purpose of the **S/M** buttons is user convenience.

The Current Message Display

Information about the most recent messages received is displayed in the lower left corner of screen:



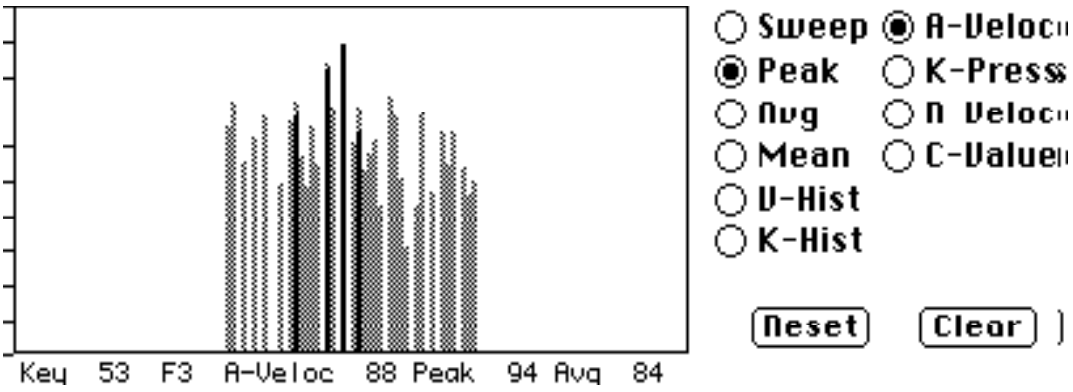
The first three lines show the last note on (NON), note off (NOF) and polyphonic key pressure (PKP) messages received. The next two display control changes; the first is for "normal" control changes (CCH, numbers 0 thru 121) while the second is for the channel mode messages (CHM, numbers 122 thru 127). Following are the last program change (PCH), the last mono pressure message (MCP) and the last pitch wheel message (PWL) and the last song change (SCH) and song position pointer (SPP).

The MIDI Time Code display is of the form "HH:MM:SS:FF.Q" where HH is hours, MM is minutes, SS is seconds, FF is frames and Q is quarter-frames. This display is based on a simple decoding of the time code message data byte; no attention is paid to the order in which the messages arrive or any other data bits in the messages.

The last line of the display shows the last valid real-time message received, except for clock messages, which are not displayed. Instead, the current tempo is calculated by measuring the time between successive clock messages. Since MIDI clocks are sent at a rate of 24 clocks/beat and the Macintosh real-time clock (which ticks 60 times a second) is not fast enough to accurately measure the interval between successive clock messages, we measure the interval over one beat (24 clocks) and display the average tempo over the last four beats. Thus, the tempo is reported every beat but requires four beats to settle after a change.

The Real-Time Display

The real-time display is a two-dimensional display of incoming MIDI data. It shows attack and release velocities and pressure values by key number or control values by control number with either peak or average values. A special histogram mode shows the frequency of values received.



The controls for the real-time display appear in the lower right hand corner of the screen. There are two groups of radio buttons and two push buttons (labeled **Clear** and **Reset**). The right-hand column of radio buttons select the display type:

A-Veloc shows the current attack (Note On) velocity values. The current value for a key is set by the Note On message and cleared by the Note Off message.

K-Press shows the current poly pressure values. The current pressure value for a key is set by the poly pressure message and cleared by both Note On and Note Off messages.

R-Veloc shows the current release (Note Off) velocity values. The current release velocity for a key is set by the Note Off message and cleared by the Note On message.

C-Value shows the current control values. The values are set by control change messages with the following exceptions: channel mode message values (control numbers 122 thru 127) are not displayed; instead, the mono pressure message value is displayed as control number 123 and the pitch wheel MSB and LSB are displayed as control numbers 125 and 126 respectively.

The left-hand column of radio buttons select the display mode:

Sweep displays the last 256 values received, in time order.

Peak displays the value (vertical axis) by key or control number (horizontal axis). The current value is displayed in black and the peak value in gray.

Avg displays the value (vertical axis) by key or control number (horizontal axis). The current value is displayed in black and the average value in gray.

Mean is a special analysis mode used to analyze key-to-key variations in keyboards. It computes the mean velocity over the entire range of values and displays the deviation of each value from the mean. It also computes and displays the maximum and standard deviation of the velocities.

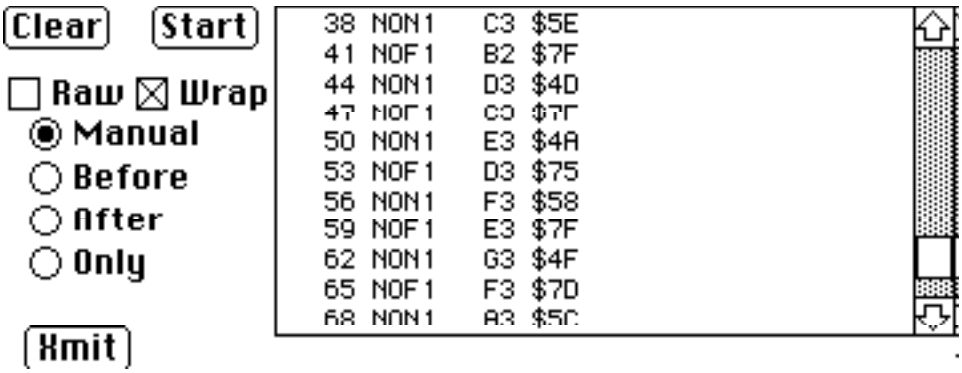
V-Hist displays the frequency of a particular value (vertical axis) by value (horizontal axis). Useful to determine the range of values produced by a particular keyboard or control. When control values are displayed, only the continuous control MSBs (control numbers 0 thru 31), switch values (control numbers 64 thru 95), mono pressure value and the pitch wheel MSB are recorded in the histogram.

K-Hist displays the frequency of note-ons (vertical axis) by key number (horizontal axis). Available only in **A-Veloc** mode. Added at the request of a composer who needed it to do score analysis.

The **Reset** button resets the peak, average or frequency values for the current display mode only. The **Clear** button clears all data associated with the current display type.

To read any value in the real-time display, just point inside the display rectangle (the cursor will change to a cross-hair) and hold the mouse button. As you drag inside the display, the information line (which appears below the display) will show data values according to the horizontal position of the mouse.

The Trace Buffer



The Trace Buffer allows you to record, edit and save incoming MIDI data.

The controls for the trace buffer appear in the upper left-hand corner of the screen, just to the left of the trace buffer display. There are two push buttons, two check boxes and four radio buttons.

The rightmost button, labeled **Start** or **Stop** turns the trace buffer on or off. The **Clear** button erases all data stored in the trace buffer.

The check box labeled **Raw** controls the input source for the trace buffer. If it is checked, then the trace buffer records incoming data directly; otherwise, it records the data coming out of the message filter. Using raw mode is the only way to see erroneous MIDI data which would otherwise be removed by the message filter.

The check box labeled **Wrap** controls the recording mode of the buffer. If it is checked, then data is recorded continuously; if the buffer is full, new data overwrites the old. Otherwise, recording stops when the buffer fills up. The wrap switch is only valid in **Manual** mode (see below).

The radio buttons select the trace buffer control mode:

Manual Tracing is controlled by the **Start/Stop** button. If the **Wrap** switch is off, tracing stops when the buffer is full.

Before Tracing is begun by pressing **Start** and continues until the matcher fires or **Stop** is pressed. Captured data includes the data which caused the matcher to fire. The **Wrap** switch is ignored in this mode.

After Tracing is enabled by pressing **Start** and begins when the matcher fires. It continues until **Stop** is pressed or the buffer is full. Captured data includes the data which caused the matcher to fire. The **Wrap** switch is ignored in this mode.

Only Tracing is enabled by pressing **Start** and disabled when the buffer fills up or **Stop** is pressed. Only matching data is recorded. The **Wrap** switch is ignored in this mode.

Normally, all trace data is displayed as hexadecimal data. The **Options** menu contains two items for controlling the format of the trace buffer display. The first, **Symbolic Display**, causes all status bytes (and

key numbers where appropriate) to be displayed symbolically. The second, **Decimal Numbers**, causes values of data bytes only to be displayed in decimal.

The following abbreviations are used in the symbolic display:

Symbol	Message	Hex Value
NON	Note ON	$9x
NOF	Note OFf	$8x
PKP	Polyphonic Key Pressure	$Ax
PCH	Program CHange	$Cx
CCH	Control CHange	$Bx
MCP	Monophonic Channel Pressure	$Dx
PWL	Pitch WheeL	$Ex
SOX	Start Of eXclusive	$F0
MTC	Midi Time Code	$F1
SPP	Song Position Pointer	$F3
SCH	Song Change	$F4
TRQ	Tune ReQuest	$F6
EOX	End Of eXclusive	$F7
CLK	CLocK	$F8
STR	sequence STaRt	$FA
CNT	sequence CoNTinue	$FB
STP	sequence SToP	$FC
SNS	active SeNSe	$FE
RST	system ReSeT	$FF

Three items in the **File** menu allow you to save and restore data recorded in the trace buffer: **Save Trace...** stores the contents of the trace buffer into a file as raw MIDI data. **Load Trace...** allows you to load the trace buffer from a previously stored file. **Save Trace As Text...** allows you to save the contents of the trace buffer as a **TEXT** file, suitably for manipulation by your favorite text editor. The format of this file will be the same as the trace buffer display; the settings of the **Symbolic Display** and **Decimal Numbers** menu options apply.

When the trace buffer is stopped, you can edit data within the buffer in the usual fashion: click and drag, cut and paste, etc. You can also paste into the transmit buffer or directly to the MIDI output.

The Data Matcher

The matcher allows you to specify a specific pattern of MIDI data bytes that will control the action of the trace buffer. You can record data which occurs before or after a match or only the data which matches the desired expression.

To get the matcher dialog, select **Matcher...** from the **Options** menu or double click on the **Before**, **After** or **Only** buttons. The dialog box contains a text item which lets you enter the matcher expression using the standard Mactintosh text editing facilities. Matcher expressions are modeled after a form of text searching expressions (known as regular expressions) used by many text editors and word processing programs. The expressions consist of terms which match successive bytes in the MIDI data stream. The following are basic matching terms:

n where **n** is any decimal number (0 thru 255), matches a single message byte (status or data).

$dd where **dd** is any hexadecimal number ($00 thru $FF), matches a single message byte (status or data). The letter 'X' may be used in either digit to indicate that it should be ignored. Upper or lower case letters may be used for the hex digits (A-F) as well as the mask (X) digit.

v1-v2 matches the value range **v1** thru **v2** inclusive. The values **v1** and **v2** may be given in decimal or hex.

? matches any single byte (status or data).

* matches any number of bytes up to but not including the first byte which matches the next term in the matching expression. If this term is the last in the expression, it matches everything up to but not including the next status byte.

In addition to the basic matching terms, the following symbolic terms may be used:

Symbol	Matches	Equivalent
DATA	any data byte	$00-$7F
STAT	any status byte	$80-$FF
NOTE	note on or off status bytes (any channel)	$80-$9F
NOF	note off status byte (any channel)	$8X
NON	note on status byte (any channel)	$9X
PKP	poly pressure status byte (any channel)	$AX
CCH	control change status byte (any channel)	$BX
PCH	program change status byte (any channel)	$CX
MCP	mono pressure status byte (any channel)	$DX
PWL	pitch wheel status byte (any channel)	$EX
SYS	any system common status byte	$F0-$F7
SOX	start-of-exclusive status byte	$F0
MTC	MIDI time code status byte	$F1
SPP	song position pointer status byte	$F3
SCH	song change status byte	$F4
TRQ	tune request status byte	$F6
EOX	end-of-exclusive status byte	$F7
REAL	any real time status byte	$F8-$FF
CLK	clock status byte	$F8
STR	start status byte	$FA
CNT	continue status byte	$FB
STP	stop status byte	$FC
SNS	active sensing status byte	$FE
RST	reset status byte	$FF

After you enter the matcher expression and click **OK**, the program converts the expression into a special form which allows for efficient execution of the matching process. If any errors occur, the program will sound an alert by beeping and highlighting (i.e., selecting) the portion of the expression where the error was detected. You can then correct the error and re-enter the expression (or click **Cancel** to leave the matcher dialog).

The matcher dialog also contains a check box labeled **Ignore Real-Time Messages**. When this is checked (the default), real-time messages are ignored by the matcher but retained as part of the matching data. This allows you to construct matching expressions without worrying about real-time messages which may appear anywhere in the MIDI data stream.

Perhaps the best way to understand the matcher is by example. To match note on or off messages, use

NOTE DATA DATA

To match note messages for the keys C4 thru C5, use

NOTE 60-72 DATA

To match note messages from a controller which believes in running status, use

NOTE *

with real-time messages ignored. To match control change messages for switch controllers only, use

CCH 64-95 DATA

To match any system exclusive message, use

SOX * STAT

Note that

SOX * EOX

is also valid but only matches messages which are actually terminated by an end-of-exclusive. Since system exclusives may be terminated by any non-real time status byte, STAT is used rather than EOX. To match any system exclusive message intended for Kurzweil equipment, use

SOX 7 * STAT

where the 7 is the manufacturer's ID number.

Kurzweil MIDIScope™ Version 1.5

We like to know who our users are. Please take time to complete this registration form and return it to:

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Waltham, MA 02154

PAN: MUHA
FAX: 617-893-2733

name: _____

address: _____

_____

_____

version: _____ obtained from_____

hardware: _____

comments: