

Programmer's Reference Manual

LAUNCHPAD 

version 1.02
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About This Manual

Launchpad S communicates using MIDI over USB in both directions. This is the only interface that the device supports. By describing the MIDI communication format, this manual contains all the information you need to be able to write software that is customised for Launchpad S.

In terms of communication, Launchpad S is largely similar to the original Launchpad, and is compatible with any software that already supports Launchpad. See the *Original Launchpad Compatibility Notes* on page 2 for a summary of how the units differ.

This is not an exhaustive document. Certain extra controller change and System Exclusive messages are used to signal between different pieces of software, for authentication, and for remote firmware upgrade. These are beyond the scope of this document. However, it is worth knowing that they exist in case you encounter them while you are playing with Launchpad S.

Number systems and MIDI conventions

There are three common ways of expressing MIDI data. All are given in this manual. The first, where appropriate, is a plain English description of the MIDI message. When we describe a musical note, middle C is deemed to be 'C 3'. MIDI channel 1 is considered the lowest-numbered MIDI channel. Controller numbers begin at zero.

Throughout this manual, MIDI messages are also expressed in plain data, with decimal and hexadecimal equivalents. The hexadecimal number will always be given with a lower-case 'h' at the end, and the decimal equivalent given in brackets. A

controller change message on MIDI channel 1, for example, is signified by the status byte B0h (176).

In all circumstances unless described otherwise, Launchpad transmits and responds only to messages on MIDI channel 1.

For Max users

For the benefit of those who use Cycling 74's Max software to process and manipulate MIDI data, a series of tutorial patches are available. These demonstrate many of Launchpad's features and capabilities within the Max environment, and can be downloaded from novationmusic.com.

Max is a world of its own, and this manual does not specifically instruct on the use of Launchpad inside its environment. Where particular tutorials are useful, though, they will be introduced.

The demonstration patches are designed to select the original Launchpad automatically, but the correct device will need choosing in the relevant drop-down boxes where Launchpad S is concerned.

Original Launchpad Compatibility Notes

We made every effort to ensure that Launchpad S will work with all the software released for the original Launchpad. What follows is a description of the differences that are already known.

Launchpad S is a class-compliant MIDI device, while Launchpad is not. This means that no additional drivers are needed to get started with Launchpad S. However, the standard class drivers on Windows do not allow different programs to use the same MIDI device simultaneously. To allow Launchpad S to be shared

between programs, you will still need to install the Novation USB driver.

Launchpad S has a bootloader mode, in which certain settings can be changed and saved by the user. These can alter its maximum current consumption and USB identity. If you are a Linux developer, you might want to be aware that the USB PID of Launchpad S can fall in a range between 20h and 2Fh.

The MIDI communication speed of Launchpad S is approximately forty times that of the original Launchpad. Many of its more advanced MIDI features were tricks to reduce MIDI traffic. Programmers could apply these in succession until their software worked smoothly and responsively. When writing for Launchpad S, heavy MIDI traffic can be exchanged seamlessly and these tricks are no longer necessary. However, if your new software generates particularly large amounts of MIDI data, please be aware that users of the original Launchpad will obtain a less satisfactory user experience.

Further differences occur because Launchpad S uses more efficient LEDs with better wavelength separation, and it drives these in a new way. If your colour vision is good, you may observe four or five distinct colours that could be used at maximum brightness to signify different settings. This was not the case on the original Launchpad, where the colour space was more modest and not so easily traversed. One ramification of the new colour space is that certain colours that appeared as yellow on the original Launchpad can now appear as yellow-green.

If backwards compatibility is desired, assume that only red, amber, and green are discernible.

If your software uses the original Launchpad's 'set duty cycle' feature, you might perceive visual differences in the way that Launchpad S interprets this command compared with Launchpad.

We have imitated this command's effect by turning it into the brightness command (page 6), but we cannot match it exactly.

Those features that are exclusive to Launchpad S are assigned their own section at the end of this manual. Otherwise, they may be applied either to the old or the new device.

Quick Start

The central grid of 64 buttons on Launchpad sends note data on MIDI channel 1. A note-on message of maximum velocity is delivered when the button is pressed, and a message of velocity zero when released. Sending the same data back to Launchpad will light or extinguish the LED behind the button.

Different note velocities produce different colours. A velocity of 0Fh (15) will light a button red; 3Ch (60) will light it green; 3Fh (63) will light it amber.

Most Launchpad communication is hardly more complicated than this.

Max patch: LP_2_MIDI_in_Cellblock.maxpat

This patch introduces the default layout of Launchpad, decomposing the location of a pressed button into its respective row and column, and displaying its incoming velocity on an 8x8 grid.

Computer-to-Launchpad Configuration Messages

■ Reset

Host » Launchpad: Channel 1: controller 0 set to 0.
B0h, 00h, 00h (176, 0, 0).

All LEDs are turned off. Launchpad's settings revert to their power-on values.

■ Turn on all LEDs

Host » Launchpad: Channel 1: controller 0 set to 125-127.
B0h, 00h, 7D-7Fh (176, 0, 125-127).

This command behaves like the *Reset* instruction above, except that the LEDs are lit amber. 7Dh (125) is the lowest intensity; 7Fh (127) is the highest.

■ Change the button layout

Host » Launchpad: Channel 1: controller 0 set to 1 or 2.
B0h, 00h, 01-02h (176, 0, 1-2).

Launchpad has two mapping modes that determine the MIDI note that corresponds to each button.

Layout 1 is the X-Y layout. This is best for writing software that uses Launchpad S as a free grid, as it is easy to navigate around the grid in any direction simply by adding or subtracting.

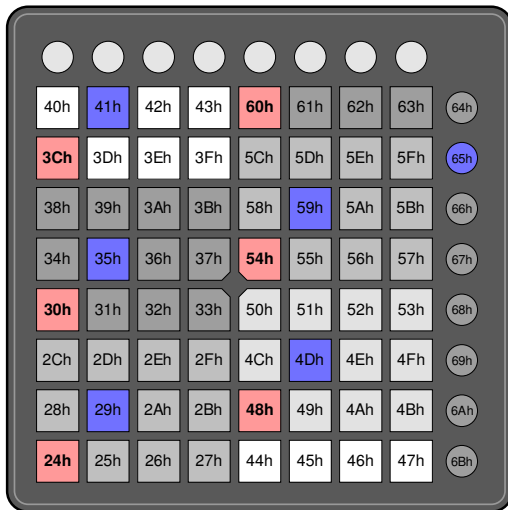
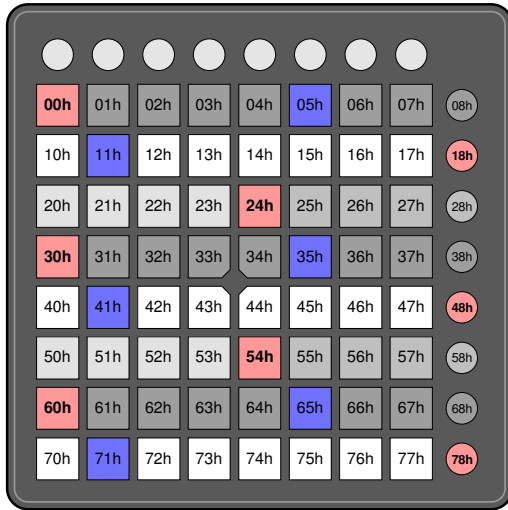
Layout 2 is the drum rack layout. This is ideal for situations where Launchpad must launch samples or deal with musical MIDI. Six continuous octaves are available in this mode, and they are laid out in a regular pattern.

Figures 1–3 (starting on page 7) illustrate the button locations and MIDI note numbers in each mapping mode.

Max patch: LP_6_DrumRackNoteLayout.maxpat

The button layout mode — either drum rack or X-Y [normal] — can be chosen from the drop-down box at the top-right of the patch. Choosing a new layout will immediately change Launchpad's button mode. The MIDI note of the most recently-pressed button is shown on the displayed piano, and the note can be played via another connected MIDI device.

Figure 1. Launchpad MIDI notes, hexadecimal values



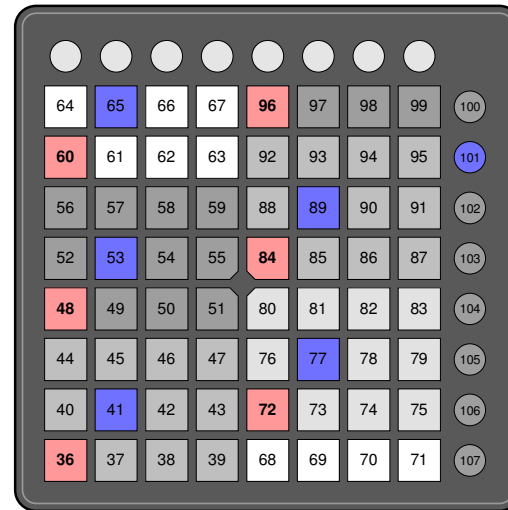
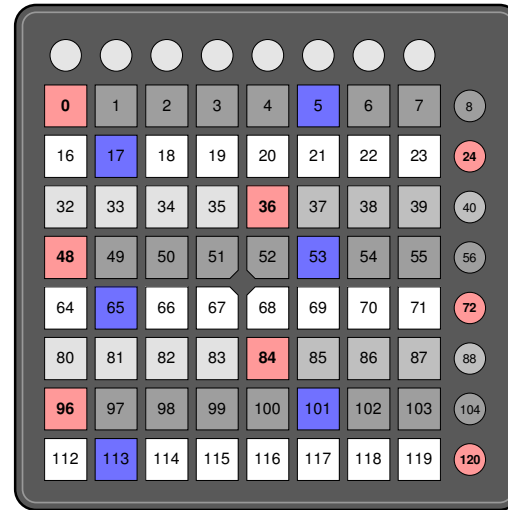
Upper Launchpad:
X-Y layout

Lower Launchpad:
Drum rack layout

Different octaves are shaded differently to make the note pattern clearer.

Cs are coloured red; Fs are coloured blue.

Figure 2. Launchpad MIDI notes, decimal values



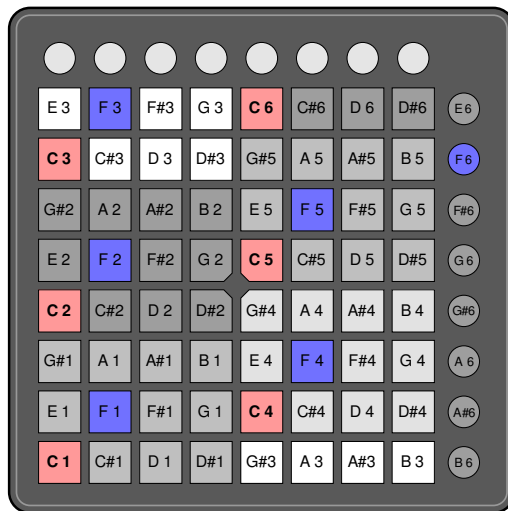
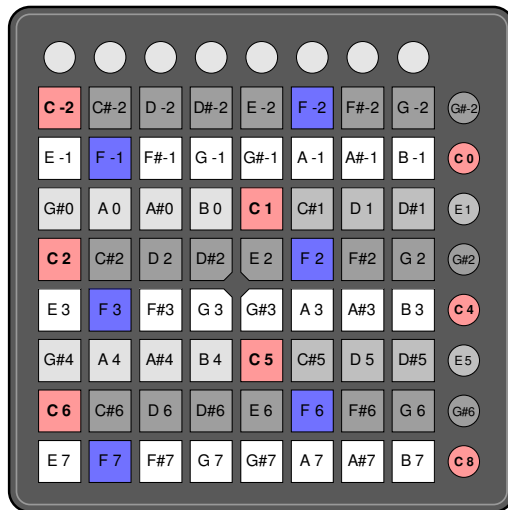
Upper Launchpad:
X-Y layout

Lower Launchpad:
Drum rack layout

Different octaves are shaded differently to make the note pattern clearer.

Cs are coloured red; Fs are coloured blue.

Figure 3. Launchpad MIDI notes, note pitches



Upper Launchpad:
X-Y layout

Lower Launchpad:
Drum rack layout

Different octaves are shaded differently to make the note pattern clearer.

Cs are coloured red; Fs are coloured blue.

Change the brightness

Host » Launchpad: Channel 1: change controller 30 or 31.
B0h, 1E-1Fh, Data (176, 30-31, Data).

This command conveys a specially-formatted fraction that Launchpad S uses to scale its overall brightness. Its effect is most pronounced when some LEDs are dimmed.

In the original Launchpad, this function set the device's duty cycle for dim LEDs, but Launchpad S is driven in a way that does not accommodate such treatment. While the new command is engineered to behave in a similar way, some differences in appearance will be experienced.

Many programs use this command: either to apply fade effects to the unit, or to suggest a metronome beat, by rhythmically setting the brightness briefly to a higher and then quickly back to its default setting.

The original Launchpad would begin to flicker visibly when duty cycles of 1/6th or less were used for any length of time, and the visual contrast would suffer when duty cycles greater than 1/5th (its default) were employed. These technical limitations provided the rationale for providing such configuration in the first place.

In Launchpad S, the default is still 1/5th. The brightness may validly be set to any value between 1/18th and 6/1, although settings of more than 1/3rd are not particularly useful, and may overload the USB host.

$$\text{Brightness} = \text{numerator} / \text{denominator}$$

When *numerator* is less than 9, send:

B0h, 1Eh, 10h×(numerator-1) + (denominator-3)
 (176, 30, 16× (numerator-1) + (denominator-3))

When *numerator* is 9 or more, send:

B0h, 1Fh, 10h×(numerator-9) + (denominator-3)
 (176, 31, 16× (numerator-9) + (denominator-3))

The following pre-baked examples may be useful. Note that the first two will flicker on an original Launchpad, and will look absolutely revolting.

Brightness	Hex message	Decimal message
1/16	B0h, 1Eh, 0Dh	176, 30, 13
1/11	B0h, 1Eh, 08h	176, 30, 8
1/7	B0h, 1Eh, 04h	176, 30, 4
1/5 (default)	B0h, 1Eh, 02h	176, 30, 2
1/3	B0h, 1Eh, 00h	176, 30, 0

Max patch: LP_8_Brightness.maxpat

This patch modulates the brightness through 2/9th, 3/9th and so on, to 9/9ths and back again. The overall effect is of the LEDs of Launchpad fading in and out. A dial can be used to set the speed of movement.

Computer-to-Launchpad LED Messages

The simplest way of changing the colour of a pad LED is to send Launchpad a note-on message on MIDI channel 1, where the note number conforms to the numbers given in Figures 1–3, and the velocity corresponds to the desired colour.

In the X-Y layout, a note value that falls within the gaps between two rows – for example, notes 9 to 0Fh (15) – will be interpreted as the last column on that row, and will therefore light the scene launch button.

Figure 4. The sixteen displayable colours of Launchpad S



Readers who are versed in the manipulation of binary will have worked out that bits 1 and 0 of the note velocity refer to the level of the red element, and bits 5 and 4 refer to the level of the green element. The red intensity is therefore varied by progressively adding 1 to the 'off' value, shown in Figure 4 as 0Ch (12). The green intensity is adjustable by progressively adding 10h (16).

Red and green light combine in equal proportions to form the amber colour, and in other proportions to form orange and yellow.

The 64 grid buttons and the eight clip launch buttons are determined by sending appropriate MIDI note messages. However, the eight round buttons at the top — the mode and cursor controls — are sent as control change messages 68h (104) to 6Fh (111) on MIDI channel 1, with the controller value containing the colour data. This makes it easier for programs to deal with them differently.

► **Example: to light the second-from-bottom left grid LED red**

```
Channel 1: note on C 6 / 60h (96), velocity 0Fh (15).  
90h, 60h, 0Fh (144, 96, 15).
```

Note: if this lights a different LED, you may be using the drum rack layout (page 5).

► **Example: to light the cursor left LED green**

```
Channel 1: set controller 6Ah (106) to 3Ch (60).  
B0h, 6Ah, 3Ch (176, 106, 60).
```

 **Max patch: LP_3_LED_ColourMix.maxpat**

Either the multi slider or drop-down box at the top of the patch window can be used to choose the colour of Launchpad's top-left grid LED. The *Hex* and *Dec* number boxes show the note velocity calculated to produce this colour.

 **Max patch: LP_7_MIDI_in_lit_Matrix.maxpat**

This patch demonstrates the use of Jitter's matrix function to store and recall conventional note messages, by switching between two screens of LEDs. Pressing buttons on the grid will toggle LEDs between red and off in one page, and green and off in the other. Pressing the *mixer* button on Launchpad changes between the two pages.

This patch uses the Jitter library, which requires QuickTime to be installed.

Rapid LED Update

To make more economical use of data, the original Launchpad featured a mode in which the entire LED grid could be updated using half the messages that would otherwise be required. This can still be employed in Launchpad S to reduce MIDI traffic.

Rapid update uses note-on messages on MIDI channel 3. In each message, the note number is treated as the colour of one LED, and the note velocity is treated as the colour of its neighbour.

Starting at the top-left-hand corner in either mode, subsequent note messages update the 64-pad grid horizontally and then vertically. They then update the eight clip launch buttons, and then the eight mode buttons.

If rapid LED update is interrupted by a valid message on MIDI channel 1, Launchpad will leave this mode and reset the cursor to the top-left-hand corner ready for subsequent updates. It is therefore essential that rapid update is used only when data traffic to Launchpad is carefully managed.

► Example: update the top row

This command, illustrating the beginning of a rapid LED update, sets the topmost row to display a pleasing spectrum of colours.

```
Channel 3: send a stream of notes and velocities
corresponding to colours.
92h, 0Fh, 1Fh, 2Fh, 3Fh, 3Fh, 3Eh, 3Dh, 3Ch.
(146, 15, 31, 47, 63, 63, 62, 61, 60).
```

Adventures in Double Buffering

We now reach our second sleight of hand intended to improve the performance of the original Launchpad. The note velocity associated with each pad is used to choose the LED colour, but also conveys two extra bits of information. Programs may use these bits to control the state of each LED at some point in the future. Launchpad updates its LEDs to reflect this new configuration in response to a certain control change message.

Essentially, Launchpad manages two sets of LED data — *buffers* — for each pad. By default, these are configured so that the buffer that is updated by incoming MIDI messages is the same as the one that is visible, so that note-on messages immediately change their respective pads.

However, the buffers can also be configured so that Launchpad's LED status is updated invisibly. With a single command, these buffers can then be swapped. The pads will instantly update to show their pre-programmed state, while the pads can again be updated invisibly ready for the next swap.

The visible buffer can alternatively be configured to swap automatically at 280ms intervals in order to configure LEDs to flash.

The extra bits within every note velocity, 3 and 2, can be set as follows:

bit 3:bit 2	Mode	Meaning
00	Ignore	Do nothing to the non-visible buffer.
01	Copy	Copy this colour to the non-visible buffer.
10	Clear	Turn off the LED in the non-visible buffer.
11	Copy	As 'Copy' above.

The colours given in Figure 4 are expressed in 'copy' mode, with bits 3 and 2 set. These examples will make it easy for software to incorporate flashing LEDs without being re-written. To use these examples in 'clear' mode (in other words, to configure the LEDs to flash), it is sufficient just to clear bit 2. This means subtracting 4 from the velocity value given in Figure 3. To set LEDs in 'ignore' mode, subtract 0Ch (12) instead. See the examples at the end of this section.

■ Change the LED buffers

Host » Launchpad: Channel 1: controller 0 set to 20-3Dh (32-61).
B0h, 00h, 20-3Dh (176, 0, 32-61).

The table below shows those control values that will prove most useful. For those with the interest and expertise to delve further, a definitive description of these settings is given in terms of bitwise logic in the original *Launchpad Programmer's Reference Manual*.

Control value	Mode	Meaning
20h (32)	Simple	(the default) Display and write to buffer 0.
24h (36)	Buffered 0	Display buffer 0, and write to buffer 1.
21h (33)	Buffered 1	Display buffer 1, and write to buffer 0.
34h (52)	Buffered 0 + Copy	Display buffer 0, write to buffer 1, copy buffer 0 to buffer 1.
31h (49)	Buffered 1 + Copy	Display buffer 1, write to buffer 0, copy buffer 1 to buffer 0.
28h (40)	Flash	Flash mode: write to buffer 0, and swap the display buffer every 280ms.

► Example: Flashing LEDs

Turn flashing on.

Channel 1: set controller 0 to 28h (40).
B0h, 00h, 28h (176, 0, 40).

Then set second-from-bottom left grid LED to light amber solidly.

Channel 1: note on C 6 / 60h (96), velocity 3Fh (63).
90h, 60h, 3Fh (144, 96, 63).

Then set the next grid LED to flash amber.

Channel 1: note on C#6 / 61h (97), velocity 3Bh (59).
90h, 61h, 3Bh (144, 97, 59).

Then set the next grid LED to flash green.

Channel 1: note on D 6 / 62h (98), velocity 38h (56).
90h, 62h, 38h (144, 98, 56).

Then turn off the first LED.

Channel 1: note on C 6 / 60h (96), velocity 0Ch (12).
90h, 60h, 0Ch (144, 96, 12).

Finally, turn flashing off.

Channel 1: set controller 0 to 20h (32).
B0h, 00h, 20h (176, 0, 32).

► Example: Double buffering

Enter buffering mode.

```
Channel 1: set controller 0 to 31h (49).  
B0h, 00h, 31h (176, 0, 49).
```

Set some LEDs. We will use 'ignore' mode to set four adjacent LEDs to red-amber-green-amber. (We are using *running status* here: part of the MIDI spec that allows us to send a single status byte followed by a stream of note/velocity pairs.)

```
Channel 1: note on C 6 / 60h (96), velocity 3.  
          note on C#6 / 61h (97), velocity 33h (51).  
          note on D 6 / 62h (98), velocity 30h (48).  
          note on D#6 / 63h (99), velocity 33h (51).  
90h, 60h, 03h, 61h, 33h, 62h, 30h, 63h, 33h.  
(144, 96, 3, 97, 51, 98, 48, 99, 51).
```

The display will update invisibly, and will not change until the buffers are cycled as follows:

```
Channel 1: set controller 0 to 34h (52).  
B0h, 00h, 34h (176, 0, 52).
```

Set the first amber LED to green, and turn off the second amber LED. We will use 'ignore' mode again: otherwise the visible state of Launchpad will change. (Note the use of running status again.)

```
Channel 1: note on C#6 / 61h (97), velocity 30h (48).  
          note on D#6 / 63h (99), velocity 0.  
90h, 61h, 30h, 63h, 00h.  
(144, 97, 48, 99, 0).
```

The display will not change until the buffers are swapped again, as follows:

```
Channel 1: set controller 0 to 31h (49).  
B0h, 00h, 31h (176, 0, 49).
```

To continue working in this way, cycle between controller values 31h (49) and 34h (52) to swap buffers. Every time this is done, all the LEDs will change instantly.

Return to the default mode when you have finished:

```
Channel 1: set controller 0 to 20h (32).  
B0h, 00h, 20h (176, 0, 32).
```

Max patch: LP_5_LED_Banks.maxpat

The 'LED colour' option chooses the transmitted note velocity. The 'bank' option determines whether the *Ignore*, *Copy* or *Clear* mode is used while sending the note. A note is sent to the top-left grid button whenever the LED colour option is changed.

Different bank options are selectable from the 'Options' drop-down menu. As soon as its state is changed, the appropriate controller message is transmitted to Launchpad.

New Features

■ Device Inquiry

Launchpad S responds to the MIDI 1.0 specification's Device Inquiry message. The original Launchpad does not. A device response can be generated by sending:

```
F0h, 7Eh, 7Fh, 06h, 01h, F7h.  
(240, 126, 127, 6, 1, 247).
```

Launchpad S will respond with data appropriate to its identity. Novation's manufacturer ID is 00h, 20h, 29h (0, 32, 41), and the device code for Launchpad S is 20h, 00h (32, 00).

■ Scrolling text

Launchpad S natively supports scrolling text. ASCII text can be embedded in a System Exclusive message. Additional bytes are reserved to change the scrolling speed or text colour.

```
F0h, 00h, 20h, 29h, 09h, colour, text ..., F7h  
(240, 0, 32, 41, 9, colour, text ..., 247)
```

Colour refers to the scroll text colour, and should be supplied in the same way as the MIDI note velocity, as described in Figure 3. Additionally, bit 4 can be set (add 64 to the velocity) in order to make the text loop.

In addition to the standard ASCII characters, Launchpad S recognises plain values of 1-7 as speed commands, where 1 is slowest and 7 is fastest. This allows the scrolling speed to be manipulated mid-text. The default speed is 4.

When the text ends, Launchpad S restores the LEDs to their previous settings. As the text either ends or loops, a controller change message will be sent back to the host, setting controller 0 to 3:

```
B0h, 00h, 03h (176, 0 3)
```

This enables software to keep track of the message's progress.

► Example: Hello world

Start the text scrolling with the following System Exclusive message:

```
F0h, 00h, 20h, 29h, 09h, 7Ch, 05h, 48h, 65h, 6Ch, 6Ch, 6Fh,  
20h, 02h, 77h, 6fh, 72h, 6ch, 64h, 21h, F7h
```

```
(240, 0, 32, 41, 9, 124, 5, 72, 101, 108, 108, 111, 32, 2,  
119, 111, 114, 108, 100, 33, 247)
```

This loops the text in green, playing 'Hello' quickly and 'world!' slowly. To stop it, just send an empty scroll command:

```
F0h, 00h, 20h, 29h, 09h, 00h, F7h  
(240, 0, 32, 41, 9, 0, 247)
```

Max patch: LP_9_Scrolling.maxpat

This patch demonstrates custom scrolling text. The colour and loop settings can be changed, and a text string entered. This is converted into the relevant System Exclusive message format, and sent to Launchpad S.

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