

# LAUNCHPAD

## MK2 Programmer's Reference Manual

Version 1.01  
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# About this Guide

Launchpad MK2 communicates using MIDI over USB in both directions. This manual, describing the MIDI communication format, is all the information you need to be able to write software that is customised for Launchpad MK2.

This is not an exhaustive document. Certain extra System Exclusive messages are used 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 MK2.

## Number Systems and MIDI conventions

There are three ways of expressing MIDI data in this manual. The first, where appropriate, is a plain English description of the message. When we describe a musical note, middle C is deemed to be 'C3' or note 60. MIDI channel 1 is considered to be the lowest-numbered MIDI channel and channels range from 1 - 16.

MIDI messages are also expressed in plain data, with decimal and hexadecimal equivalents. The hexadecimal number will always be followed by an 'h' and the decimal equivalent given in brackets. For example a note on message on channel 1 is signified by the status byte 90h (144).

## 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 MK2's features and capabilities within the Max environment.

A runtime version of Max is available from [www.cycling74.com](http://www.cycling74.com).

# Bootloader

Launchpad MK2 has a bootloader mode that allows the user to configure and save certain settings. The bootloader is accessed by holding the **Session**, **User 1**, **User 2** and **Mixer** buttons while plugging the device in. Figure 1 shows the functions of the bootloader.

The top two rows of square buttons can be used to set the device ID of Launchpad MK2. The device ID ranges from 1 – 16 and the selected ID is represented by an orange button. This also sets the USB identity, which ranges from 69h to 78h.

The next two rows can be used to set the communications channel for User 1 and User 2 layouts. Row 3 represents User 1 (channels 1 – 8) and row 4 represents User 2 (channels 9 – 16). Certain channels are reserved and cannot be selected – these are represented by a dimly lit red button. Available channels (6 – 8 for User 1, 14 – 16 for User 2) are represented by dimly lit blue button. Selected channels are represented by a bright blue button.

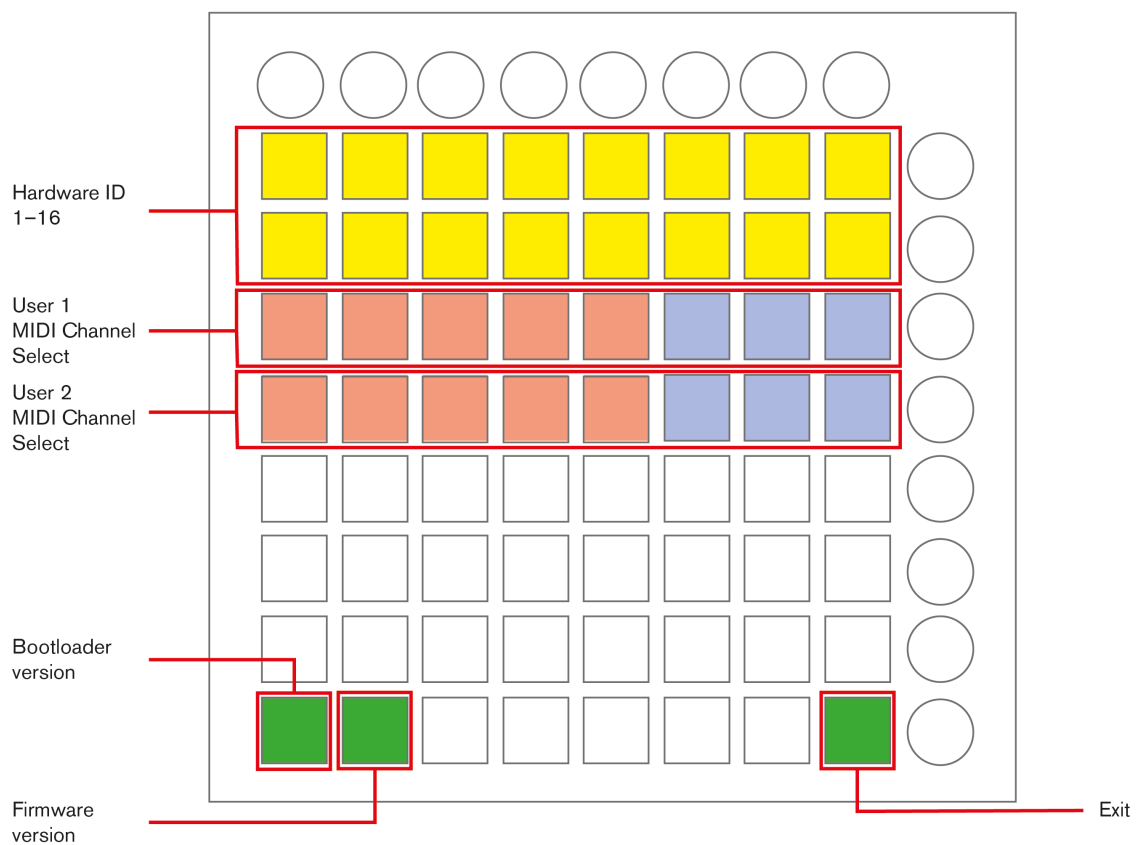


Figure 1: The functions of the bootloader

# Basic Features

## Basic Communication

The central grid of 64 square buttons and the 8 right-hand round buttons send note data to the host. A note-on message with maximum velocity is sent when the button is pressed, and a note-on message with velocity 0 when released.

Note-on messages can also be used to light the LED behind each button. The velocity of the note-on message determines the colour of the LED.

A note-on message with velocity 0, or a note-off message of any velocity will turn the LED off.

The top row of round buttons send control change messages to the host, where the controller number is the address of the button. Pressing the button sends a control change message with a value of 7Fh (127) and releasing sends the value as 0. Similarly, they will light when a control change message is received with the controller value determining the colour of the LED.



Max patch: LPMK2\_Basic\_Communication.maxpat

*This patch introduces basic messages to and from Launchpad MK2, decomposing each message and displaying it in the console window. It also shows Session, User 1 and User 2 layouts.*

## Colours

Launchpad MK2 has a colour palette of 128 colours shown in figure 2. Colour 0 turns the LED off.



Figure 2: Launchpad MK2 colour table



Max patch: LPMK2\_Colours.maxpat

*This patch provides two methods of lighting the whole of Launchpad MK2 in a variety of colours.*

# Layouts

Launchpad MK2 has three layouts that respond to note messages – Session, User 1 (Drum) and User 2. Volume and Pan layouts are discussed in the “Advanced Features” section of this guide.

- Change the button layout

```
Host >> Launchpad MK2:    F0h 00h 20h 29h 02h 18h 22h <Layout> F7h
                          (240,0, 32, 41, 2, 24, 34, <Layout>,247)
```

Where the layout byte is:

- 00h - Session
- 01h - User 1 (drum rack)
- 02h - User 2
- 03h - (reserved for Ableton Live)
- 04h - Volume
- 05h - Pan

The layout determines the MIDI note number that the buttons send and receive. Layout 0 is Session layout. This is best for writing software that uses Launchpad MK2 as a grid as it is easy to navigate by adding and subtracting - adding 1 moves to the right 1 button, adding 10 moves up one button.

Layout 1 is User 1 or Drum layout. This is ideal for situations where Launchpad MK2 must launch samples or deal with musical MIDI.

Layout 2 is User 2 and is the same as Session.

Figure 3 shows these layouts in hexadecimal, figure 4 in decimal and figure 5 in note names. In each of these images Cs are coloured red and Fs are coloured blue.

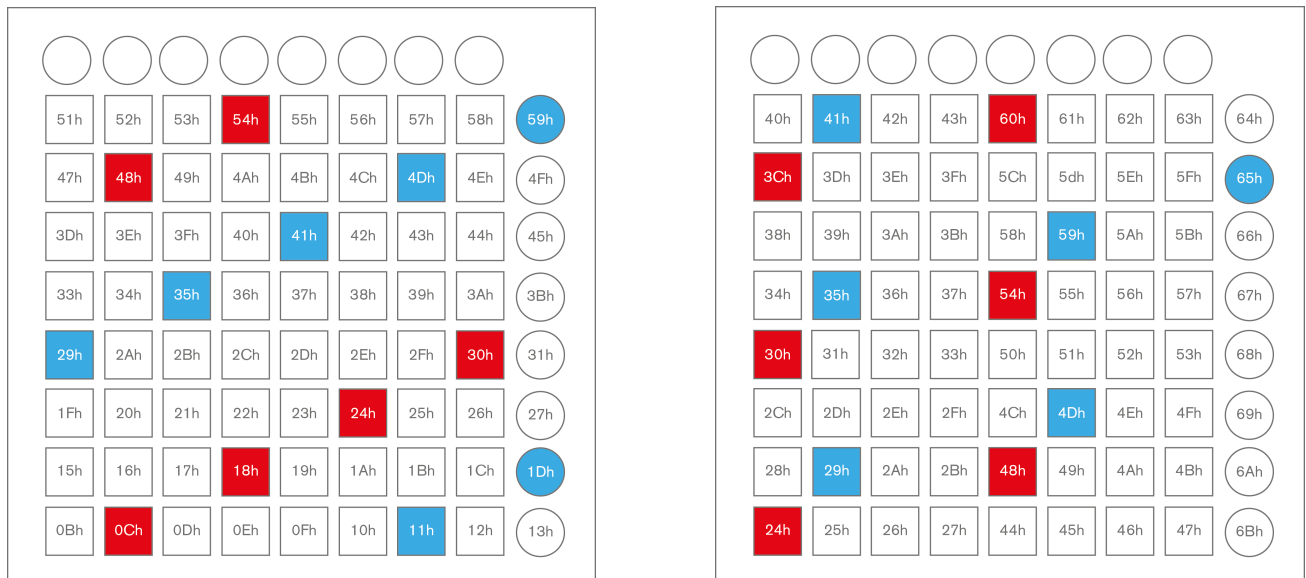


Figure 3: Session (L) and Drum (R) Layouts in hexadecimal

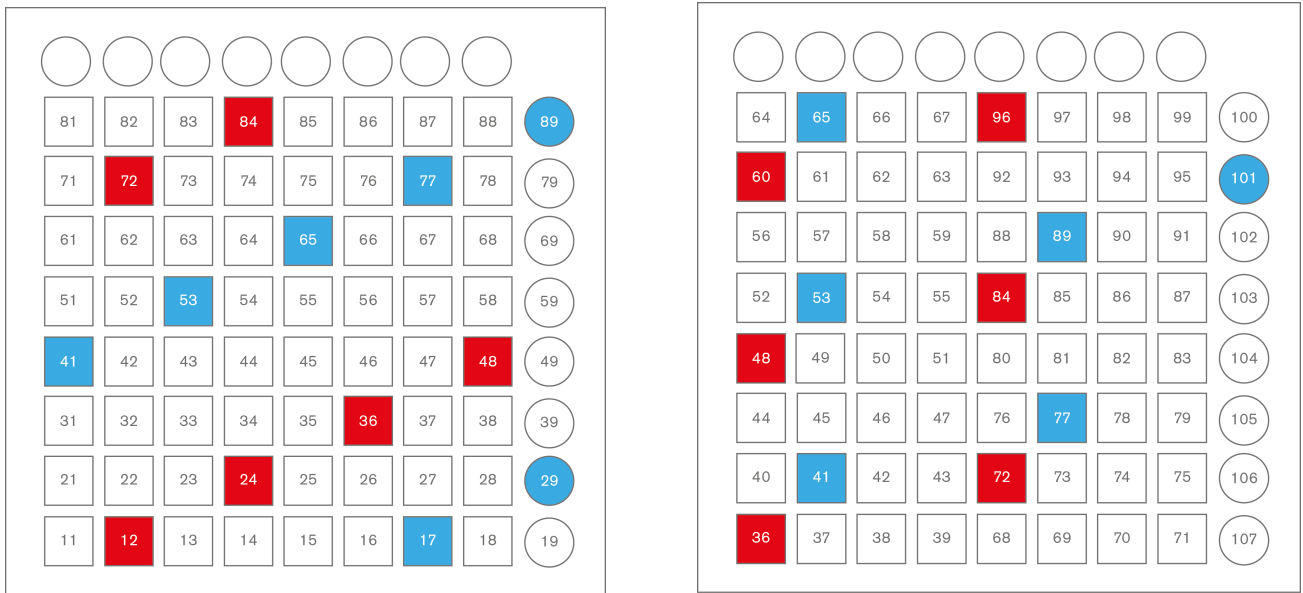


Figure 4: Session (L) and Drum (R) layouts in decimal

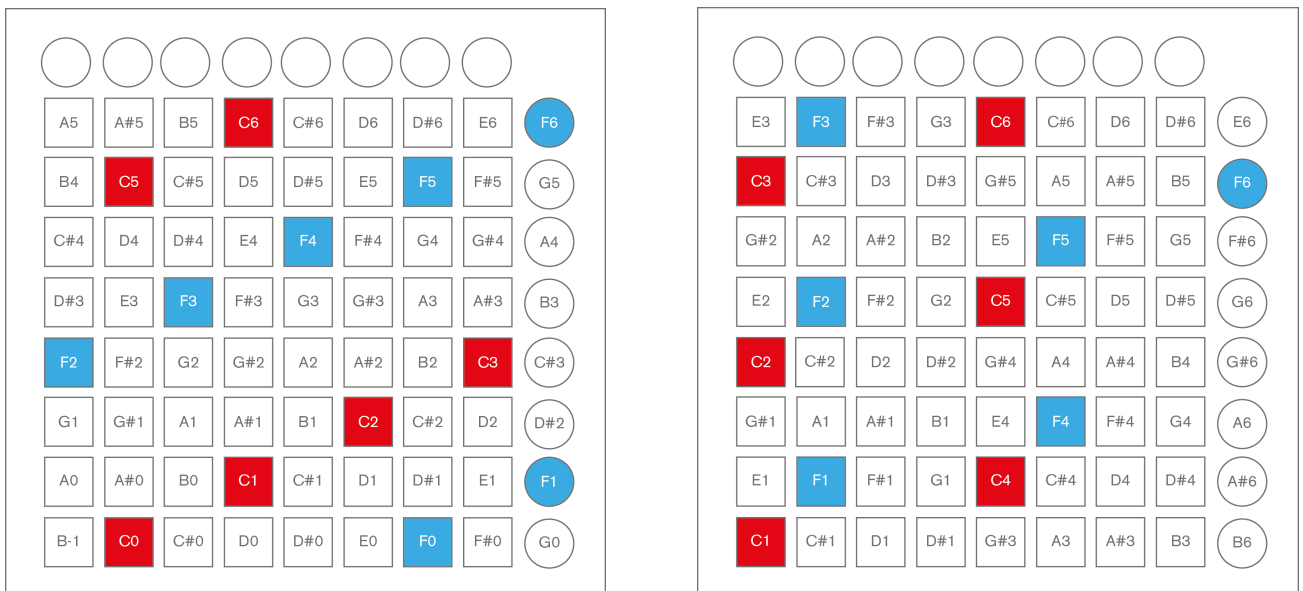


Figure 5: Session (L) and Drum (R) layouts note names

The controller numbers for the top row of round buttons does not change with layout and is always as 68h to 6Fh (104 – 111), as shown in figure 6.



Figure 6: Controller numbers for the top row in hexadecimal (top) and decimal (bottom)

## Channels

In order to prevent messages intended for one layout interfering with the others, each layout sends and receives messages on a different channel. Session layout uses channel 1.

- **Example: light top left grid LED blue in Session layout**

```
Host >> Launchpad MK2:    Channel 1: note-on A5/51h (81), velocity 2Dh (45)
                          90h 51h 2Dh (144, 81, 45)
```

- **Example: light the cursor left LED pink in Session layout**

```
Host >> Launchpad MK2:    Channel 1: set controller 6Ah (106) to 35h (53)
                          B0h 6Ah 35h (176, 106, 53)
```

User 1 and User 2 layouts use the channel selected in the bootloader.

- **Example: light second-from-bottom left LED orange in User 1 layout with the channel set to 8**

```
Host >> Launchpad MK2:    Channel 8: note-on E2/28h (40), velocity 09h (9)
                          97h 28h 09h (151, 40, 9)
```

- **Example: light Mixer LED yellow in User 2 layout with the channel set to 14**

```
Host >> Launchpad MK2:    Channel 14: set controller 6Fh (111) to 0Dh (13)
                          BDh 6Fh 0Dh (189, 111, 13)
```

## Flashing

Launchpad MK2 supports flashing between two colours on all three layouts. The flash colour is set by sending a note-on message (or CC for the top 8 round buttons) to the device on channel 2. When a message is received on channel 2, Launchpad MK2 will then begin to flash between the flash colour (B) and the current colour of the LED (A), with a 50% duty cycle (shown in figure 7). Flashing (and pulsing) happens in time with MIDI beat clock (see 'MIDI Clock' below), the last known tempo or will default to 120 bpm.

Flashing can be stopped by sending the LED a message on channel 1.

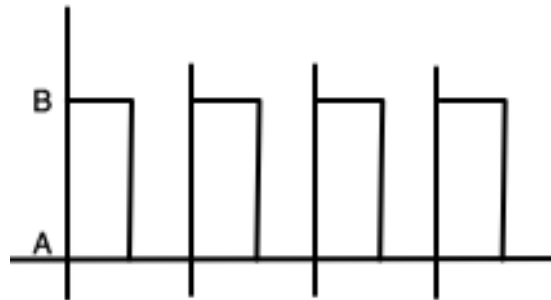


Figure 7: The flashing waveform

- **Example: set a single pad to flash between red and off (Session layout)**

The LEDs are all off. Set the bottom left LED to flash between red and off.

```
Host >> Launchpad MK2:    Channel 2: note-on B-1/0Bh (11), velocity 05h (5)
                          91h 0Bh 05h (145, 11, 5)
```

The LED will flash between red and off. The sequence will start with red.

To stop flashing and turn the LED off:

```
Host >> Launchpad MK2:    Channel 1: note-on B-1/0Bh (11), velocity 00h (0)
                          90h 0Bh 00h (144, 11, 0)
```

- **Example: set a single pad to flash between red and green (Session layout)**

The LEDs are all off. Set the bottom left LED to light green.

```
Host >> Launchpad MK2:    Channel 1: note-on B-1/0Bh (11), velocity 15h (21)
                          90h 0Bh 15h (144, 11, 21)
```

Set the flash colour to red, start flashing.

```
Host >> Launchpad MK2:    Channel 2: note-on B-1/0Bh (11), velocity 05h (5)
                          91h 0Bh 05h (145, 11, 5)
```

The LED will flash between red and green. The sequence will start with red.

To stop flashing and turn the LED blue:

```
Host >> Launchpad MK2:    Channel 1: note-on B-1/0Bh (11), velocity 2Dh (45)
                          90h 0Bh 2Dh (144, 11, 45)
```

## Pulsing

Launchpad MK2 also supports pulsing, where the colour of the LED rhythmically increases and decreases in brightness (as shown in figure 8). Pulsing is started by sending the LED a note-on message (or CC for the top 8 round buttons) on channel 3 and can be stopped by sending a message to the LED on channel 1.

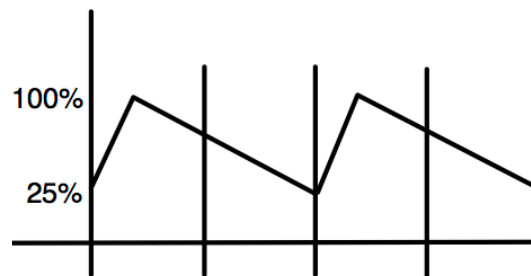


Figure 8: The pulsing waveform

- **Example: set a single pad to pulse purple (Session layout)**

The LEDs are all off. Set the top right grid LED to pulse purple.

```
Host >> Launchpad MK2:    Channel 3: note-on E6/58h (88), velocity 51h (81)
                          92h 58h 51h (146, 88, 81)
```

To stop pulsing and turn the LED off:

```
Host >> Launchpad MK2:    Channel 1: note-on E6/58h (88), velocity 00h (0)
                          90h 58h 00h (144, 88, 00)
```



Max patch: LPMK2\_Flashing.maxpat

*This patch introduces flashing and pulsing. The mode can be set to static, flash or pulse. Pads will then do the selected action in a random colour when pressed. The tempo can also be altered.*

## Device Inquiry

Launchpad MK2 responds to the MIDI specification's Device Inquiry message.

- **Device Inquiry**

```
Host >> Launchpad MK2:    F0h 7Eh 7Fh 06h 01h F7h
                          (240,126,127, 6, 1, 247)
```

Launchpad MK2 will respond:

```
Launchpad MK2 >> Host:
    F0h 7Eh <device ID> 06h 02h 00h 20h 29h 69h 00h 00h 00h <firmware revision 4 Bytes> F7h
    (240,126,<device ID>, 6, 2, 0, 32, 41,105, 0, 0, 0,<firmware revision 4 Bytes>, 247)
```

The firmware revision number is represented by four bytes, where revision 138 would be given as 00h, 01h, 03h, 08h.

# Advanced Features

## Lighting LEDs Using SysEx Messages

It is possible to control Launchpad MK2's LEDs using SysEx messages. This allows a number of LEDs to be updated quickly with one message. The index of the LED is taken to be the same as Session layout, regardless of the layout Launchpad MK2 is currently in, with the top 8 round buttons indexed as 68h to 6Fh (104 – 111).

- **Light LED using SysEx**

```
Host >> Launchpad MK2:   F0h 00h 20h 29h 02h 18h 0Ah <LED> <Colour> F7h
                          (240, 0, 32, 41, 2, 24, 10, <LED> <Colour> 247)
```

Message can be repeated up to 80 times.

- **Light a column of LEDs using SysEx**

Columns are numbered left to right, 0 - 8.

```
Host >> Launchpad MK2:   F0h 00h 20h 29h 02h 18h 0Ch <Column> <Colour> F7h
                          (240, 0, 32, 41, 2, 24, 12, <Column> <Colour> 247)
```

Message can be repeated up to 9 times.

- **Light a row of LEDs using SysEx**

Rows are numbered bottom to top, 0 - 8.

```
Host >> Launchpad MK2:   F0h 00h 20h 29h 02h 18h 0Dh <Row> <Colour> F7h
                          (240, 0, 32, 41, 2, 24, 13, <Row> <Colour> 247)
```

Message can be repeated up to 9 times.

- **Light all LEDs using SysEx**

```
Host >> Launchpad MK2:   F0h 00h 20h 29h 02h 18h 0Eh <Colour> F7h
                          (240, 0, 32, 41, 2, 24, 14, <Colour> 247)
```

Message cannot be repeated.

- **Flash LED using SysEx**

The LED will flash between the chosen colour and its current colour.

```
Host >> Launchpad MK2:    F0h 00h 20h 29h 02h 18h 23h <LED> <Colour> F7h  
                          (240, 0, 32, 41, 2, 24, 35, <LED> <Colour> 247)
```

Message can be repeated up to 80 times.

- **Pulse LED using SysEx**

```
Host >> Launchpad MK2:    F0h 00h 20h 29h 02h 18h 28h <LED> <Colour> F7h  
                          (240, 0, 32, 41, 2, 24, 40, <LED> <Colour> 247)
```

Message can be repeated up to 80 times.

## RGB Mode

The brightness of the individual red, green and blue elements of the LED can be controlled to create any colour. Each element has a brightness value from 00h – 3Fh (0 – 63), where 0 is off and 3Fh is full brightness.

- **Light LED using SysEx (RGB mode)**

```
Host >> Launchpad MK2:    F0h 00h 20h 29h 02h 18h 0Bh <LED>, <Red> <Green> <Blue> F7h  
                          (240, 0, 32, 41, 2, 24, 10, <LED>, <Red> <Green> <Blue> 247)
```

Message can be repeated up to 80 times.

## MIDI Clock

By default, Launchpad MK2 will flash and pulse at 120 BPM. This can be altered by sending Launchpad MK2 F8h (248) messages (MIDI clock), which should be sent at a rate of 24 per beat. To set a tempo of 100 BPM, 2400 MIDI clock messages should be sent each minute, or with a time interval of 25ms.

Launchpad MK2 supports tempos between 40 and 240 BPM.

## Virtual Faders

Launchpad MK2 has two virtual fader modes, one with volume style faders and one with pan style (the two styles cannot be mixed). In fader mode the grid becomes 8 faders controlled by CC messages.

To enter fader mode use the layout change SysEx message with the layout byte set to 04h (4) for volume faders and 05h (5) for pan faders.

### ▪ Change the button layout

```
Host >> Launchpad MK2:    F0h 00h 20h 29h 02h 18h 22h <Layout> F7h  
                          (240, 0, 32, 41, 2, 24, 34, <Layout> 247)
```

After one of the fader layouts have been selected the faders must be initialised.

### ▪ Initialise a fader

```
Host >> Launchpad MK2:    F0h 00h 20h 29h 02h 18h 2Bh <Number> <Type> <Colour> <Value> F7h  
                          (240, 0, 32, 41, 2, 24, 43, <Number> <Type> <Colour> <Value> 247)
```

Message can be repeated up to 8 times.

Number - Index of the fader, numbered left to right, 00h - 07h (0 - 7)  
Type - Fader (00h) or Pan (01h). This must match the selected layout  
Colour - 00h - 7Fh (0 - 127)  
Value - Initial value for the fader 00h - 7Fh (0 - 127)

The fader will light up according to its current value with volume faders lighting from the bottom up, and pan faders lighting from the centre out.

The level of a fader can be set by sending Launchpad MK2 control change messages. The controller numbers of the faders (in both layouts) are, left to right, 15h - 1Ch (21 - 28) and the controller value sets the level of the fader. Each LED will light when the level is greater than or equal to the LEDs threshold value.

When a button is pressed to change the level of a fader, Launchpad MK2 will move the fader to that position and send interim values to smooth the transition.



Max patch: LPMK2\_Faders.maxpat

*This patch uses fader mode to create a spectrum analyser. Load in a piece of music and the faders will move according to the level in 8 frequency bands.*

## Text scrolling

Launchpad MK2 natively supports scrolling text. ASCII text can be embedded in a System Exclusive message. Additional bytes are reserved to change the colour, looping and speed.

### ▪ Start text scrolling

```
Host >> Launchpad MK2:    F0h 00h 20h 29h 02h 18h 14h <Colour> <Loop> <Text> F7h
                          (240, 0, 32, 41, 2, 24, 20, <Colour> <Loop> <Text> 247)
```

Colour - Scroll text colour 00h - 7Fh (0 - 127)

Loop - Set to 01h (1) to loop the message

In addition to the standard ASCII characters, Launchpad MK2 recognises plain values 1 – 7 as speed commands (where 1 is the 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 MK2 restores the LEDs to their previous settings. As the text either ends or loops, a SysEx message will be sent back to the host.

```
Launchpad MK2 >> Host:    F0h 00h 20h 29h 02h 18h 15h F7h
                          (240, 0, 32, 41, 2, 24, 21, 247)
```

### ▪ Example: hello world

Start the text scrolling.

```
Host >> Launchpad MK2:
F0h 00h 20h 29h 02h 18h 14h 7Ch 01h 05h 48h 65h 6Ch 6Ch 6Fh 20h 02h 77h 6Fh 72h 6Ch 64h
21h F7h
```

```
(240, 0, 32, 41, 2, 4, 20, 124, 1, 5, 72, 101, 108, 108, 111, 32, 2, 119, 111, 114, 108,
100, 33, 247)
```

This loops the text in yellow, playing “Hello” quickly and “world!” slowly. To stop it, send an empty scroll command.

```
Host >> Launchpad MK2:    F0h 00h 20h 29h 02h 18h 14h F7h
                          (240, 0, 32, 41, 2, 24, 20, 247)
```



Max patch: LPMK2\_Scrolling.maxpat

*This patch introduces text scrolling. Set the colour, the loop byte and the message, then trigger the scrolling.*

## System Exclusive Messages

Each of the following SysEx messages have the same header

F0h 00h 20h 29h 02h 18h  
(240, 00, 32, 41, 2, 24)

Following this is the 6<sup>th</sup> byte and then further values depending on the message. All SysEx messages are terminated by:

F7h (247)

Parameter Name	6th Byte	Value 1	Value 2	Value 3	Value 4	Repeatable?	Notes
<b>Set LEDs (standard colour mode)</b>	0Ah (10)	LED 0Bh - 6Fh (11-111)	Colour 00h - 7Fh (0-127)	--	--	Yes, up to 80 times	
<b>Set LEDs (RGB mode)</b>	0Bh (11)	LED 0Bh - 6Fh (11-111)	Red 00h - 3Fh (0-63)	Green 00h - 3Fh (0-63)	Blue 00h - 3Fh (0-63)	Yes, up to 80 times	
<b>Set LEDs by column</b>	0Ch (12)	Column number (0-8)	Colour 00h - 7Fh (0-127)	--	--	Yes, up to 9 times	Columns are numbered from left to right
<b>Set LEDs by row</b>	0Dh (13)	Row number (0- 8)	Colour 00h - 7Fh (0-127)	--	--	Yes, up to 9 times	Rows are numbered from bottom to top
<b>Set all LEDs</b>	0Eh (14)	Colour 00h - 7Fh (0-127)	--	--	--	No	A colour value of 0 switches off all LEDs
<b>Flash LED</b>	23h (35)	Mode (unused, 0)	LED 0Bh - 6Fh (11-111)	Colour 00h - 7Fh (0-127)	--	Yes, up to 80 times	Selected LED flashes between current lit colour and colour specified in value 3. If selected LED is current not lit then it will flash between off and colour specified in value 3.

<b>Pulse LED</b>	28h (40)	Mode (unused, 0)	LED 0Bh - 6Fh (11-111)	Colour 00h - 7Fh (0-127)	--	Yes, up to 80 times	Selected LED pulses with the colour specified in value 3.
<b>Scroll text across pads</b>	14h (20)	Colour 00h - 7Fh (0-127)	Loop 0 = loop off 1 = loop on	Text	--	No	Text can be standard ASCII characters or plain values 1 - 7 to change speed
<b>Layout selection</b>	22h (34)	Layout (0-5)	--	--	--	No	00 - Session 01 - User 1 (Drum Rack) 02 - User 2 04 - Fader 05 - Pan
<b>Fader Setup</b>	2Bh (43)	Fader number (0- 7)	Fader type 0=volume 1=pan	Colour 00h - 7Fh (0-127)	Initial Value 00h - 7Fh (0-127)	Yes, up to 8 times	

## Other SysEx Messages

Launchpad MK2 responds to 3 further SysEx messages.

<b>Device Inquiry</b>	F0h 7Eh <device ID> 06h 01h F7h (240, 126, <device ID>, 6, 1, 247)	Read information about the connected device. Device ID is from 00h to 0Fh and must match the value chosen in the bootloader. When Device ID is 7F, all Launchpad MK2s with respond regardless of device ID.
<b>Version Inquiry</b>	F0h 00h 20h 29h 00h 70h F7h (240, 0, 32, 41, 0, 112, 247)	Returns the current bootloader and firmware versions and size of bootloader in KB
<b>Set to bootloader</b>	F0h 00h 20h 29h 00h 71h 00h 69h F7h (240, 0, 32, 41, 0, 113, 0, 105, 247)	Force the Launchpad MK2 into bootloader mode