

# TWITCH

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## Programmer's Reference Manual

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## About this Manual

This manual describes the MIDI operation of Twitch in detail, allowing you to write software that interacts with the control surface. It is assumed that you are familiar with using MIDI: particularly controller change and note messages.

The use and performance of Twitch as an audio interface is beyond the scope of this document. Audio functionality is considered only when it interacts with MIDI control.

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## Our Conventions

To avoid repetition, the consistent parts of Twitch's behaviour, and the standards used within this manual are outlined here.

### Number systems and MIDI usage

There are many ways of expressing MIDI data. The three most common conventions are used in this manual. The first, where appropriate, is a plain English description of the MIDI message. In our notation, we deem middle C to be 'C 3'. MIDI channel 1 is considered the lowest-numbered MIDI channel. Controller numbers begin at zero.

MIDI messages are also expressed as plain data, and given in hexadecimal and decimal equivalents. For numbers greater than 9 (when the decimal and hexadecimal systems differ), the hexadecimal number is given first, with a lower-case 'h' at the end. The decimal equivalent is then given in brackets. For example, middle C is note number 3Ch (60). A message on MIDI channel 8 is signalled by the status byte 97h (151), or the controller change status byte B7h (183).

As a rule, notes and control messages that pertain to deck A, and all common operations, are sent on MIDI channel 8. Controls for deck B are sent on MIDI channel 9. Where appropriate, data for decks C and D are sent on MIDI channels 10 and 11, and the effects section occupies MIDI channel 12.

### Push buttons and backlight LEDs

Every button is assigned a MIDI channel and note number. A MIDI note on message is sent when a button is pushed, with velocity 7Fh (127). When released, it sends a message with velocity 0.

Every push button on Twitch has an LED backlight. The rectangular buttons have single LEDs behind them. These are all red, except HOT CUES (amber), LOOP/AUTO LOOP (green), and BEAT GRID/LOOP ROLL (green).

The larger square buttons are backlit with bi-coloured LEDs. These can be set to red, green, amber (made by turning on both elements simultaneously), or another colour in that part of the spectrum.

A button LED is illuminated by sending a note on message to Twitch. The note number and channel that controls a backlight is the same as the message sent by that button. For single-LED backlights, a velocity of 0-16 sets that LED's intensity, with 0 being off and 16 being full brightness. Any number above this illuminates the LED with full brightness.

In the case of bi-coloured LEDs, the lower 4 bits of the velocity express the light intensity, and the upper 3 bits the LED colour, from red to green. So, to convert a colour to a velocity value, pick an intensity from 0 to 15, and add to this number 0 for red, 40h (64) for amber, and 70h (112) for green.

## Rotary encoders

Rotary encoders are each assigned a characteristic MIDI channel and controller number. They send incremental control change data in two's complement format: for example, a value of 1 indicates a single-step clockwise movement, and 7Fh (127) indicates a single-step anticlockwise movement. The theoretical highest and lowest values under this system are 3Fh (63 decimal, indicating 63 clockwise steps) and 40h (64 decimal, indicating 64 anticlockwise steps). However, as Twitch sends encoder position changes at a rate of 50 per second, it is impossible to obtain values this high.

There is no software acceleration. A complete revolution of an encoder will always produce an aggregated sum of +30 in a clockwise direction, and -30 in an anticlockwise direction.

In addition to turning, every rotary encoder has an integral push-button that can be activated by pressing it. Like the standard push-buttons, this is assigned a characteristic MIDI channel and note number. These are identical to the controller number that the encoder sends. For example, turning the browse encoder sends control change number 55h (85 decimal) on MIDI channel 8, while pressing the encoder sends note number 55h (85 decimal; C# 5) on MIDI channel 8.

## Potentiometers and faders

Potentiometers and faders send 7-bit control change messages corresponding to their absolute position, with 0 being the extreme anticlockwise, left-hand or bottom end-stop, and 7Fh (127) being the extreme clockwise, right-hand or top end-stop. This data is sent to the host at a maximum rate of 200 messages per second per control. The six EQ potentiometers, labelled 'HIGH', 'MID', and 'LOW' are centre-detented. They rest at 40h (64) on the detent.

In basic mode, the potentiometers and faders (with the exception of the cross-fader) are paged. In other words, the MIDI channel or controller number that corresponds to a physical control can change depending on the currently-selected deck or effects page. Whenever a page is changed, the current position of its potentiometers is remembered. If one is moved before a page is re-entered, it must be returned to or passed through its last position on that page before it will resume sending data. This process is often referred to as *pick-up*, and prevents unwanted jumps in value from occurring.

A consequence of this is that sending a controller change message to Twitch in basic mode that corresponds to a paged potentiometer will move its pick-up position to that value, even if that potentiometer is on the current page.

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## Basic and Advanced Modes

Twitch's controls can appear in a choice of two ways. When it is turned on, Twitch behaves as a general-purpose MIDI control surface that is designed to perform well with most software. This is *basic mode*. It is in this mode that the Traktor overlay is most useful.

When Serato ITCH is loaded, Twitch changes to a different mode of operation, called *advanced mode*. Many automatic functions of the control surface are disabled in advanced mode, and most of Twitch behaves as a simple grid of buttons. This means that a computer program can obtain absolute control over the way that Twitch responds to the user.

As a MIDI programmer, you may choose to use Twitch in either mode. In fact, there is an amount of commonality between the two modes, so simple patches or programs may be compatible with both. Using basic mode will make it easier to get started, but some of the decisions about how the control surface operates will already be made for you. Advanced mode will require more work, but will open more possibilities.

In places where the behaviour of Twitch's control surface changes substantially between basic mode and advanced mode, this manual covers the two modes in separate sections. Any illustrations pertaining to Twitch in basic mode will be shown with the Traktor overlay in place.

### Entering advanced mode and returning to basic mode

There are three ways of putting Twitch into advanced mode:

- Sending a special control change message;
- Pressing a special button combination;
- Using the appropriate System Exclusive message.

The control change message to enter advanced mode is as follows:

```
Host » Twitch:   On MIDI channel 8, set controller number 0 to value 111
                  (in hex: B7 00 6F; in decimal: 183 0 111)
```

Alternatively, holding the BACK and FWD keys [OPEN and CLOSE] while pushing the BROWSE wheel instructs Twitch to enter advanced mode, or to switch back to basic mode.

The most reliable way of returning to basic mode is with a software reset. It is good practice to send this when exiting any program:

```
Host » Twitch:   On MIDI channel 8, set controller number 0 to value 0
                  (in hex: B7 00 00; in decimal: 183 0 0)
```

The System Exclusive message is part of a more complex arbitration with Serato ITCH. Although you may encounter this message if you examine the MIDI traffic, its details are beyond the scope of this manual.

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## Getting Started

Here are some functions that are useful for diagnosis, and when a program starts, exits, or suddenly changes mode.

### Lighting all LEDs, and turning them off again

The following command lights all LEDs on Twitch. It is useful in early stages to prove that you have control of the device.

```
Host » Twitch:    On MIDI channel 8, set controller number 0 to value 127  
                  (in hex: B7 00 7F; in decimal: 183 0 127)
```

The next command turns off all LEDs. It cancels the above command effectively, but be wary of using it in basic mode, as it will not restore any LEDs that ought to be on. To initialise Twitch when you first take control of it, use the software reset described in the previous section instead.

```
Host » Twitch:    On MIDI channel 8, set controller number 0 to value 112  
                  (in hex: B7 00 70; in decimal: 183 0 112)
```

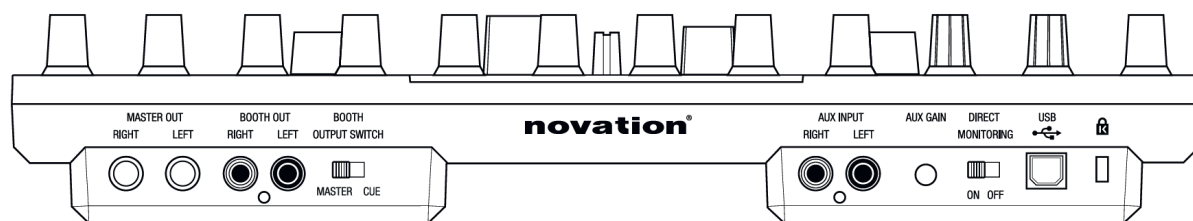
### Requesting fader and potentiometer positions

When taking control of Twitch, your program may need to ascertain the initial positions of all potentiometers, faders, and the 'direct monitoring' switch. These will be reported in response to a software reset. Alternatively, to send position data without affecting any of Twitch's settings, use the following message:

```
Host » Twitch:    On MIDI channel 8, set controller number 0 to value 1  
                  (in hex: B7 00 01; in decimal: 183 0 1)
```

In basic mode, this command returns only the values of those controls that are on the visible pages.

## Direct Monitoring



Rear panel of Twitch

There are two sliding switches on the rear panel of Twitch: the direct monitoring switch and the booth output switch. The booth output switch is connected only to Twitch's audio circuitry, and does not interact at all with the MIDI control interface.

The direct monitoring feature is under MIDI control. It allows the microphone and auxiliary inputs to be mixed straight into the master output, permitting zero-latency monitoring. By default, the slide switch automatically changes the internal audio routing. This behaviour may be overridden if, for example, a program is inserting certain effects into the signal path that might be ruined if the input signal is combined with them.

Whenever it is moved, the direct monitoring switch sends a standard MIDI note:

**Twitch » Host:** On MIDI channel 8, send note A -2 with either velocity 0 or 127  
(in hex: 97 09 00/7F; in decimal: 151 9 0/127)

7Fh (127) is returned when the direct monitoring switch is in the 'ON' position. The automatic audio routing may be overridden by sending the same MIDI note back to Twitch:

**Host » Twitch:** On MIDI channel 8, send note A -2 with a specific velocity  
(in hex: 97 09 *velocity*; in decimal: 151 9 *velocity*)

where *velocity* is:

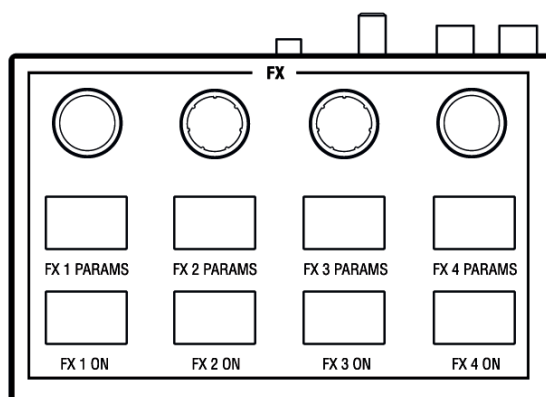
Hex	Decimal	Meaning
01–3F	1–63	Turn off direct monitoring, overriding the switch position.
40–7F	64–127	Turn on direct monitoring, overriding the switch position.
00	0	Routing is determined automatically by the position of the switch.

The power-on default is 0.

## FX Section: Basic Mode

The FX section contains two potentiometers and two encoders, assigned over five pages. Four FX PARAMS buttons automatically change between these pages, and four common FX ON buttons can be used to turn effects on and off. (The two 'FX select' encoders, not shown here, are covered in the *Central Deck Section: Basic Mode* section of this manual.)

Each FX PARAMS button selects a specific page, and pressing it will light its backlight and cancel any others. A fifth page is accessed by pushing the currently-lit FX PARAMS button so that all the LEDs in the group are extinguished.



FX section: Basic mode (with Traktor overlay)

The two potentiometers and two encoders send controller change messages according to the current page:

**Twitch » Host:** On MIDI channel 12, sends control change 0-19  
(in hex: BB 00-13 value; in decimal: 187 0-19 value)

The controller numbers are:

	No page	FX 1 page	FX 2 page	FX 3 page	FX 4 page
Left potentiometer	0	4	8	0Ch (12)	10h (16)
Left encoder	1	5	9	0Dh (13)	11h (17)
Right encoder	2	6	0Ah (10)	0Eh (14)	12h (18)
Right potentiometer	3	7	0Bh (11)	0Fh (15)	13h (19)

FX ON buttons send out the following notes on MIDI channel 12 when pressed, and their backlights may be controlled externally by returning the same notes:

FX ON 1	G# 0	20h (32)
FX ON 2	A 0	21h (33)
FX ON 3	A# 0	22h (34)
FX ON 4	B 0	23h (35)

FX PARAMS buttons send out the following notes when pressed, but may not be controlled externally:

FX PARAMS 1	E 0	1Ch (28)
FX PARAMS 2	F 0	1Dh (29)
FX PARAMS 3	F# 0	1Eh (30)
FX PARAMS 4	G 0	1Fh (31)

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## FX Section: Advanced Mode

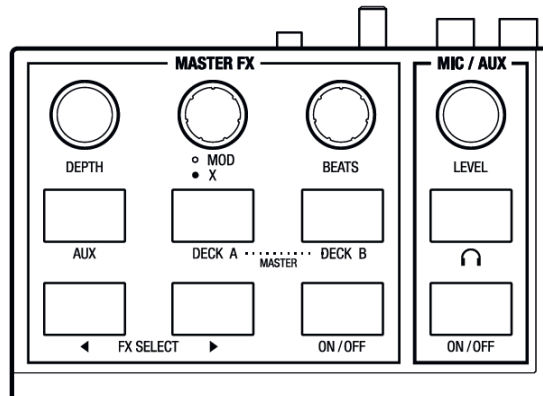
The FX and MIC/AUX sections are mapped to the following controller numbers and notes on MIDI channel 8.

### Potentiometers and Encoders

Depth		5Bh (91)
Mod/X	G# 5	5Ch (92)
Beats	A 5	5Dh (93)
Aux level		0Ch (12)

### Buttons

FX Aux	C 0	18h (24)
FX Deck A	C# 0	19h (25)
FX Deck B	D 0	1Ah (26)
FX Select ◀	D# 0	1Bh (27)
FX Select ▶	E 0	1Ch (28)
FX On/Off	F 0	1Dh (29)
Aux 🎧	B -2	0Bh (11)
Aux On/Off	C -1	0Ch (12)



FX section: Advanced mode

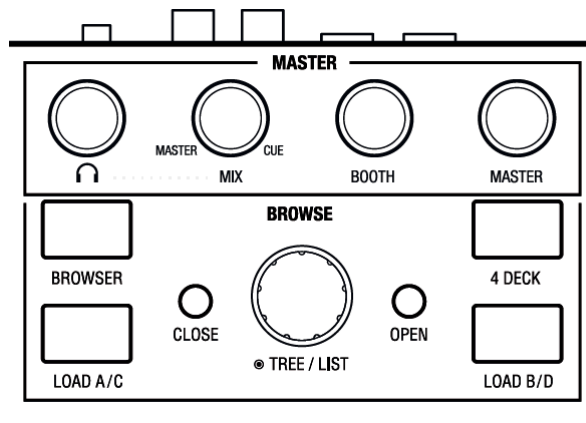


## Browse Section

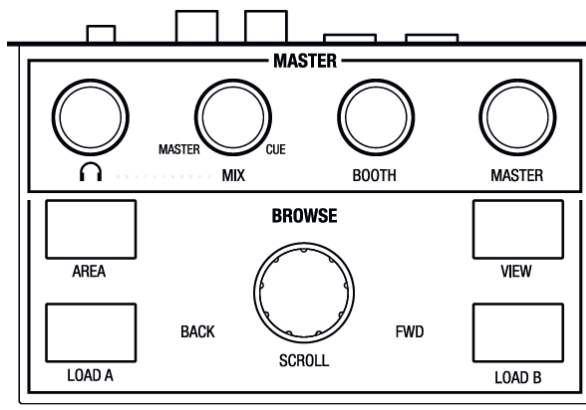
These controls behave identically in either mode: only the printed legend is different. The four potentiometers at the top of the section are audio-only controls: they are not accessible by MIDI.

The browse encoder is mapped to controller and note C# 5, number 55h (85) on MIDI channel 8. All other buttons are mapped to the following notes on MIDI channel 8:

Name (basic)	Name (advanced)	Note
Browser	Area	G# 4 50h (80)
4 Deck	View	A 4 51h (81)
Load A/C	Load A	A# 4 52h (82)
Load B/D	Load B	B 4 53h (83)
Close	Back	C 5 54h (84)
Open	Fwd	D 5 56h (86)

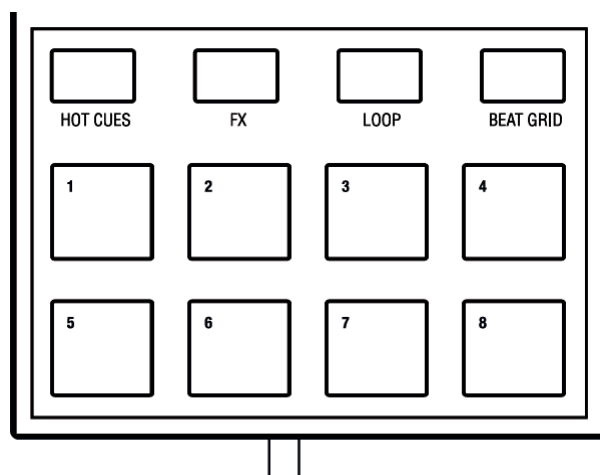


Browse section: Basic mode (with Traktor overlay)



Browse section: Advanced mode

## Performance Section: Basic Mode



Performance section: Basic mode (with Traktor overlay)

When assigned to Deck A, the left-hand performance section sends and responds to MIDI channel 8. As Deck C, it communicates over MIDI channel 10. The right-hand section sends and responds to MIDI channel 9 as Deck B, and MIDI channel 11 as Deck D.

The four performance mode buttons send the following notes when the mode is changed:

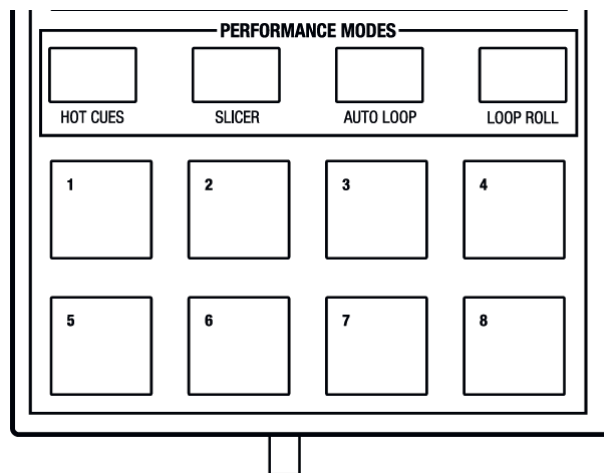
Name	Note
Hot Cues	G# 2 38h (56)
FX	A 2 39h (57)
Loop	A# 2 3Ah (58)
Beat Grid	B 2 3Bh (59)

The performance pads on each side of Twitch are paged according to the performance mode. All button backlights are stored and updated automatically over all four decks, so that they reflect the state of the currently selected deck and page. Note numbers in the four pages are arranged contiguously, as follows:

	Pad 1	Pad 2	Pad 3	Pad 4
<b>Hot Cues</b>	C 6 60h (96)	C# 6 61h (97)	D 6 62h (98)	D# 6 63h (99)
<b>FX</b>	G# 6 68h (104)	A 6 69h (105)	A# 6 6Ah (106)	B 6 6Bh (107)
<b>Loop</b>	E 7 70h (112)	F 7 71h (113)	F# 7 72h (114)	G 7 73h (115)
<b>Beat Grid</b>	C 8 78h (120)	C# 8 79h (121)	D 8 7Ah (122)	D# 8 7Bh (123)
	Pad 5	Pad 6	Pad 7	Pad 8
<b>Hot Cues</b>	E 6 64h (100)	F 6 65h (101)	F# 6 66h (102)	G 6 67h (103)
<b>FX</b>	C 7 6Ch (108)	C# 7 6Dh (109)	D 7 6Eh (110)	D# 7 6Fh (111)
<b>Loop</b>	G# 7 74h (116)	A 7 75h (117)	A# 7 76h (118)	B 7 77h (119)
<b>Beat Grid</b>	E 8 7Ch (124)	F 8 7Dh (125)	F# 8 7Eh (126)	G 8 7Fh (127)

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## Performance Section: Advanced Mode



Performance section: Advanced mode

The left-hand performance section sends and responds to MIDI channel 8. The right-hand section sends and responds to MIDI channel 10.

The four performance mode buttons send the following notes:

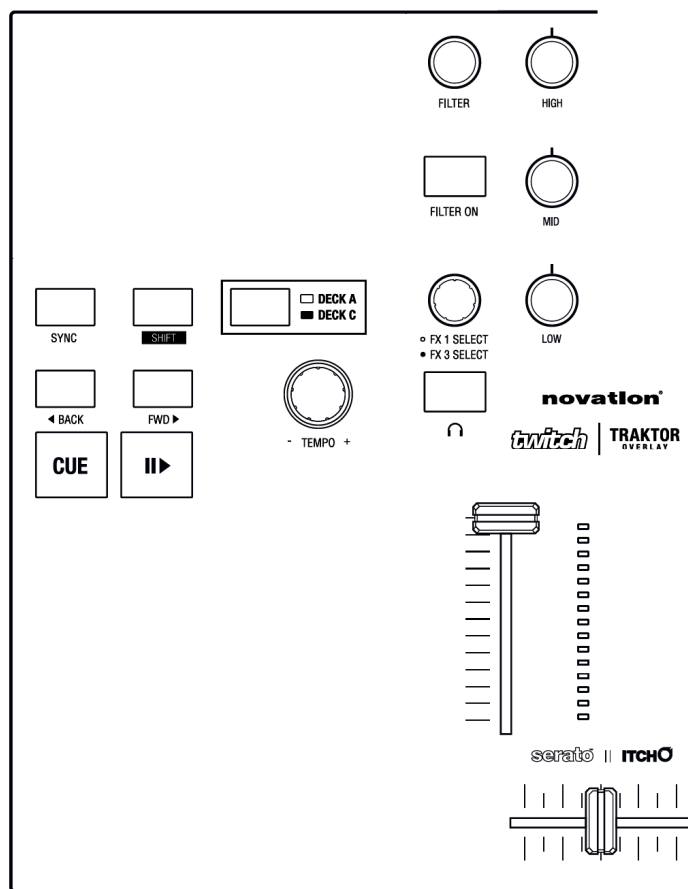
Name	Note
Hot Cues	G# 2 38h (56)
Slicer	A 2 39h (57)
Auto Loop	A# 2 3Ah (58)
Loop Roll	B 2 3Bh (59)

In advanced mode, these behave as simple buttons: their backlights may be programmed normally, there is no automatic functionality associated with them, and there is only one logical page for the performance pads.

Performance pads send and respond to the following MIDI notes:

Pad	Note
1	C 3 3Ch (60)
2	C# 3 3Dh (61)
3	D 3 3Eh (62)
4	D# 3 3Fh (63)
5	E 3 40h (64)
6	F 3 41h (65)
7	F# 3 42h (66)
8	G 3 43h (67)

## Central Deck Section: Basic Mode



Central deck section: Basic mode (with Traktor overlay)

The controls for Decks A and C are shown in the illustration above, and those for Decks B and D are a mirror image. Also shown is the crossfader, which is shared between the decks. It is not affected by the deck toggle buttons, and always sends data on controller number 8 on MIDI channel 8.

The FX select encoders are also unaffected by the deck toggle state. The left encoder always sends data as controller number 6 (note F# -2 when pushed) on MIDI channel 8, and the right encoder similarly on MIDI channel 9.

All other controls are paged according to the state of the deck toggle buttons. When pressed, these toggle buttons send note C -2 (0) on MIDI channel 8 for decks A/C, and channel 9 for decks B/D. Each backlight illuminates automatically to indicate that deck C or deck D is active. The four decks are assigned MIDI channels as follows:

Deck	MIDI channel	Status byte examples
A	8	97h (151: note on); B7h (183: control change)
B	9	98h (162: note on); B8h (184: control change)
C	10	99h (163: note on); B9h (185: control change)
D	11	9Ah (164: note on); BAh (186: control change)

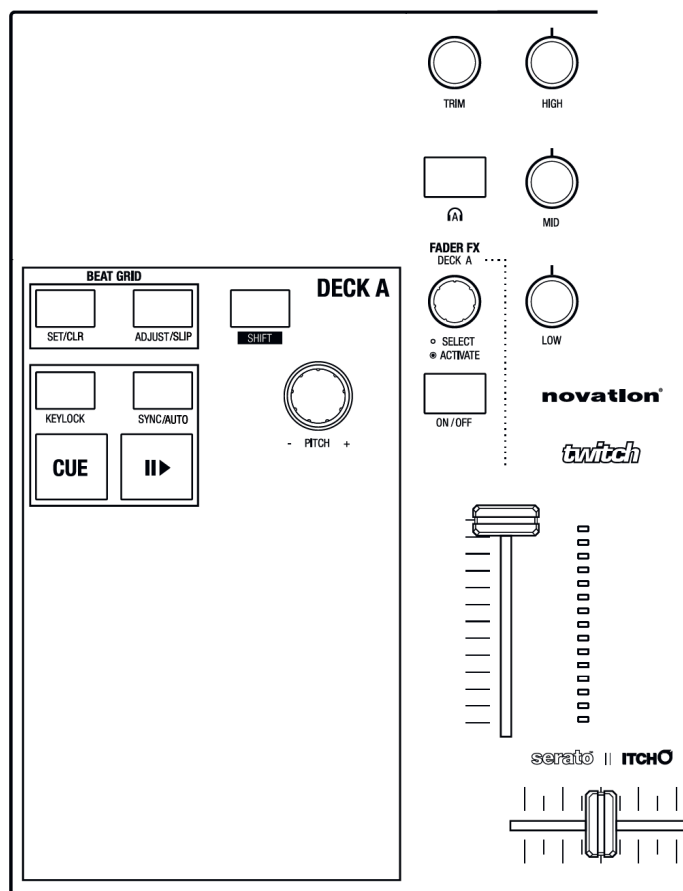
Continuous controls are assigned the following controller and note numbers:

Tempo encoder	D#-2	3
Main fader		7
Trim		9
Low EQ		46h (70)
Mid EQ		47h (71)
High EQ		48h (72)

Buttons are given these note numbers:

Sync	E -1	10h (16)
SHIFT	F -1	11h (17)
Back ◀	F#-1	12h (18)
Fwd ▶	G -1	13h (19)
Cue	A#-1	16h (22)
Play/Pause	B -1	17h (23)
Filter on	A#-2	0Ah (10)
🔊	C#-1	0Dh (13)

## Central Deck Section: Advanced Mode



Central deck section: Advanced mode

The central controls for Deck A are shown above. Those for deck B are a mirror image. Deck A is assigned MIDI channel 8, and deck B MIDI channel 9. The crossfader is assigned controller number 8 on MIDI channel 8.

Rotary controls and faders are assigned the following controller and note numbers:

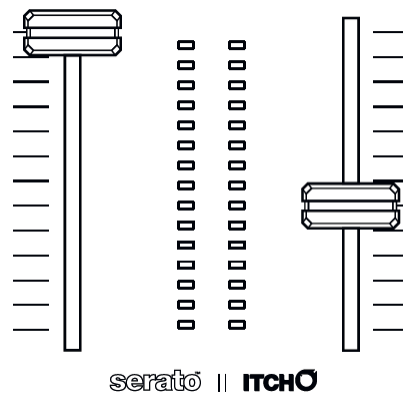
Pitch encoder	D#-2	3
FX encoder	F#-2	6
Main fader		7
Trim		9
Low EQ		46h (70)
Mid EQ		47h (71)
High EQ		48h (72)

Buttons are given these note numbers:

Set/Clr	E -1	10h (16)
Adjust/Slip	F -1	11h (17)
Shift	C -2	0
Keylock	F#-1	12h (18)
Sync/Auto	G -1	13h (19)
Cue	A#-1	16h (22)
Play/Pause	B -1	17h (23)
A/B	A#-2	0Ah (10)
Fader FX on	C#-1	0Dh (13)

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## Central Deck Section: LED meters



The LED meters, comprising two 15-segment LED bars, are paged over the four decks in basic mode. Communication therefore takes place on MIDI channels 8-11. In advanced mode, only channels 8 and 9 are used, for the left and right meter respectively.

There are three ways of sending LED data, each requiring a different MIDI note on message:

**Host » Twitch:** On MIDI channel 8-11, send note F# 5, A# 5, or B 5.  
(in hex: 97-9A 5A/E/F *velocity*; in decimal: 151-154 90/4/5 *velocity*)

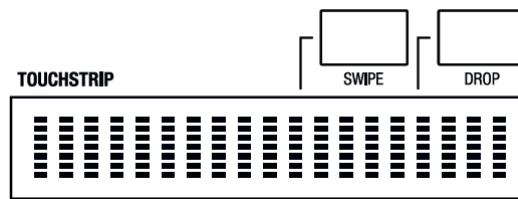
where the note number is one of three values:

F# 5	5Ah (90)	Illuminates a single spot of light.
A# 5	5Eh (94)	Illuminates a solid bar.
B 5	5Fh (95)	Illuminates a solid bar with automatic decay ballistics (for audio level metering).

A velocity of 0 turns the meter off; 1 shows a single spot; 7Fh (127) is full deflection.

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## Touchstrips: Basic Mode



In basic mode, the SWIPE and DROP buttons and backlights are administered automatically by Twitch, and neither send nor respond to MIDI data. They affect the type of data sent by the touch strip. Once in DROP mode, Twitch will revert to SWIPE as soon as the touch strip is released or the deck A/C or B/D button is pressed. The MIDI channel used for communication depends on the currently active deck. See *Central Deck Section: Basic Mode* for more detailed information.

When a finger is placed on a touch strip, a note on message is sent with note B 3, number 47h (71) and a velocity of 1–7Fh (127) according to the finger position along the strip with, for example, 1 specifying a touch on the left edge, and 127 the right. A note message is sent with velocity zero when the user's finger is released.

In SWIPE mode, incremental two's complement data is sent on controller number 35h (53) according to the speed with which the finger is moved. This is equivalent to touch strip mode 14h (20) in advanced mode. In DROP mode, absolute position information is sent continuously on controller number 34h (52), from 0 to 7F (127). This is equivalent to mode 2 in advanced mode.

By default, the touch strip is gently backlit, and a stripe automatically lights to track the position of the user's finger. This can be turned off or overridden using the following message:

```
Host » Twitch:   On MIDI channel 8/9, send controller number 21.  
                 (in hex: B7/8 15 value; in decimal: 183/4 21 value)
```

Set *value* to:

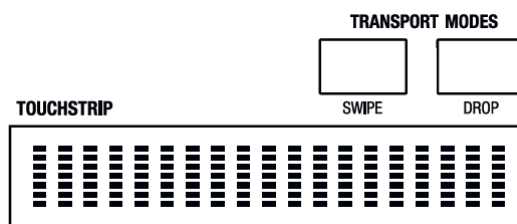
- 0 to turn off the backlight completely;
- 1-3 to turn on the backlight with increasing intensity;
- 10h (16) to turn off the backlight and disable the finger-following stripe;
- 11–13h (17–19) turn on the backlight as above, but disable the finger-following stripe.

Once the finger-following has been turned off, the backlights can be programmed as specified in advanced mode. Note that this message affects the left and right touch strip irrespective of the currently selected deck.



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## Touchstrips: Advanced Mode



In advanced mode, the left touch strip communicates on MIDI channel 8, and the right touch strip on MIDI channel 9. The SWIPE and DROP buttons communicate using note G# -1 and A -1, numbers 14h (20) and 15h (21) respectively, and do not automatically alter the behaviour of the touch strips.

As with basic mode, placing a finger on a touch strip sends a note on message from note B 3, number 47h (71), with a velocity of 1-7Fh (127), according to the finger position along the strip. A note message with velocity zero is sent when the user's finger is released.

Advanced mode presents a large number of options for sending continuous data from the touch strip. The touch strip is capable of 9-bit absolute position data: this permits a spatial resolution of about 0.2mm along the touch strip, but means that a variation of MIDI's 14-bit controller convention must be applied. In sending 9-bit data, the top two bits are conveyed whenever they change, using controller number 14h or 16h (20 or 22) while the remaining seven bits are conveyed in controller number 34h or 36h (52 or 54). In relative position data, a tenth bit is used as a sign bit.

The data mode is selected using the following control change message:

**Host » Twitch:**     **On MIDI channel 8/9, send controller number 20.**  
                          (in hex: B7/8 14 *value*; in decimal: 183/4 20 *value*)

where *value* determines the mode as follows:

- |          |   |
|----------|---|
| 0        | Send 9-bit absolute position over controllers 34h and 14h (52 and 20).  |
| 1        | ... also send pinch gesture data, when detected, over controller 37h (55).  |
| 2        | Send 7-bit absolute data over controller 34h (52) only.   |
| 3        | ... also send pinch gesture data, when detected, over controller 37h (55).  |
| 10h (16) | Send 7-bit incremental data over controller 35h (53).   |
| 11h (17) | ... with faster damping following a fling gesture.  |
| 12h (18) | ... with strict linearity, so that a movement of a certain distance always produces a repeatable increment.         |
| 13h (19) | ... with strict linearity and faster damping.   |
| 14h (20) | ... with sensitivity, weighting, and damping optimised for Traktor.   |
| 20h (32) | Send 9-bit relative position data over controller 36h and 16h (54 and 22).  |
| 21h (33) | ... with finger position measured relative to the centre of the strip, rather than the first area that was touched. |
| 22h (34) | ... without the sprung return to zero.  |
| 23h (35) | ... with finger position measured relative to the centre of the strip, but without the sprung return to zero.       |

30h (48) No data sent apart from the initial note on and terminal note off.  
40h (64) No data sent at all.

The incremental data modes also feature fling gestures so that, when a travelling finger is removed from the touch strip, sent data comes to a gentle stop rather than ceasing abruptly. Under some circumstances, it is desirable to halt this data. Another control change message is therefore provided to brake all momentum-based effects immediately:

**Host » Twitch:** On MIDI channel 8/9, set controller number 41 to 0.  
(in hex: B7/8 29 0; in decimal: 183/4 41 0)

As in basic mode, the backlights for the light guides are changed using the following control change message:

**Host » Twitch:** On MIDI channel 8/9, send controller number 21.  
(in hex: B7/8 16 *value*; in decimal: 183/4 21 *value*)

Set *value* to:

10h (16) to turn off the backlight;  
11–13h (17–19) turn on the backlight with increasing intensity.

To light a spot on the backlight, send the following control change message:

**Host » Twitch:** On MIDI channel 8/9, send controller number 22.  
(in hex: B7/8 16 *value*; in decimal: 183/4 22 *value*)

where *value* is 0 to turn off the spot, and 1–7Fh (127) to steer the spot from the left to the right of the meter.

Alternatively, more subtle control over the touch strip lighting pattern may be obtained using the following System Exclusive message (which involves a little more knowledge of MIDI):

**Host » Twitch:** Hex F0 00 20 29 00 16 *data[10 bytes]* F7  
Decimal 240 0 32 41 0 22 *data[10 bytes]* 247

The first data byte is given by 10h (16) to control the left touch strip LEDs, 20h (32) to control the right touch strip LEDs, or 30h (48) to control both simultaneously. To this byte is added an intensity for the leftmost backlight LED, from 0 to 7. The remaining nine data bytes give the intensities of the remaining 18 LEDs. Adjacent pairs of LEDs are encoded in each byte as follows:

10h (16) × intensity of LED on the left side of the pair + intensity of LED on the right side of the pair.

The intensity limits are 0 to 7.