

# Designing MIDI Controllers for Flux

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## **Sending NRPN Values**

NRPNs (Non-Registered Parameter-Numbers) offer the ability to send 14 bit parameter values (a value range of up to 16,384) to control parameters that cannot be controlled in full by the standard 0-127 value range of MIDI CC messages. This is achieved by sending more than one set of controller data to represent the value that you wish to transmit.

4 controller messages are used to send a single NRPN message. The controller numbers used are:

*2 parameter address messages:*

99 (Most Significant Byte (MSB))

98(Least Significant Byte (LSB))

*2 value messages:*

6(MSB)

38(LSB)

Each of these bytes offer 128 possible values. Controller 6 offers ‘coarse’ 128 value steps while controller 38 offers ‘fine’ single value steps in the sent message. The following simple equations can be used to split any 14-bit value into a MSB and LSB.

$$\text{input}/128 = \text{MSB (all decimal places should be truncated)}$$

$$\text{input}\%128 = \text{LSB}$$

### **An Example Message**

The same logic applies to the parameter selection messages (99 and 98). For example, to send a parameter value of 1000 to parameter number 129:

*Parameter Number calc:*

$$\text{input}/128 = \text{MSB}$$

$$\text{input}\%128 = \text{LSB}$$

$$129/128 = 1$$

$$129\%128 = 1$$

$$\text{Controller 99} = 1$$

$$\text{Controller 98} = 1$$

*Value Calc:*

$$\text{input}/128 = \text{MSB}$$

$$\text{input}\%128 = \text{LSB}$$

$$1000/128 = 7$$

$$1000\%128 = 104$$

$$\text{Controller 6} = 7$$

*Controller 38 = 104*

In the above example, our full message would be controller 99 = 1, controller 98 = 1, controller 6 = 7 and controller 38 = 104. This set of messages would set parameter number 129 to value 1000.

As demonstrated, a total of 4 sets of controller data are used to send an NRPN to control a Flux parameter. Some NRPN implementations send an 'end message' to confirm that all NRPN data sets have been sent. In the interest of efficiency, Flux does not use this method. Flux offers thousands of MIDI destinations, so to minimize data transfers Flux concludes that all NRPN messages have been received when a controller 38 message is received. When designing your Flux controller, make sure that controller message 38 is sent last in your set of NRPN messages. The order of the other 3 controller messages is arbitrary in the Flux implementation.

Only parameters with a range greater than 128 values use NRPN, all other Flux parameters are addressed using standard MIDI CC messages.

## MIDI Notes Out

There are 12 MIDI note outputs sent when Flux is running, 1 main rhythm output and 2 auxiliary rhythm outputs per channel. MIDI note velocity can be set to a fixed value or modulated with CV from any of the 4 Flux channels (modes are found on the config page of the Flux UI). All note outputs are sent on MIDI channel 10 and specific MIDI note outputs can be found in the following table:

Flux Ch	Main Output	Aux 1	Aux 2	Main Output Note	Aux 1 Note	Aux 2 Note
1	35	36	37	B0	C1	C#1
2	38	39	40	D1	D#1	E1
3	41	42	43	F1	F#1	G1
4	44	45	46	G#1	A1	A#1

## Burst Mode

Burst mode uses a single step on each channel that can be triggered via the 4 gate inputs or via MIDI note on messages. While the module still references the internal BPM, channels may be triggered at any interval. If a second trigger is received before the burst has concluded, it will retrigger from the beginning. The step to trigger can be selected with the LAST parameter.

In burst mode, compression and expansion are not limited to the end of the step length. Compression and expansion can therefore be used to alter the effective BPM of each channel individually by shortening or elongating the rhythm created by the selected step's parameters.

The following notes trigger each channel in burst mode:

Flux Ch	MIDI Ch	Note	Midi Note No
1	10	G0	31
2	10	G#0	32
3	10	A0	33
4	10	A#0	34

## **Using MIDI Charts**

A full MIDI implementation chart is provided below. All parameter numbers for the 4 Flux channels are identical. MIDI channels are used to determine which Flux channel parameter is the desired destination.

To address a specific step on a specific channel a step select parameter number is provided. This is much more efficient than providing an address for all 16 steps' parameters. When designing your controller, make sure to send a step select message before sending messages to a steps' parameters. You only need to send a step select message once, then update all parameters that you wish to. Send a different step select message to begin addressing the parameters of another step.

When designing your controller, UI elements should be limited to the parameter range listed to avoid a circumstance in which the UI is displaying values that are outside of the destination parameter range. Flux will check all incoming messages for values that are outside of the parameter range and clip values at either extreme.

### *Main UI Messages*

MIDI Channel 1 = Flux Main UI Channel 1

MIDI Channel 2 = Flux Main UI Channel 2

MIDI Channel 3 = Flux Main UI Channel 3

MIDI Channel 4 = Flux Main UI Channel 4

### *Modulation Messages*

MIDI Channel 5 = Flux Evolve/Macro Pots/CV Inputs Channel 1

MIDI Channel 6 = Flux Evolve/Macro Pots/CV Inputs Channel 2

MIDI Channel 7 = Flux Evolve/Macro Pots/CV Inputs Channel 3

MIDI Channel 8 = Flux Evolve/Macro Pots/CV Inputs Channel 4

**Standard CC Charts (non-NRPN)**

**Main UI (selected with messages sent on MIDI Chs 1-4):**

Controller	Parameter	Value Range	MIDI Ch	16 steps?	Notes
1	Density	0-64	1,2,3,4	Y	
2	Gate Length	10-90	1,2,3,4	Y	
3	Curve Select	1-58	1,2,3,4	Y	
4	Diff	0-100	1,2,3,4	Y	Now NRPN 16 (0-200)
5	Last	1-16	1,2,3,4	N	Now NRPN 15 (1-136)
7	Mod	1-8	1,2,3,4	Y	
8	Step Length	1-64	1,2,3,4	Y	
9	Humanize	0-127	1,2,3,4	Y	
10	Mask Select	0-17	1,2,3,4	Y	
11	Mask Shift	0-64	1,2,3,4	Y	
12	Aux 1	0-94	1,2,3,4	N Now Y	Now NRPN 17 (0-182)
14	Aux 2	0-94	1,2,3,4	N Now Y	Now NRPN 18 (0-182)
15	CV Mode	0-5	1,2,3,4	Y	
16	Sample & Hold	0-1	1,2,3,4	Y	
17	Attack	0-100	1,2,3,4	Y	
18	Release	0-100	1,2,3,4	Y	
19	Sync	0-1	1,2,3,4	Y	
20	Quant Nodes	0-24	1,2,3,4	Y	
21	Quant Point 1	0-1	1,2,3,4	Y	
22	Quant Point 2	0-1	1,2,3,4	Y	
23	Quant Point 3	0-1	1,2,3,4	Y	
24	Quant Point 4	0-1	1,2,3,4	Y	
25	Quant Point 5	0-1	1,2,3,4	Y	
26	Quant Point 6	0-1	1,2,3,4	Y	
27	Quant Point 7	0-1	1,2,3,4	Y	
28	Quant Point 8	0-1	1,2,3,4	Y	
29	Quant Point 9	0-1	1,2,3,4	Y	
30	Quant Point 10	0-1	1,2,3,4	Y	
31	Quant Point 11	0-1	1,2,3,4	Y	
32	Quant Point 12	0-1	1,2,3,4	Y	
33	Quant Point 13	0-1	1,2,3,4	Y	
34	Quant Point 14	0-1	1,2,3,4	Y	
35	Quant Point 15	0-1	1,2,3,4	Y	
36	Quant Point 16	0-1	1,2,3,4	Y	
37	Quant Point 17	0-1	1,2,3,4	Y	
39	Quant Point 18	0-1	1,2,3,4	Y	
40	Quant Point 19	0-1	1,2,3,4	Y	
41	Quant Point 20	0-1	1,2,3,4	Y	
42	Quant Point 21	0-1	1,2,3,4	Y	
43	Quant Point 22	0-1	1,2,3,4	Y	
44	Quant Point 23	0-1	1,2,3,4	Y	
45	Quant Point 24	0-1	1,2,3,4	Y	
46	Shuffle 16th	2-64	1,2,3,4	N	
47	Clock Source	0-4	1,2,3,4	N	
48	PPQN	0-6	1,2,3,4	N	

49	Generator Mode	0-1	1,2,3,4	N	
50	Generator Steps	1-16	1,2,3,4	N	
51	Generator Density	1-16	1,2,3,4	N	
52	Steps On/Off	0-32	1,2,3,4	N	All 16 step on/off destinations can be controlled with the value of this message. A message of 0 switches step 1 off. A message of 1 switches step 1 on. A message of 2 switches step 2 off etc
53	Start Stop	0-1	1,2,3,4	N	
54	Outputs On/Off (this feature is available over MIDI only)	0-32	1,2,3,4	N	All 16 step outputs can be switched on/off with the value of this message. A message of 0 switches output 1 off. A message of 1 switches output 1 on. A message of 2 switches output 2 off etc
55	Step Select	1-16	1,2,3,4	N	This message is used to target the parameters of a specific step. This message should be sent before the parameter messages.



**Modulation UI (MIDI Chs 5-8):**

Controller	Parameter	Value Range	Midi CH	Notes
<b>Evolve</b>				
1	VCA Max	0-100	5,6,7,8	
2	Probability %	0-100	5,6,7,8	
3	Gate Max	0-80	5,6,7,8	
4	Gate %	0-100	5,6,7,8	
5	Density Max	0-64	5,6,7,8	
7	Density %	0-100	5,6,7,8	
8	Curve Select Max	0-58	5,6,7,8	
9	Curve Select %	0-100	5,6,7,8	
10	Curvature Value %	0-100	5,6,7,8	
11	Diff Max	0-100	5,6,7,8	
12	Diff %	0-100	5,6,7,8	
13	Comp Max	0-100	5,6,7,8	
14	Comp %	0-100	5,6,7,8	
15	Phase Shift %	0-100	5,6,7,8	
16	Humanize Max	0-127	5,6,7,8	
17	Humanize %	0-100	5,6,7,8	
18	Mask Max	0-17	5,6,7,8	
19	Mask %	0-100	5,6,7,8	
20	Mask Shift Max	0-64	5,6,7,8	
21	Mask Shift %	0-100	5,6,7,8	
22	MinV Min %	0-100	5,6,7,8	
23	MaxV %	0-100	5,6,7,8	
24	Attack Max	0-100	5,6,7,8	
25	Attack %	0-100	5,6,7,8	
26	Release Max	0-100	5,6,7,8	
27	Release %	0-100	5,6,7,8	
28	Acurve %	0-100	5,6,7,8	
29	Rcurve %	0-100	5,6,7,8	
30	Frequency %	0-100	5,6,7,8	
31	Shuffle %	0-100	5,6,7,8	
32	Shuffle 16 <sup>th</sup> Max	0-64	5,6,7,8	
33	Shuffle 16 <sup>th</sup> %	0-100	5,6,7,8	
34	BPM %	0-100	5,6,7,8	
<b>Macro Pots</b>				
35	VCA Bus	0-2	5,6,7,8	
36	Gate Bus	0-2	5,6,7,8	
37	Density Bus	0-2	5,6,7,8	
39	Value Bus	0-2	5,6,7,8	
40	Diff Bus	0-2	5,6,7,8	
41	Comp Bus	0-2	5,6,7,8	
42	Phase Bus	0-2	5,6,7,8	
43	Humanize Bus	0-2	5,6,7,8	

44	Mask > Bus	0-2	5,6,7,8	
45	MinV Bus	0-2	5,6,7,8	
46	MaxV Bus	0-2	5,6,7,8	
47	Attack Bus	0-2	5,6,7,8	
48	Release Bus	0-2	5,6,7,8	
49	Acurve Bus	0-2	5,6,7,8	
50	Rcurve Bus	0-2	5,6,7,8	
51	Frequency Bus	0-2	5,6,7,8	
	<b>CV Inputs</b>			
52	VCA Bus	0-2	5,6,7,8	
53	Gate Bus	0-2	5,6,7,8	
54	Density Bus	0-2	5,6,7,8	
55	Value Bus	0-2	5,6,7,8	
56	Diff Bus	0-2	5,6,7,8	
57	Comp Bus	0-2	5,6,7,8	
58	Phase Bus	0-2	5,6,7,8	
59	Humanize Bus	0-2	5,6,7,8	
60	Mask > Bus	0-2	5,6,7,8	
61	MinV Bus	0-2	5,6,7,8	
62	MaxV Bus	0-2	5,6,7,8	
63	Attack Bus	0-2	5,6,7,8	
64	Release Bus	0-2	5,6,7,8	
65	Acurve Bus	0-2	5,6,7,8	
66	Rcurve Bus	0-2	5,6,7,8	
67	Frequency Bus	0-2	5,6,7,8	

**NRPN Charts**

**Main UI NRPNs (MIDI Chs 1-4):**

Controller	Parameter	Flux Range	MIDI Range	MIDI Ch	Notes
1	Curve Value	-20.00-20.00	0-4000	1,2,3,4	
2	Probability	0-200	0-200	1,2,3,4	TR0-100% = 0-100. ST1-100% = 101-200.
3	Phase Shift	0-359	0-359	1,2,3,4	
4	Compression	-100-99	0-200	1,2,3,4	
5	MinV	0-8000	0-8000	1,2,3,4	MinV should not exceed MaxV or it will be clipped
6	MaxV	0-8000	0-8000	1,2,3,4	
7	Acurve	-2000-2000	0-4000	1,2,3,4	
8	Rcurve	-2000-2000	0-4000	1,2,3,4	
9	Freq	.01-20.00	1-2000	1,2,3,4	
10	BPM	1-499	1-499	1,2,3,4	
11	Shuffle	0-315	0-315	1,2,3,4	
12	Main Out MIDI Velocity mode	0-304	0-304	1,2,3,4	
13	Aux 1 MIDI Velocity Mode	0-304	0-304	1,2,3,4	
14	Aux 2 MIDI Velocity Mode	0-304	0-304	1,2,3,4	

**Modulation NRPNs (MIDI Chs 5-8):**

Controller	Parameter	Flux Range	MIDI Range	MIDI CH	Notes
<b>Evolve</b>					
1	VCA Length	0-1024	0-1024	5,6,7,8	
2	VCA LFO	0-611	0-611	5,6,7,8	
3	Prob Length	0-1024	0-1024	5,6,7,8	
4	Prob LFO	0-611	0-611	5,6,7,8	
5	Prob Max	0-200	0-200	5,6,7,8	
6	Gate Length	0-1024	0-1024	5,6,7,8	
7	Gate LFO	0-611	0-611	5,6,7,8	
8	Density Length	0-1024	0-1024	5,6,7,8	
9	Density LFO	0-611	0-611	5,6,7,8	
10	Curve Length	0-1024	0-1024	5,6,7,8	
11	Curve LFO	0-611	0-611	5,6,7,8	

12	Value Max	0.00-10.00	0-1000	5,6,7,8	
13	Value Length	0-1024	0-1024	5,6,7,8	
14	Value LFO	0-611	0-611	5,6,7,8	
15	Diff Length	0-1024	0-1024	5,6,7,8	
16	Diff LFO	0-611	0-611	5,6,7,8	
17	Comp Length	0-1024	0-1024	5,6,7,8	
18	Comp LFO	0-611	0-611	5,6,7,8	
19	Phase Max	0-359	0-359	5,6,7,8	
20	Phase Length	0-1024	0-1024	5,6,7,8	
21	Phase LFO	0-611	0-611	5,6,7,8	
22	Humanize Length	0-1024	0-1024	5,6,7,8	
23	Humanize LFO	0-611	0-611	5,6,7,8	
24	Mask Sel Length	0-1024	0-1024	5,6,7,8	
25	Mask Sel LFO	0-611	0-611	5,6,7,8	
26	Mask > Length	0-1024	0-1024	5,6,7,8	
27	Mask > LFO	0-611	0-611	5,6,7,8	
28	MinV Max			5,6,7,8	
29	MinV Length	0-1024	0-1024	5,6,7,8	
30	MinV LFO	0-611	0-611	5,6,7,8	
31	MaxV Max	0-8000	0-8000	5,6,7,8	
32	MaxV Length	0-1024	0-1024	5,6,7,8	
33	MaxV LFO	0-611	0-611	5,6,7,8	
34	Attack Length	0-1024	0-1024	5,6,7,8	
35	Attack LFO	0-611	0-611	5,6,7,8	
36	Release Length	0-1024	0-1024	5,6,7,8	
37	Release LFO	0-611	0-611	5,6,7,8	
38	Acurve Max	0.00-10.00	0-1000	5,6,7,8	
39	Acurve Length	0-1024	0-1024	5,6,7,8	
40	Acurve LFO	0-611	0-611	5,6,7,8	
41	Rcurve Max	0.00-10.00	0-1000	5,6,7,8	
42	Rcurve Length	0-1024	0-1024	5,6,7,8	
43	Rcurve LFO	0-611	0-611	5,6,7,8	
44	Freq Max	0.00-20.00	0-2000	5,6,7,8	
45	Freq Length	0-1024	0-1024	5,6,7,8	
46	Freq LFO	0-611	0-611	5,6,7,8	
47	Shuffle Max	0-315	0-315	5,6,7,8	
48	Shuffle Length	0-1024	0-1024	5,6,7,8	
49	Shuffle LFO	0-611	0-611	5,6,7,8	
50	Shuffle 16 <sup>th</sup> Length	0-1024	0-1024	5,6,7,8	
51	Shuffle 16 <sup>th</sup> LFO	0-611	0-611	5,6,7,8	

52	BPM Max	0-499	0-499	5,6,7,8	
53	BPM Length	0-1024	0-1024	5,6,7,8	
54	BPM LFO	0-611	0-611	5,6,7,8	
	<b>Macro Pots</b>				
55	VCA 1	-100-100	0-201	5,6,7,8	
56	VCA 2	-100-100	0-201	5,6,7,8	
57	VCA 3	-100-100	0-201	5,6,7,8	
58	VCA 4	-100-100	0-201	5,6,7,8	
59	Gate 1	-80-80	0-161	5,6,7,8	
60	Gate 2	-80-80	0-161	5,6,7,8	
61	Gate 3	-80-80	0-161	5,6,7,8	
62	Gate 4	-80-80	0-161	5,6,7,8	
63	Density 1	-64-64	0-129	5,6,7,8	
64	Density 2	-64-64	0-129	5,6,7,8	
65	Density 3	-64-64	0-129	5,6,7,8	
66	Density 4	-64-64	0-129	5,6,7,8	
67	Value 1	-10.00-10.00	0-2001	5,6,7,8	
68	Value 2	-10.00-10.00	0-2001	5,6,7,8	
69	Value 3	-10.00-10.00	0-2001	5,6,7,8	
70	Value 4	-10.00-10.00	0-2001	5,6,7,8	
71	Diff 1	-100-100	0-201	5,6,7,8	
72	Diff 2	-100-100	0-201	5,6,7,8	
73	Diff 3	-100-100	0-201	5,6,7,8	
74	Diff 4	-100-100	0-201	5,6,7,8	
75	Comp 1	-100-100	0-201	5,6,7,8	
76	Comp 2	-100-100	0-201	5,6,7,8	
77	Comp 3	-100-100	0-201	5,6,7,8	
78	Comp 4	-100-100	0-201	5,6,7,8	
79	Phase 1	-359-359	0-719	5,6,7,8	
80	Phase 2	-359-359	0-719	5,6,7,8	
81	Phase 3	-359-359	0-719	5,6,7,8	
82	Phase 4	-359-359	0-719	5,6,7,8	
83	Humanize 1	-127-127	0-255	5,6,7,8	
84	Humanize 2	-127-127	0-255	5,6,7,8	
85	Humanize 3	-127-127	0-255	5,6,7,8	
86	Humanize 4	-127-127	0-255	5,6,7,8	
87	Mask> 1	-64-64	0-129	5,6,7,8	
88	Mask> 2	-64-64	0-129	5,6,7,8	
89	Mask> 3	-64-64	0-129	5,6,7,8	
90	Mask> 4	-64-64	0-129	5,6,7,8	
91	MinV 1	-8000-8000	0-16001	5,6,7,8	
92	MinV 2	-8000-8000	0-16001	5,6,7,8	
93	MinV 3	-8000-8000	0-16001	5,6,7,8	
94	MinV 4	-8000-8000	0-16001	5,6,7,8	
95	MaxV 1	-8000-8000	0-16001	5,6,7,8	
96	MaxV 2	-8000-8000	0-16001	5,6,7,8	
97	MaxV 3	-8000-8000	0-16001	5,6,7,8	



154	Phase 2	-359-359	0-719	5,6,7,8	
155	Phase 3	-359-359	0-719	5,6,7,8	
156	Phase 4	-359-359	0-719	5,6,7,8	
157	Humanize 1	-127-127	0-255	5,6,7,8	
158	Humanize 2	-127-127	0-255	5,6,7,8	
159	Humanize 3	-127-127	0-255	5,6,7,8	
160	Humanize 4	-127-127	0-255	5,6,7,8	
161	Mask> 1	-64-64	0-129	5,6,7,8	
162	Mask> 2	-64-64	0-129	5,6,7,8	
163	Mask> 3	-64-64	0-129	5,6,7,8	
164	Mask> 4	-64-64	0-129	5,6,7,8	
165	MinV 1	-8000-8000	0-16001	5,6,7,8	
166	MinV 2	-8000-8000	0-16001	5,6,7,8	
167	MinV 3	-8000-8000	0-16001	5,6,7,8	
168	MinV 4	-8000-8000	0-16001	5,6,7,8	
169	MaxV 1	-8000-8000	0-16001	5,6,7,8	
170	MaxV 2	-8000-8000	0-16001	5,6,7,8	
171	MaxV 3	-8000-8000	0-16001	5,6,7,8	
172	MaxV 4	-8000-8000	0-16001	5,6,7,8	
173	Attack 1	-100-100	0-201	5,6,7,8	
174	Attack 2	-100-100	0-201	5,6,7,8	
175	Attack 3	-100-100	0-201	5,6,7,8	
176	Attack 4	-100-100	0-201	5,6,7,8	
177	Release 1	-100-100	0-201	5,6,7,8	
178	Release 2	-100-100	0-201	5,6,7,8	
179	Release 3	-100-100	0-201	5,6,7,8	
180	Release 4	-100-100	0-201	5,6,7,8	
181	Acur 1	-10.00-10.00	0-2001	5,6,7,8	
182	Acur 2	-10.00-10.00	0-2001	5,6,7,8	
183	Acur 3	-10.00-10.00	0-2001	5,6,7,8	
184	Acur 4	-10.00-10.00	0-2001	5,6,7,8	
185	Rcur 1	-10.00-10.00	0-2001	5,6,7,8	
186	Rcur 2	-10.00-10.00	0-2001	5,6,7,8	
187	Rcur 3	-10.00-10.00	0-2001	5,6,7,8	
188	Rcur 4	-10.00-10.00	0-2001	5,6,7,8	
189	Freq 1	-20.00-20.00	0-4001	5,6,7,8	
190	Freq 2	-20.00-20.00	0-4001	5,6,7,8	
191	Freq 3	-20.00-20.00	0-4001	5,6,7,8	
192	Freq 4	-20.00-20.00	0-4001	5,6,7,8	

**Please note: Support for Custom Devices**

Unfortunately, we do not have the resources to offer support for custom MIDI controller creations. We would love to see/hear the results of your experiments, but we cannot offer support in troubleshooting custom MIDI devices. Instead, we have created a set of Max4Live devices and accompanying documents to demonstrate building MIDI devices to control Flux. If you run into issues building a controller, please reference our Max designs to troubleshoot any issues that you face. We recommend paying particular attention to selecting steps to edit as discussed in this document. Please feel free to use our example devices as a starting point for your MIDI controller designs if using MAX.

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