Custom oscillator for KORG logue SDK synthesizers

Operations Manual

v.1.8-21

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Introduction

FM64 is a set of custom oscillator variations for KORG prologue, minilogue XD and NTS-1 synthesizers that reproduces Yamaha DX / TX series 6-operator FM synthesis. The oscillator must be prepopulated with the Yamaha DX7 voice banks (ROMs) of your choice using the online constructor (see in the next section) before uploading to the synthesizer. For information on how to upload a custom oscillator to the synthesizer and how to activate it, please refer to the Synthesizer Owner's Manual and Sound Librarian Owner's Manual for your KORG synthesizer model.

Quick start

The raw oscillator file has no banks inside and won't produce any sound. To make the oscillator work you must first populate it with the voice banks.

Obtaining the oscillator with custom voices

1. Navigate to the online constructor web page.
2. Select your KORG synthesizer model to define the target format of the oscillator file.
3. Locate the FM64 oscillator row by the column **NAME**
4. Check the **SIZE** column of this row, the last multiplier is the maximum number of voice banks this oscillator can contain.
5. Click the **Upload** button located in the **CUSTOM DATA** column of this row.
6. In the file open dialog select one to several (up to obtained in step 4) voice bank files.
7. Check the **CUSTOM NAME** cell in this row. This name is generated from the names of the uploaded banks and you can alter it now. This name will be displayed by the Librarian and your synthesizer.
8. Click the **Download** button located in the **CUSTOM UNIT** cell of this row.
9. Now you can upload the oscillator file to your KORG synthesizer with the Librarian application.

Changing oscillator custom parameters

1. Proceed with steps 1 thru 7 of the previous section.
2. Click on one of the highlighted values in the columns **SHAPE**, **ALT**, **PARAM 1**, **PARAM 2**, **PARAM 3**, **PARAM 4**, **PARAM 5**, **PARAM 6** of this row.
3. From the popup menu select the desired custom parameter for the parameter selected in step 2. You need to scroll with the mouse wheel to reach all of the available custom parameters.
4. Repeat steps 2 and 3 for other oscillator parameters you wish to reassign.
5. Proceed with steps 8 and 9 of the previous section.

Advanced features

Oscillator variations

Custom oscillators are limited both in space and performance so it is not possible to fit all the features in the single oscillator. For the enhanced creativity there are several precompiled oscillator variations with different sets of features. The following table summarizes differences between variations:

Feature \ Oscillator	FM64	FM65	FM66	FM67	FM68	FM69
Preset algorithm count	84	84	84	84	84	84
User algorithm count	-	16	-	-	-	-
Voice bank count	5	5	4	3	2	5
Feedback count	1	2	1	1	1	1
Waveform count	1	1	8	16	1	1
Custom parameters count	127	130	137	137	127	127
Waveform customization			+	+		
Chromatic mode	+	+	+	+	+	
Kit mode	+	+	+	+	+	+
AMP LUT depth x width (bits)	11 x 16	11 x 16	11 x 16	11 x 16	13 x 16	11 x 16
Mixing quality (bits)	32	16	32	32	32	32

Velocity

Velocity is not passed natively to the custom oscillators. To control the voice velocity, the custom parameter is used. When Velocity is assigned to the Shape or Alt (Shift + Shape), the enhanced 10-bit precision will be used. By default velocity is assigned to the Shape knob. When Velocity is assigned to the oscillator parameter knob, it will have 7-bit precision and be limited to 100, similar to the first generation of Yamaha DX / TX series synthesizers.

Share and Alt assign

Shape Assign and Alt Assign custom parameters allows to assign any of the existing custom parameters to the Shape or Alt (Shift + Shape) respectively. Custom parameter numbers are specified in the Custom parameters list. Since Shape and Alt (Shift + Shape) are unipolar, positive custom parameter number only affects bipolar custom parameter value in a positive range and negative custom parameter number affects bipolar custom parameter in a negative range.

Chromatic and kit modes

There are two modes available in the oscillators depending on the variation. The chromatic mode is a standard mode for the keyboard instrument when keys controls the pitch of the oscillator, i.e. plays notes of the same voice. The kit mode is normally for drums, when each key plays different voice.

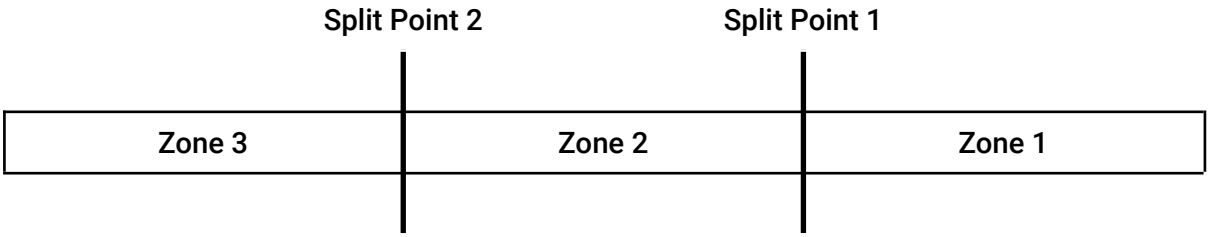
Banks and voices

For negative voices, banks are wrapped backwards, starting from the maximum available bank for the current oscillator variation regardless of the number of banks that uploaded into this oscillator in the online constructor. In the table below you can find the actual bank and voice mapping:

Banks \ Voice	**-96…-65**	**-64…-33**	**-32…-1**	**0**	**1…32**	**33… 63**	**64…96**
1	Bank 1	Bank 1	Bank 1	Kit mode	Bank 1	Bank 1	Bank 1
2	Bank 2	Bank 1	Bank 2	Kit mode	Bank 1	Bank 2	Bank 1
3	Bank 1	Bank 2	Bank 3	Kit mode	Bank 1	Bank 2	Bank 3
4	Bank 2	Bank 3	Bank 4	Kit mode	Bank 1	Bank 2	Bank 3
5	Bank 3	Bank 4	Bank 5	Kit mode	Bank 1	Bank 2	Bank 3
6	Bank 4	Bank 5	Bank 6	Kit mode	Bank 1	Bank 2	Bank 3

Zones

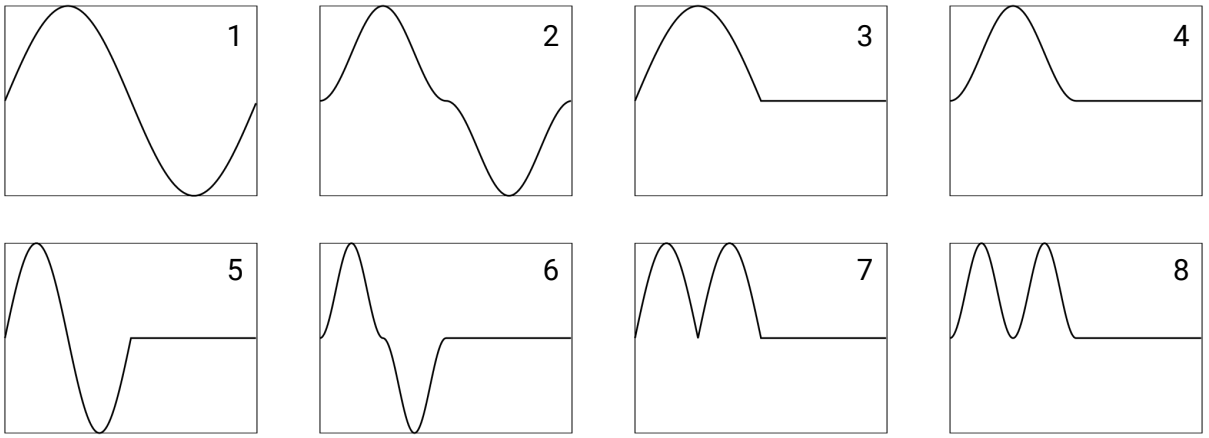
It is possible to split the keyboard to up to three zones and assign different voices to each of them. Split points determines the edge notes between two neighbor zones. Relative position of zones and split points are shown below:



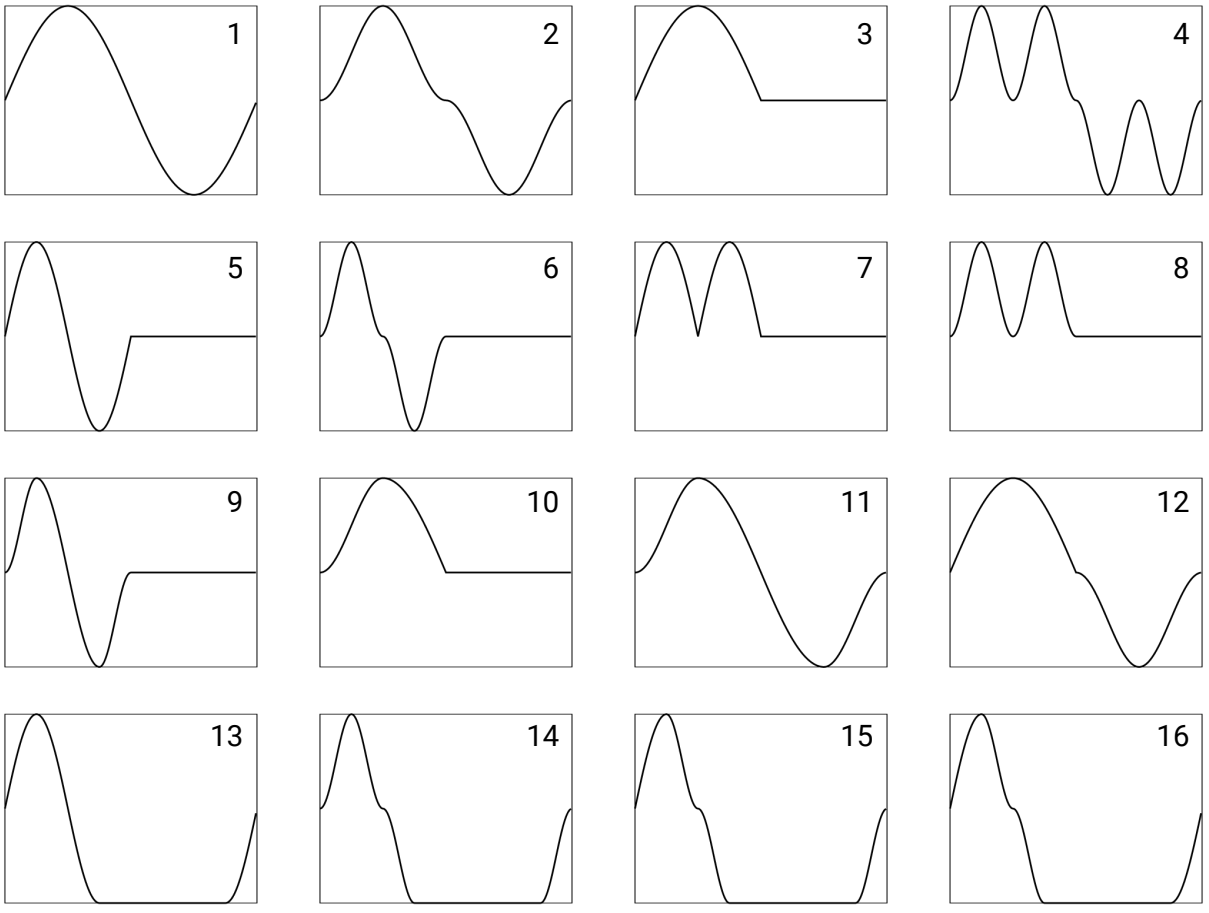
Waveforms list

Depending on the variation, an oscillator can support more than just one sine wave. Several variations also support waveform customization, that means they can be also altered with the online constructor. Custom waveforms must start from zero sample value to avoid sound artifacts. Waveforms can be selected with the custom parameters.

FM66 variant is preloaded waveforms similar to Yamaha DX11 / TX81Z:



FM67 variant is preloaded with waveforms similar to Yamaha SY77 / TG77 / SY99:

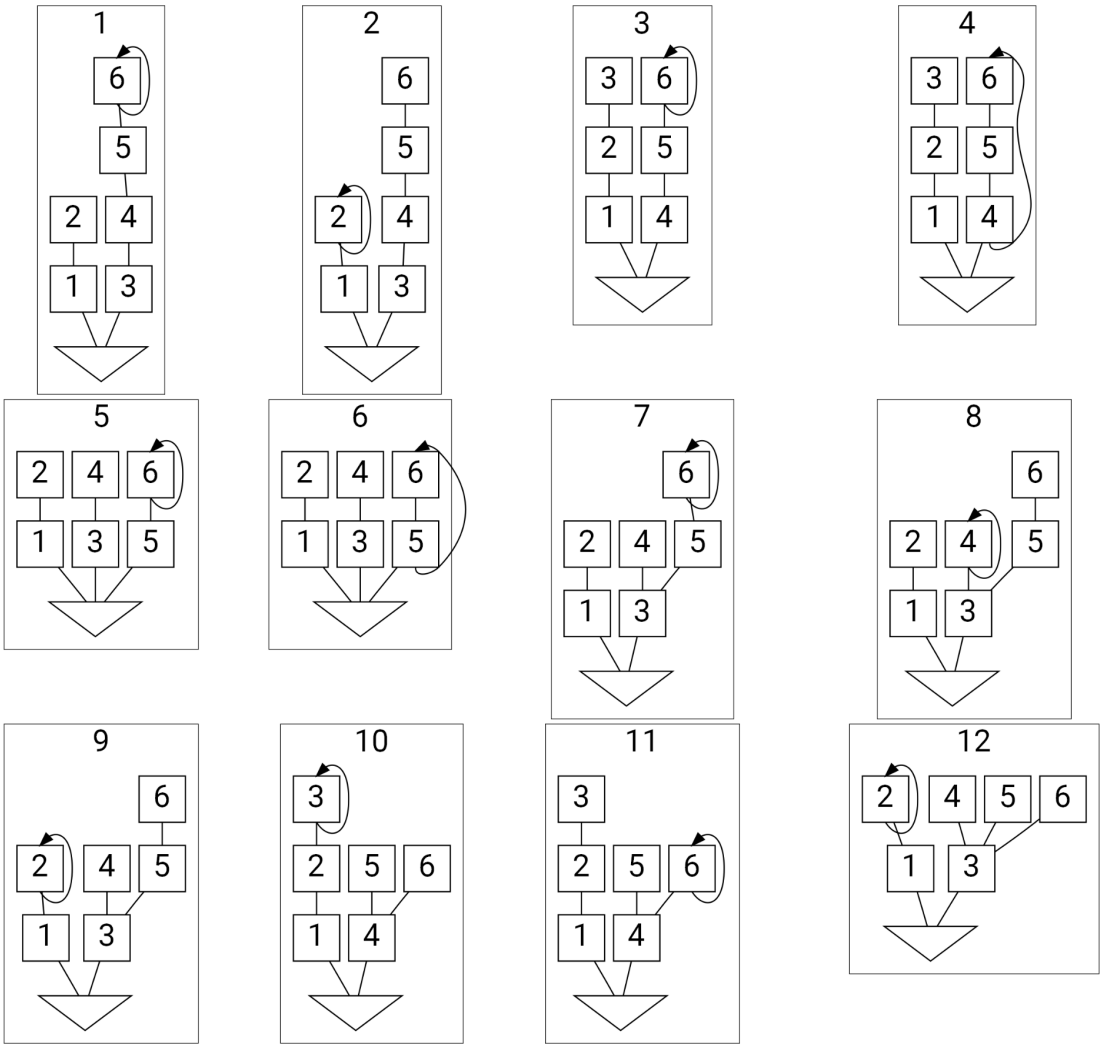


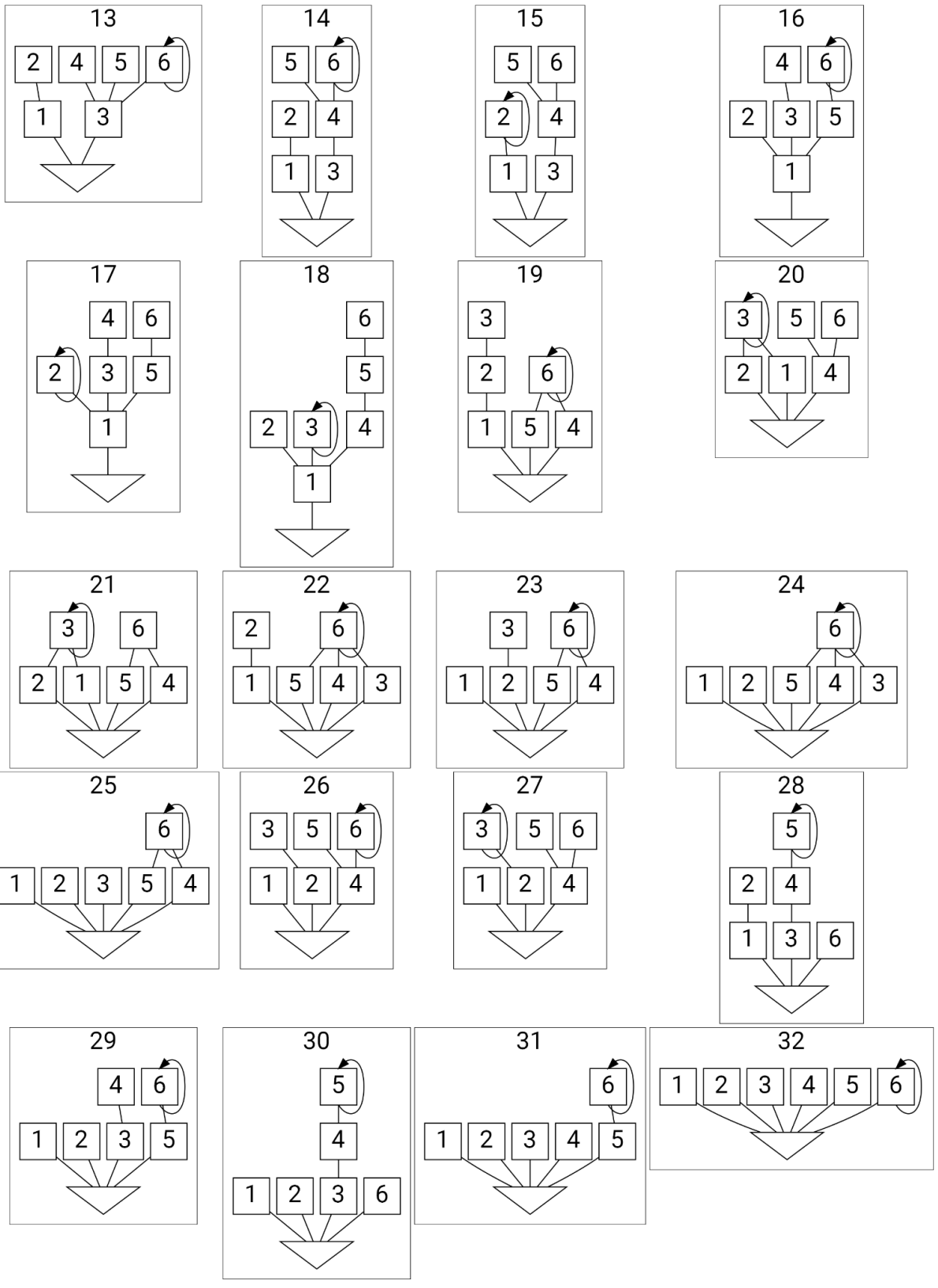
Algorithms list

All oscillator variations support 32 Yamaha DX7 and 8 additional KORG opsix algorithms. There are also 45 Yamaha SY77 algorithms supported with feedback count limitation. Several oscillator variations support additional user algorithms that can be imported with the online constructor from op6program files. Voice algorithm can be altered with custom parameters. Exact algorithm mapping shown in the following table:

Synth \ Algorithm	1…19	20	21…32	33…40	41…80	81…84[1]	85…100
Yamaha DX7	1…32			-			
KORG opsix	1…40				-		user
Yamaha SY77	-	41	-		1…40	42…45[1]	-

[1] : algorithm 82 have only one feedback, unlike the original Yamaha SY77 algorithm 43

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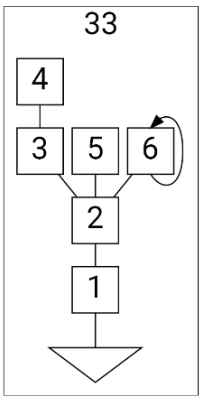
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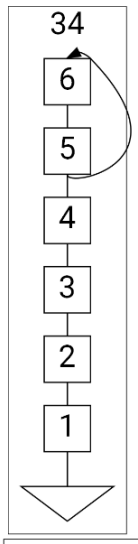
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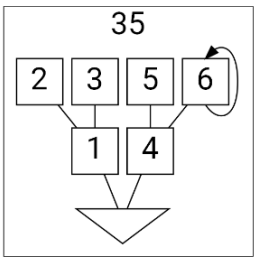
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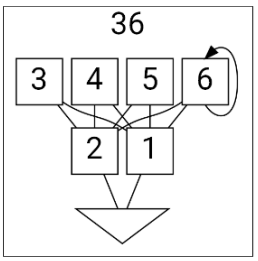
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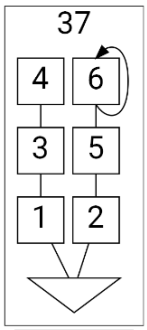
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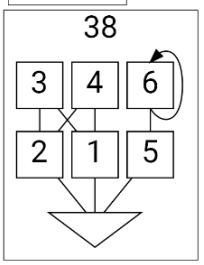
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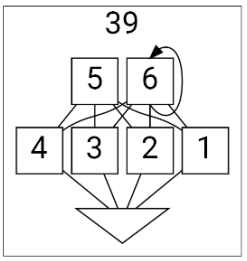
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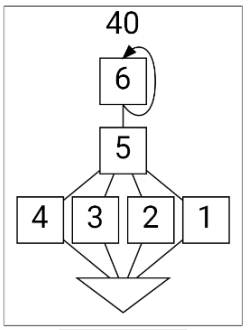
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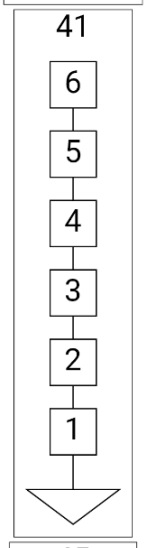
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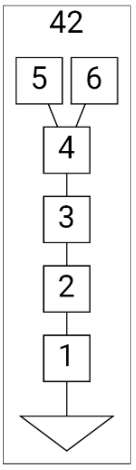
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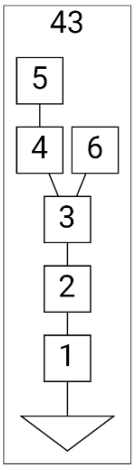
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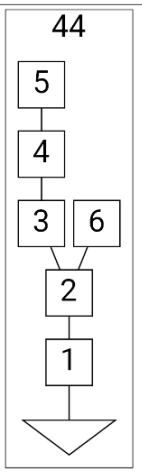
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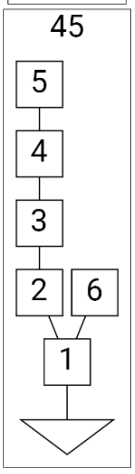
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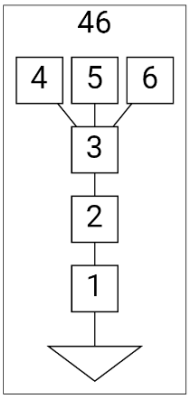
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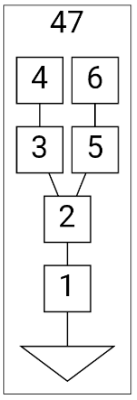
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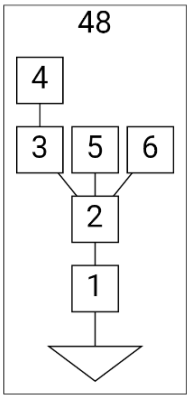
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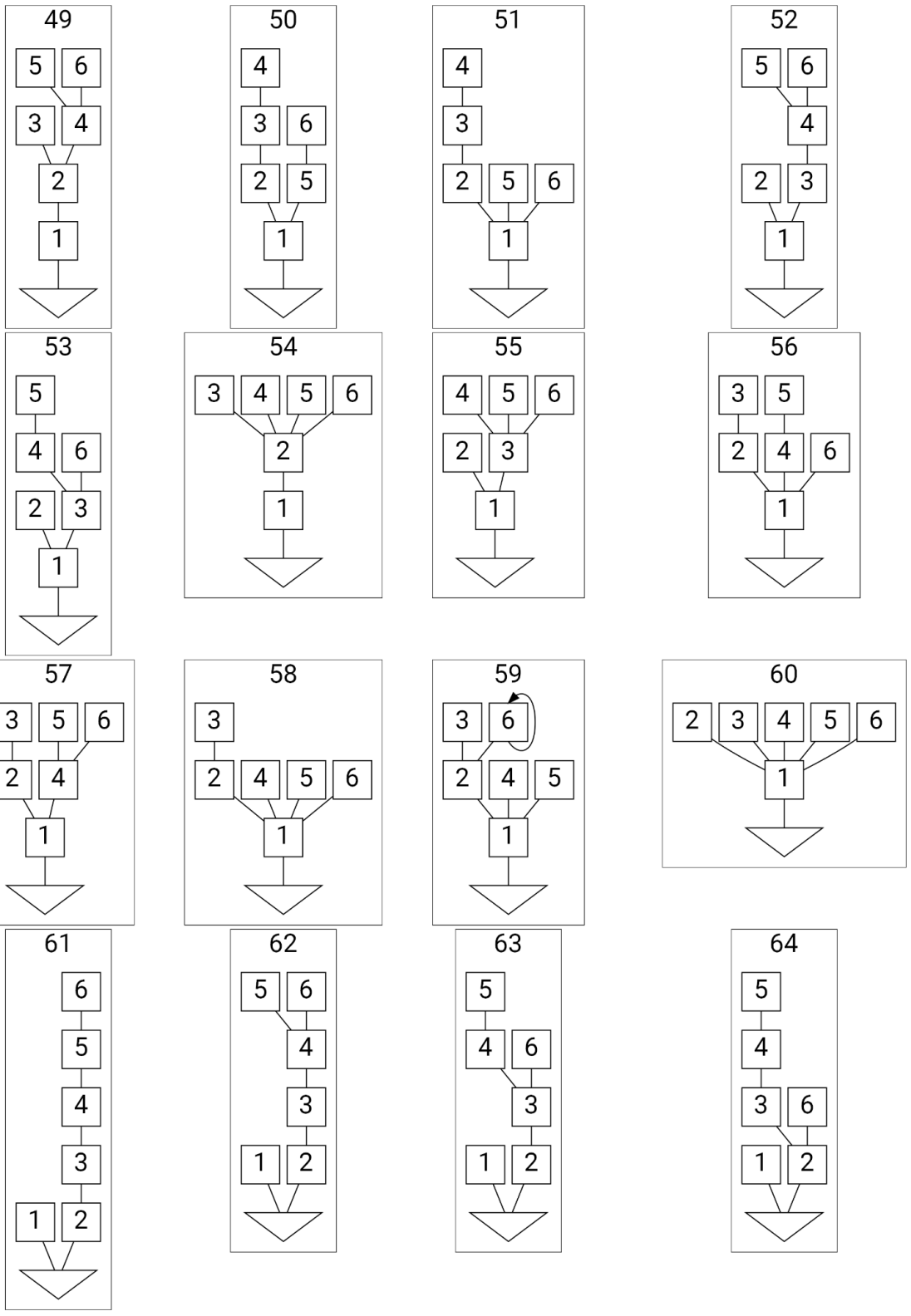
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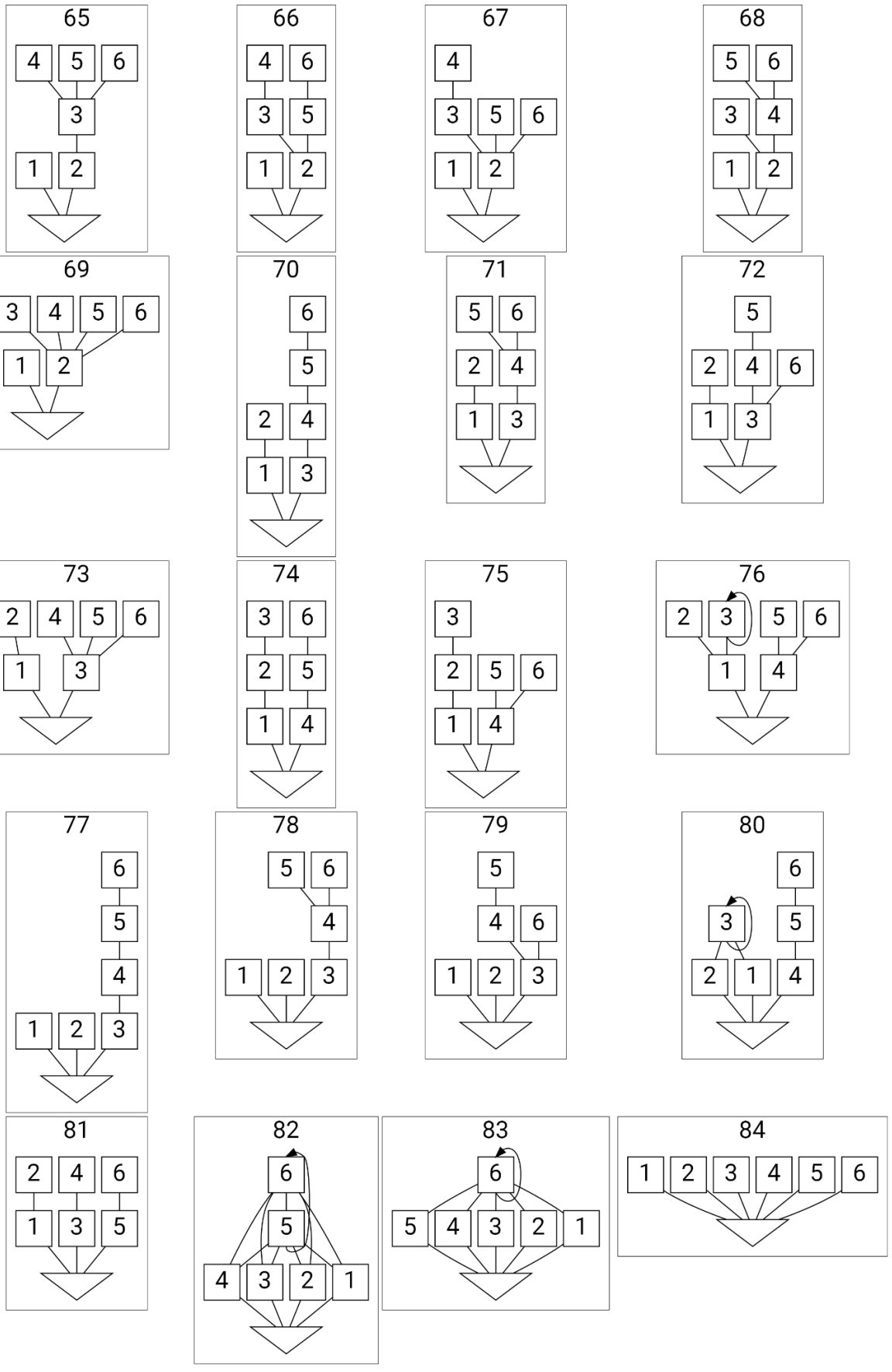
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Custom parameters list

#	Custom param	Range	Description
0	Velocity	0…127 (1)	Note velocity
1	Voice 1	-96…96	Voice for zone 1
2	Voice 2	-96…96	Voice for zone 2
3	Voice 3	-96…96	Voice for zone 3
4	Split Point1	1…101 (2)	Split point between zone 1 and 2
5	Split Point2	1…101 (2)	Split point between zone 2 and 3
6	Transpose 1	-99…100 (2)	Transpose for zone 1
7	Transpose 2	-99…100 (2)	Transpose for zone 2
8	Transpose 3	-99…100 (2)	Transpose for zone 3
9	Voice Shift1	-99…100	Voice shift for zone 1
10	Voice Shift2	-99…100	Voice shift for zone 2
11	Voice Shift3	-99…100	Voice shift for zone 3
12	Shape Assign	-99…99	Assign custom parameter # to Shape
13	Alt Assign	-99…99	Assign custom parameter # to Alt (Shift + Shape)
14	FB offset	-99…100 (3)	Feedback 1 offset
15	FB2 offset	-99…100 (3)	Feedback 2 offset
16	FB scale	-99…100 (4)	Feedback 1 multiplier
17	FB2 scale	-99…100 (4)	Feedback 2 multiplier
18	FB route	0…66 (5)	Feedback 1 route
19	FB2 route	0…66 (5)	Feedback 2 route
20	Alg select	0…100 (6)	Algorithm select
21	Alg offset	-99…99	Algorithm offset
22	Lvl offs All	-99…99	Level offset for all operators
23	Lvl offs Car	-99…99	Level offset for carriers
24	Lvl offs Mod	-99…99	Level offset for modulators
25	Lvl offs Op1	-99…99	Level offset for operator 1
26	Lvl offs Op2	-99…99	Level offset for operator 2

27	Lvl offs Op3	-99…99	Level offset for operator 3
28	Lvl offs Op4	-99…99	Level offset for operator 4
29	Lvl offs Op5	-99…99	Level offset for operator 5
30	Lvl offs Op6	-99…99	Level offset for operator 6
31	Lvl scal All	-99…100 (4)	Level multiplier for all operators
32	Lvl scal Car	-99…100 (4)	Level multiplier for carriers
33	Lvl scal Mod	-99…100 (4)	Level multiplier for modulators
34	Lvl scal Op1	-99…100 (4)	Level multiplier for operator 1
35	Lvl scal Op2	-99…100 (4)	Level multiplier for operator 2
36	Lvl scal Op3	-99…100 (4)	Level multiplier for operator 3
37	Lvl scal Op4	-99…100 (4)	Level multiplier for operator 4
38	Lvl scal Op5	-99…100 (4)	Level multiplier for operator 5
39	Lvl scal Op6	-99…100 (4)	Level multiplier for operator 6
40	KLS offs All	-99…99	Keyboard level scaling offset for all operators
41	KLS offset Car	-99…99	Keyboard level scaling offset for carriers
42	KLS offset Mod	-99…99	Keyboard level scaling offset for modulators
43	KLS offset Op1	-99…99	Keyboard level scaling offset for operators 1
44	KLS offset Op2	-99…99	Keyboard level scaling offset for operators 2
45	KLS offset Op3	-99…99	Keyboard level scaling offset for operators 3
46	KLS offset Op4	-99…99	Keyboard level scaling offset for operators 4
47	KLS offset Op5	-99…99	Keyboard level scaling offset for operators 5
48	KLS offset Op6	-99…99	Keyboard level scaling offset for operators 6
49	KLS scal All	-99…100 (4)	Keyboard level scaling multiplier for all operators
50	KLS scal Car	-99…100 (4)	Keyboard level scaling multiplier carriers
51	KLS scal Mod	-99…100 (4)	Keyboard level scaling multiplier modulators
52	KLS scal Op1	-99…100 (4)	Keyboard level scaling multiplier for operator 1
53	KLS scal Op2	-99…100 (4)	Keyboard level scaling multiplier for operator 2
54	KLS scal Op3	-99…100 (4)	Keyboard level scaling multiplier for operator 3
55	KLS scal Op4	-99…100 (4)	Keyboard level scaling multiplier for operator 4
56	KLS scal Op5	-99…100 (4)	Keyboard level scaling multiplier for operator 5

57	KLS scal Op6	-99…100 [4]	Keyboard level scaling multiplier for operator 6
58	KVS offs All	-99…100 [3]	Key velocity sensitivity offset for all operators
59	KVS offs Car	-99…100 [3]	Key velocity sensitivity offset for carriers
60	KVS offs Mod	-99…100 [3]	Key velocity sensitivity offset for operators
61	KVS offs Op1	-99…100 [3]	Key velocity sensitivity offset operator 1
62	KVS offs Op2	-99…100 [3]	Key velocity sensitivity offset operator 2
63	KVS offs Op3	-99…100 [3]	Key velocity sensitivity offset operator 3
64	KVS offs Op4	-99…100 [3]	Key velocity sensitivity offset operator 4
65	KVS offs Op5	-99…100 [3]	Key velocity sensitivity offset operator 5
66	KVS offs Op6	-99…100 [3]	Key velocity sensitivity offset operator 6
67	KVS scal All	-99…100 [4]	Key velocity sensitivity multiplier for all operators
68	KVS scal Car	-99…100 [4]	Key velocity sensitivity multiplier for carriers
69	KVS scal Mod	-99…100 [4]	Key velocity sensitivity multiplier for modulators
70	KVS scal Op1	-99…100 [4]	Key velocity sensitivity multiplier for operator 1
71	KVS scal Op2	-99…100 [4]	Key velocity sensitivity multiplier for operator 2
72	KVS scal Op3	-99…100 [4]	Key velocity sensitivity multiplier for operator 3
73	KVS scal Op4	-99…100 [4]	Key velocity sensitivity multiplier for operator 4
74	KVS scal Op5	-99…100 [4]	Key velocity sensitivity multiplier for operator 5
75	KVS scal Op6	-99…100 [4]	Key velocity sensitivity multiplier for operator 6
76	Rat offs All	-99…99	EG rate offset for all operators
77	Rat offs Car	-99…99	EG rate offset for carriers
78	Rat offs Mod	-99…99	EG rate offset for modulators
79	Rat offs Op1	-99…99	EG rate offset for operator 1
80	Rat offs Op2	-99…99	EG rate offset for operator 2
81	Rat offs Op3	-99…99	EG rate offset for operator 3
82	Rat offs Op4	-99…99	EG rate offset for operator 4
83	Rat offs Op5	-99…99	EG rate offset for operator 5
84	Rat offs Op6	-99…99	EG rate offset for operator 6
85	Rat scal All	-99…100 [4]	EG rate multiplier for all operators
86	Rat scal Car	-99…100 [4]	EG rate multiplier for carriers

87	Rat scal Mod	-99…100 (4)	EG rate multiplier for modulators
88	Rat scal Op1	-99…100 (4)	EG rate multiplier for operator 1
89	Rat scal Op2	-99…100 (4)	EG rate multiplier for operator 2
90	Rat scal Op3	-99…100 (4)	EG rate multiplier for operator 3
91	Rat scal Op4	-99…100 (4)	EG rate multiplier for operator 4
92	Rat scal Op5	-99…100 (4)	EG rate multiplier for operator 5
93	Rat scal Op6	-99…100 (4)	EG rate multiplier for operator 6
94	KRS offs All	-99…100 (3)	Keyboard EG rate scaling offset for all operators
95	KRS offs Car	-99…100 (3)	Keyboard EG rate scaling offset for carriers
96	KRS offs Mod	-99…100 (3)	Keyboard EG rate scaling offset for modulators
97	KRS offs Op1	-99…100 (3)	Keyboard EG rate scaling offset for operator 1
98	KRS offs Op2	-99…100 (3)	Keyboard EG rate scaling offset for operator 2
99	KRS offs Op3	-99…100 (3)	Keyboard EG rate scaling offset for operator 3
100	KRS offs Op4	-99…100 (3)	Keyboard EG rate scaling offset for operator 4
101	KRS offs Op5	-99…100 (3)	Keyboard EG rate scaling offset for operator 5
102	KRS offs Op6	-99…100 (3)	Keyboard EG rate scaling offset for operator 6
103	KRS scal All	-99…100 (4)	Keyboard EG rate multiplier for all operators
104	KRS scal Car	-99…100 (4)	Keyboard EG rate multiplier for carriers
105	KRS scal Mod	-99…100 (4)	Keyboard EG rate multiplier for modulators
106	KRS scal Op1	-99…100 (4)	Keyboard EG rate multiplier for operator 1
107	KRS scal Op2	-99…100 (4)	Keyboard EG rate multiplier for operator 2
108	KRS scal Op3	-99…100 (4)	Keyboard EG rate multiplier for operator 3
109	KRS scal Op4	-99…100 (4)	Keyboard EG rate multiplier for operator 4
110	KRS scal Op5	-99…100 (4)	Keyboard EG rate multiplier for operator 5
111	KRS scal Op6	-99…100 (4)	Keyboard EG rate multiplier for operator 6
112	Det offs All	-99…100 (7)	Detune offset in cents for all operators
113	Det offs Car	-99…100 (7)	Detune offset in cents for carriers
114	Det offs Mod	-99…100 (7)	Detune offset in cents for modulators
115	Det offs Op1	-99…100 (7)	Detune offset in cents for operator 1
116	Det offs Op2	-99…100 (7)	Detune offset in cents for operator 2

117	Det offs Op3	-99…100 [7]	Detune offset in cents for operator 3
118	Det offs Op4	-99…100 [7]	Detune offset in cents for operator 4
119	Det offs Op5	-99…100 [7]	Detune offset in cents for operator 5
120	Det offs Op6	-99…100 [7]	Detune offset in cents for operator 6
121	Det scal All	-99…100 [4]	Detune multiplier for all operators
122	Det scal Car	-99…100 [4]	Detune multiplier for carriers
123	Det scal Mod	-99…100 [4]	Detune multiplier for modulators
124	Det scal Op1	-99…100 [4]	Detune multiplier for operator 1
125	Det scal Op2	-99…100 [4]	Detune multiplier for operator 2
126	Det scal Op3	-99…100 [4]	Detune multiplier for operator 3
127	Det scal Op4	-99…100 [4]	Detune multiplier for operator 4
128	Det scal Op5	-99…100 [4]	Detune multiplier for operator 5
129	Det scal Op6	-99…100 [4]	Detune multiplier for operator 6
130	Waveform C+M	-77…77 [8]	Waveform offset for carriers and modulators
131	Waveform 1+2	-77…77 [8]	Waveform offset for operators 1 and 2
132	Waveform 3+4	-77…77 [8]	Waveform offset for operators 3 and 4
133	Waveform 5+6	-77…77 [8]	Waveform offset for operators 5 and 6
134	Waveform Op1	-15…15	Waveform offset for operator 1
135	Waveform Op2	-15…15	Waveform offset for operator 2
136	Waveform Op3	-15…15	Waveform offset for operator 3
137	Waveform Op4	-15…15	Waveform offset for operator 4
138	Waveform Op5	-15…15	Waveform offset for operator 5
139	Waveform Op6	-15…15	Waveform offset for operator 6

[1] : 0...100 with the step of 1 when assigned to the oscillator parameter,
0..127 with the step of 0.125 when assigned to the Shape or Alt (Shift + Shape)

[2] : semitones / notes

[3] : -6.93…+7 with the step of 0.07

[4] : x0.01…x2 multiplier with the step of 0.01

[5] : 0 - keep voice feedback route
higher digit - feedback source operator, 1…6 (0→1, 7...9→6)

lower digit - feedback destination operator, 1…6 (0→1, 7...9→6)

(6) : 0 - keep voice algorithm
1...100 - set algorithm explicitly

(7) : cents

(8) : higher digit - carriers and odd operators,
lower digit - modulators and even operators

Known issues and limitations

- prologue and minilogue XD synthesizers can produce distorted sound or hang when LFO is routed to the Shape. This is due to high CPU utilization of the oscillator and additional CPU load produced by the firmware code for the Shape LFO. To restore normal operation the synthesizer power cycle is needed.
- NTS-1 can produce distorted sound when more than 2 effects are enabled. This is due to high CPU utilization of the oscillator and shared CPU architecture of the NTS-1. Disable excessive effects to get normal sound from the oscillator.
- On prologue, restoring the assigned parameter value with program recall is only valid in case Shape assign is assigned to the Alt (Shift + Shape) due to a parameter initialization order of the current firmware. On minilogue XD in opposite, this is the only combination that won't restore the value of the assigned parameter.
- Native Yamaha DX / TX series LFO, Amp and pitch modulations are not supported due to performance limitations.
- All ascending EG stages (e.x. typical Attack) are exponential. Implementing the reference semi-linear behaviour will introduce computational complexity that is not currently affordable.

Q & A

Q: Where to get voice banks?
A: Just search over the Internet for the Yamaha DX7 voice bank files.

Q: I got the voice bank, but the online constructor refuses it / voices sounds bad. What is the correct format?
A: Any VMEM packed voice bank for Yamaha DX1, DX5, DX7, DX7II, DX7s, TX7, TX802, TX816 both in SysEx (4104 bytes) or RAW (4096 bytes) will work. Any other format, including voice banks for Yamaha DX9, DX11, DX21, DX21, DX27s, DX100, TZ81Z will not work.

Q: Does the online constructor collect uploaded banks?
A: All the oscillator customization operations are done in JavaScript of your browser, so no actual upload occurs. Online constructor does not store any data, except for the your browser cookie setting of the last selected synthesizer model.

Q: There is a FM48 custom oscillator available, why is it not covered with this manual?
A: FM48 is oscillator variation for 4-operator Yamaha DX / TX series synthesizer voices. It is still experimental and very inaccurate.

Q: I found the bug / wish to propose a new feature or improvement. How can I report it?
A: Please create a new issue at GitHub or if you don't have a GitHub account, just send me an email to dukesrg@gmail.com.

Q: Is this oscillator free? / Is this an open beta version? / How much will it cost?
A: This oscillator is my hobby, it is and will be free and open source. If you're still itching about using this oscillator for free, you can PayPal me a pint of cider.