# **MIDIbox Quad Genesis: Front Panel**



To build the front panel of MIDIbox Quad Genesis, you will need (details on each part below):

- An aluminum front panel OR 3D Printed Front Panel (See Below)
- A PCB to hold all the buttons, LEDs, encoders, etc., and of course all these electronic components themselves
- A bunch of 3D printed transparent button caps
- Some 3D printed transparent LED pipes for the FM widget
- A 2×40 standard MIDIbox-compliant character LCD screen
- Knob caps for the encoders, including a datawheel-style cap for the datawheel encoder
- The dual-gang and single-gang potentiometers (one each per synth, not per module!) for the Genesis module volume controls, and their appropriate knob caps (see MBHP\_GENESIS)
- A whole bunch of M3 or 4-40 screws, nuts, washers, and standoffs
- Standard MIDIbox 10-pin and 16-pin IDC cables, for connecting the front panel PCB to the core's J8/9 and for connecting the LCD to the core's J15A

#### **Dimensions**

The aluminum (or acrylic) front panel of MIDIbox Quad Genesis is 15" x 11" (38.1 x 27.9 cm), and the front panel PCB itself is 13.85" x 9.85" (35.18 x 25.02 cm), leaving a 0.57" (1.45 cm) border around the edge. The aluminum I used was 1/16" (0.062" or 1.57 mm); this may be a consideration if you use acrylic which is much thicker (2mm should probably be fine but 3mm might be a problem, with the 3D printed buttons - **Update** - Smithy has provided modified files for 3D printed buttons and light pipes

to fit 3mm panels below. ).

The spacing between the underside of the front panel and the upper side of the PCB is about 0.27" (7 mm), which is originally defined by the encoders and the 3D printed buttons are made to match this. I used 1/4" nylon spacers/standoffs from eBay plus a flat washer (4-40 or M3) to achieve this spacing. I used 0.75" 4-40 screws to put together the front panel, in which case the depth of the assembly was 0.75" with the electrolytic capacitors and pin header / IDC connector sticking out past this. The panel and PCB can be fastened together with 4-40 or M3 screws.

### **Aluminum Front Panel**

There are two designs available here: my original, and a modified design with the LED pipes in the LED rings having been replaced by 3mm LEDs just sticking through holes in the aluminum.

It took me over 2 hours just to insert the tiny LED pipes in the slits in one single front panel with the first design, which is why I recommend the second. Since they're 3D printed (see below), they have a small range of sizes, and at that scale some are too big and some are too small. I still left them in place for the FM widget and the DAC VU meter; if you don't want those either for some reason, it shouldn't be hard to replace them with holes.

All the LED holes and screw mounting holes are 1/8" (3.17 mm), which should give 3mm LEDs a little play (some are in practice slightly wider than 3mm, and some aren't actually 3mm at all), and are also big enough for both M3 and 4-40" screws. On my own panel, I had to drill out some of the holes a bit for the yellow and green LEDs sticking through the front panel; I recommend you buy the LEDs you're going to put through the holes first and measure them before you have the front panel manufactured.

It may be possible to make the front panel out of acrylic, a-la MIDIbox SEQ V4. Since the front panel PCB is bolted to it in many places, it will probably be sturdy enough. If it's not, there's a row of screw holes slightly below halfway down the panel, and maybe you can have those screws go into an aluminum bar spanning the width of the front panel and attaching to the sides of your case, to provide extra support in the middle.

#### **Downloads**

(You will need to be logged in to your MIDIbox Forum account to access these downloads)

mbqg fp original.fpd

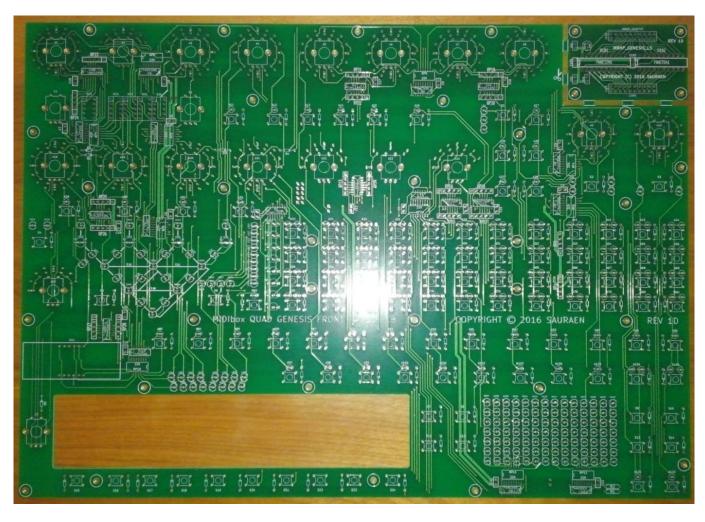
mbgg fp modledrings.fpd

## MBQG\_FP PCB

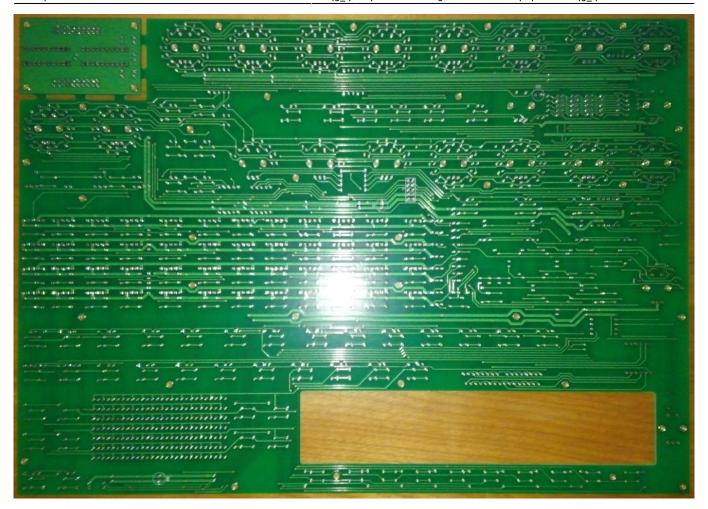
A custom front panel PCB is purchaseable directly from Sauraen for \$50 plus at-cost shipping. It includes a free detachable MBHP\_GENESIS\_LS PCB in the space where the volume knobs will be on the front panel. If you are interested in purchasing one, contact Sauraen by private message at the MIDIbox Forums or post in the MIDIbox Quad Genesis thread there.

## **Photos**

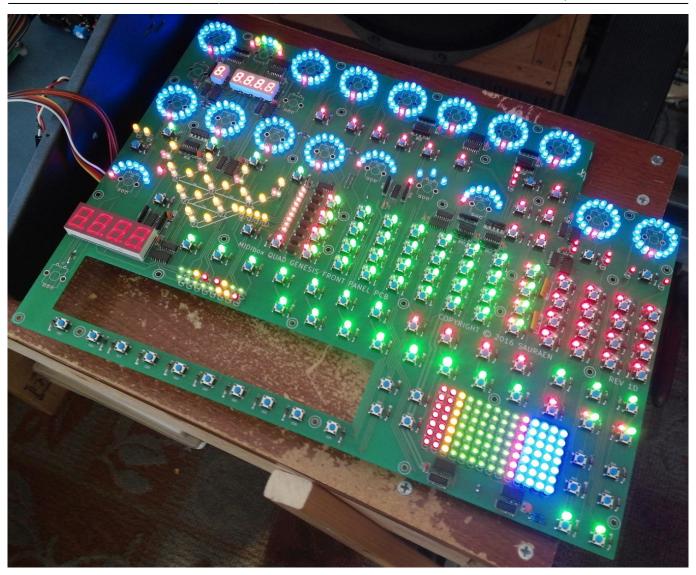
### Front:



Back:



Populated and with almost all LEDs lit:



## Parts List for MBQG\_FP PCB

This is the set of parts I used to build the two MIDIbox Quad Genesis units I constructed. It can also serve as guidelines for if you're building your own board from scratch on veroboard. Here are some notes and caveats:

- As explained above in the section of the aluminum front panel, I used LED pipes for the LED rings, to give them a distinctive oblong shape. To save money on the milling costs and labor on inserting hundreds of tiny plastic pieces into the front panel, most of which are either too small or too big, I recommend making the LED rings just by having 3mm LEDs sticking up through the aluminum. In this case, the LEDs I used below will be too bright to look at directly-they were used to illuminate the LED pipes. So please consider changing to different LEDs.
- Please note that for the LEDs which are under illuminated buttons or under the remaining LED pipes, you will need LEDs which are very bright like the ones below! Cheap 1mcd LEDs will be completely invisible! You need at least 1000mcd; the brightnesses I used are listed below. If you are going to the trouble of making this thing, don't skimp on the LEDs!
- Also don't skimp on the encoders! For MIDIbox FM V2.0/V2.1 I used cheap encoders from China to save money, and many of them barely work anymore!
- Of course, the color of all the LEDs is completely up to personal preference, though you should always use the same two colors beneath all bi-color buttons. Please plan out carefully how

- many of each type of LED you will need based on your color preferences and which LEDs will be sticking through the front panel versus lighting up buttons or light pipes. Trust me, you don't want to use regular LEDs to try to light up the plastic, it'll look dim and poor; and you don't want to use the high-brightness LEDs sticking through the front panel, they will blind you!
- On the PCB itself, the individual buttons, LEDs, and diodes are usually not marked. To simplify PCB design in KiCad, "assemblies" were created with e.g. an encoder and 16 LEDs, or a button, two LEDs, and a diode. This is why they're marked "A21" or whatever. All the diodes are the same 1N914 or 1N4148 (or actually any through-hole small signal diode), and each one has a cathode marking, so there should never be any confusion. With the exception of the LEDs in the LED rings, every LED on the board has an actual diode symbol marked, so there should be no confusion about which direction they go (square pad is anode is longer lead). In the LED rings, the four quadrant LEDs' directions are marked, and the rest go in the corresponding direction, following around the circle (anode always on inside). All the tact switches are also the same-just make sure each one is pushed in fully before soldering!

Description	Mouser P/N	Quantity
Encoders; 0.1" board mount with switch; bushing; 24 PPR, 24 detent; etc. If you want to save a couple dollars, you can use the ones without the switch for all the encoders except the datawheel and the four Operator Level encoders-those are the only ones for which the switch is wired up.	652-PEC12R3220FS0024	21
Tact switches; standard, 5mm high	611-PTS645SM502	115
Diodes for button matrix	583-1N4148-T	120
Red LEDs for lighting buttons/caps (4500mcd (!))	604-WP710A10SRC/J4	87
Orange LEDs for lighting buttons/caps (2700mcd (!))	604-WP710A10SEC	9
Yellow LEDs for lighting buttons/caps (3200mcd (!))	859-LTL17KYV3JS	18
Green LEDs for lighting buttons/caps (7200mcd (!))	859-LTL17KTGX3KS	76
Blue LEDs for lighting buttons/caps (1500mcd (!))	859-LTL17KTBS3KS	220
Red LEDs for panel indication (i.e. sticking through holes in front panel) (Tinted, Diffused)	604-WP710A10SRD/D	26
Orange LEDs for panel indication (Tinted, Diffused)	696-SSL-LX3044SOD	7
Yellow LEDs for panel indication (Tinted, Diffused) (For some reason I ended up using these only for the yellow LEDs in the commands display and the load meter, not for the crosspoints in the FM widget; it may have been because I wanted clear-looking LEDs in the FM widget to go with all the other clear/white things there, or because these LEDs are closer to yellow than to amber, and the other LEDs in the FM widget were more amber)	710-151031YS06000	23
Green LEDs for panel indication (Tinted, Clear-I couldn't get appropriate brightness diffused ones)	859-LTL1CHJGTNN	51
Blue LEDs for panel indication (NOT tinted, Diffused-the picture lies, they're white diffused but light up blue; and actually these are a bit too bright to use for sticking through the front panel. You could fudge something with the resistors supplying these columns to try to reduce the brightness, but I might recommend looking for alternative LEDs.)	593-VAOL-3LSBY1	28
Red/Green 5mm LEDs for FM widget operator nodes (3 wire common ANODE)	696-LLX5099SRSGCCA	4

Description	Mouser P/N	Quantity
Large LED display	859-LTC-5623HR	1
Small LED displays	859-LSHD-7501	5
Row drive NMOSFETs (2n7000s aren't strong enough)	689-VN3205N3-G	8
74HC595 shift registers, SOIC-16	511-M74HC595YRM13TR	12
74HC165 shift registers, SOIC-16	863-MC74HC165ADR2G	8
220 ohm x 8 resistor packs, SOIC-16	652-4816P-1LF-220	11
10k ohm x 4 resistor packs, SIL-5 (RP13-RP28, not RP0 and RP1)	858-L051S103LF	16
1k ohm x 4 resistor packs, SIL-5 (these are just RP0 and RP1)	652-4605X-1LF-1K	2
Electrolytic caps (470 uF)	647-UVR1C471MPD	3
Ceramic/film caps (0.1 uF)	Buy by the 100 from eBay	~20
10k dual gang audio taper panel mount pot (OPN2 volume)	313-1240F-10K	1
10k audio taper panel mount pot	858-P160KNPC15A10K	1
5×2 pin header	Buy in larger size (preferably from eBay) and snap off	1

**Don't forget**: the  $2\times40$  character LCD, the pin header for the LCD, the ribbon cable and IDC connectors for the LCD and front panel, knob caps for the regular encoders, datawheel knob cap for the datawheel, knob caps for the volume pots.

## **Schematic and Reference Designators**

Schematic image (unfortunately, MIDIbox Gallery scaled down the original image, and offsite documentation is frowned upon):

For Color fields, as discussed above, you may change the colors to whatever you want, but it is recommended to keep the colors consistent (e.g. make everything "green" below be the same color, and everything "red" below be a different color). For the Red/Green buttons below, the Red LED is always on the left and the Green LED is always on the right.

Ref. Des.	Туре	Color	Description
A1	Encoder + 16-LED ring	Blue	FM operator parameter "Harmonic" ("FMult")
A2	Encoder + 7-LED ring	Rainbow	FM operator parameter "Detune"
A3	Encoder + 16-LED ring	Blue	FM operator parameter "Atk Rate"
A4	Encoder + 16-LED ring	Blue	FM operator parameter "Dec1 Rate"
A5	Encoder + 16-LED ring	Blue	FM operator parameter "Dec1 Level"
A6	Encoder + 16-LED ring	Blue	FM operator parameter "Dec2 Rate"
A7	Encoder + 16-LED ring	Blue	FM operator parameter "Rel Rate"
A8	Encoder + 16-LED ring	Blue	OPN2 parameter "Ch3 CSM Freq"
A9	Encoder + 16-LED ring	Blue	PSG voice parameter "Freq"
A10	Encoder + 16-LED ring	Blue	PSG voice parameter "Volume"
A11	Button + LED	Red	FM operator parameter "KSR" (Key Scale Rate)
A12	Button + LED	Red	FM operator SSG-EG parameter "On"
A13	Button + LED	Red	FM operator SSG-EG parameter "Init"

Ref. Des.	Туре	Color	Description
A14	Button + LED	Red	FM operator SSG-EG parameter "Toggle"
A15	Button + LED	Red	FM operator SSG-EG parameter "Hold"
A16	Button + LED	Red	FM operator parameter "LFO AM" (LFO → operator amplitude modulation toggle)
A17	Button + LED	Red	OPN2 parameter "Ch3 CSM Fast" (originally Timer A fast, now Timer A enable)
A18-A21	Encoder + 16-LED ring	Blue	FM voice parameter "Oper 1 Level" - "Oper 4 Level"
A22	Encoder + 8-LED ring	Blue	FM voice parameter "LFO-Freq Depth" (LFO → frequency modulation depth)
A23	Encoder + 4-LED ring	Blue	FM voice parameter "LFO-Amp Depth" (LFO → amplitude modulation depth)
A24	Encoder + 8-LED ring	Blue	OPN2 parameter "LFO Freq"
A25	Button + LED	Red	OPN2 parameter "Ugly" (now-famous test bit 0x21:4)
A26	Button + LED	Red	OPN2 parameter "DAC Override" (test bit 0x2C:5)
A27	Button + LED	Red	OPN2 parameter "LFO Enable"
A28	Button + LED	Red	OPN2 parameter "EG Enable" (invert of test bit 0x21:5)
A29-A32	Button + LED	Green	Operator Selection 1-4
A33-A44	Button + 2 LEDs	Red/Green	Genesis 1 Voice Selection: DAC, FM voices 1–6, OPN2 globals, PSG voices 1-3, noise
A45-A56	Button + 2 LEDs	Red/Green	Genesis 2 Voice Selection: DAC, FM voices 1–6, OPN2 globals, PSG voices 1-3, noise
A57	Encoder + 8-LED ring	Blue	OPN2 voice parameter "Feedback"
A58-A69	Button + 2 LEDs	Red/Green	Genesis 3 Voice Selection: DAC, FM voices 1-6, OPN2 globals, PSG voices 1-3, noise
A70-A81	Button + 2 LEDs	Red/Green	Genesis 4 Voice Selection: DAC, FM voices 1–6, OPN2 globals, PSG voices 1-3, noise
A82	Button + LED	Red	OPN2 parameter "DAC Enable"
A83	Button + LED	Green	System Mode
A84	Button + LED	Green	Voice Mode
A85	Button + LED	Green	Channel Mode
A86	Button + LED	Green	Program Mode
A87	Button + LED	Green	VGM Editor Mode
A88	Button + LED	Green	Modulator Mode
A89	Button + LED	Green	Sample Mode
A90	Button + LED	Red	Mute
A91	Button + LED	Red	Solo
A92	Button + LED	Red	Release
A93	Button + LED	Red	Panel Override
A94	Button + LED	Green	Restart
A95	Button + LED	Green	Play
A96	Button + LED	Green	Reset
A97	Button + LED	Green	Load
A98	Button + LED	Green	Save
A99	Button + LED	Green	New
A100	Button + LED	Green	Delete
A101	Button + LED	Green	Crop

Ref. Des.	Туре	Color	Description
A102	Button + LED	Green	Capture
A103	Button + LED	Green	Duplicate
A104	Button + LED	Green	Paste
A105	Button + LED	Red/Green	
A106	Button + LED	Red/Green	
A100	7-LED Column	Red	VGM Commands Display: Ctrl
A107	7-LED Column	Red	VGM Commands Display: Time
			1 2
A109	7-LED Column	Yellow	VGM Commands Display: OPN2
A110	7-LED Column	Green	VGM Commands Display: FM 1
A111	7-LED Column	Green	VGM Commands Display: FM 2
A112	7-LED Column	Green	VGM Commands Display: FM 3
A113	7-LED Column	Green	VGM Commands Display: FM 4
A114	7-LED Column	Green	VGM Commands Display: FM 5
A115	7-LED Column	Green	VGM Commands Display: FM 6
A116	7-LED Column	Orange	VGM Commands Display: DAC
A117	7-LED Column	Blue	VGM Commands Display: OP/SQ 1
A118	7-LED Column	Blue	VGM Commands Display: OP/SQ 2
A119	7-LED Column	Blue	VGM Commands Display: OP/SQ 3
A120	7-LED Column	Blue	VGM Commands Display: OP4/NS
A121	Button + LED	Green	Commands View
A122	Button + LED	Green	State View
A123	Button + LED	Red	Group
C1-C20	Capacitor	N/A	0.1uF ceramic or film capacitors for chips
C21-C23	Capacitor	N/A	470uF electrolytic capacitors for power rails, reverse mounted
D1-D5	Diode	N/A	Diodes for encoder buttons; all normal button diodes included in Assembly or Switch
DS1	LED Display	Red	Main Display
DS2	LED Display	Red	Octave
DS3-DS6	LED Display	Red	Frequency
E1	Encoder	N/A	OPN2 voice parameter "Octave"
E2	Encoder	N/A	OPN2 voice parameter "Frequency"
E3	Encoder	N/A	Datawheel
LD1-LD3	LED	Red	OPN2 Ch3 Mode
LD4-LD7	LED	Red	PSG Noise Freq
LD8-LD9	LED	Red	PSG Noise Type
LD10, LD16	LED	Yellow	FM Voice Output
LD11-LD14,		TCIIOVV	TH Voice Output
LD24-LD29, LD37-LD40, LD48-LD49		FM Widget Path	
LD15, LD17, LD22, LD23, LD30, LD31, LD36, LD42, LD44		Orange	DAC VU Meter
LD18-LD21	Bicolor LED	Red/Green	FM Widget Operator Node

Ref. Des.	Туре	Color	Description
LD33-LD35, LD45-LD46, LD51	LED	Yellow	FM Widget Path Node
LD32	LED	Red	FM Widget Feedback
LD41, LD43, LD47, LD50	LED	Yellow	Key On
LD52-LD53, LD58-LD59, LD60-LD64,		Green	System Load Meter
LD54, LD57, LD65-LD66,	LED	Yellow	System Load Meter
LD55-LD56, LD67	LED	Red	System Load Meter
R1-R2	Resistors	N/A	2.2k terminating resistors for clock and latch lines
RP0-RP1	Resistor Packs	N/A	1k row driver pull-ups (to reduce ghosting)
RP2-RP12	Resistor Packs	N/A	220 ohm LED column current limiters
RP13-RP28	Resistor Packs	N/A	10k button column pull-ups
S1	Button	N/A	OPN2 Ch3 Mode
S2	Button	N/A	PSG Noise Freq
S3	Button	N/A	PSG Noise Type
S4	Button	N/A	FM Voice Output
S5	Button	N/A	Algorithm
S6	Button	N/A	Key On
S7	Button	N/A	Mark Beginning
S8	Button	N/A	Move Up
S9	Button	N/A	Up One Command
S10	Button	N/A	Up One State
S11	Button	N/A	Mark End
S12	Button	N/A	Move Down
S13	Button	N/A	Down One Command
S14	Button	N/A	Down One State
S15	Button	N/A	Menu
S16-S23	Button	N/A	Softkeys
S24	Button	N/A	Enter
TF1	Triforce	Red	Triforce of Power
TF2	Triforce	Blue	Triforce of Wisdom
TF3	Triforce	Green	Triforce of Courage
U1-U12	IC	N/A	74HC595 Output Shift Register, SMD
U13-U20	IC	N/A	74HC165 Input Shift Register, SMD

## **Custom PCB / Veroboard Info**

This is the mapping for the MBQG\_FP board itself-if you have the commercially produced PCB from Sauraen, you don't need this info because it's already in the copper!

MIDIbox Quad Genesis supports its front panel controls in any valid MIDIbox button-LED matrix

configuration, with the following restrictions:

#### **DOUT Restrictions**

- The same BLM must be used for buttons and LEDs, and it must have 8 rows.
- LED display digits must be common anode, connected with their anode to a DOUT shift register pin, and their cathodes to the row lines in the order 0-7 = A-B-C-D-E-F-G-DP.

#### **DIN Restrictions**

- The same BLM must be used for buttons and LEDs, and it must have 8 rows.
- Encoders must have their common pin grounded, and their two switching pins directly connected to two DIN shift register pins (not in the matrix).

For now, the mapping is hard-coded in frontpanel.c, but eventually (if there is interest), it will be read from a text-based configuration file on the SD card upon startup. If you match the matrix maps below, you won't need to edit this at all.

## **DOUT Matrix Map**

#### Syntax:

- X = no item
- B = button
- EB = encoder button (push)
- L = LED
- R = Red
- G = Green
- G# = Genesis #
- O# = LED Ring Segment # (counted from bottom, clockwise)
- LW# = LED, FM Widget, Reference Designator # (since there is no good way to label the individual widget segments)

All LED display digits are wired, from rows 0 to 7: A-B-C-D-E-F-G-DP

VGM Commands Matrix is wired, from top to bottom, 0-1-2-3-4-5-6 (row 7 not used for any columns)

Counting the individual segments in the LED displays, there are 638 LEDs on the front panel.

SR	IDX	BIT	0	1	2	3	4	5	6	7	
		0 ROW0 DRIVER (ACTIVE HIGH)									
		1	ROW1 DRIVER (ACTIVE HIGH)								
		2			R	OW2 DRIVER (A	CTIVE HIGH)				
U1	,	3			R	OW3 DRIVER (A	CTIVE HIGH)				
01	1	4		ROW4 DRIVER (ACTIVE HIGH)							
		5		ROW5 DRIVER (ACTIVE HIGH)							
		6			R	OW6 DRIVER (A	CTIVE HIGH)				
		7			R	OW7 DRIVER (A	CTIVE HIGH)				

SR	IDX	RIT	0	1	2	3	4	5	6	7
31	IDA	_	LR_G1_DAC	LG_G1_DAC	LR_G2_DAC	LG_G2_DAC	LR_G3_DAC	LG_G3_DAC	LR_G4_DAC	LG_G4_DAC
			LR_G1_V1	LG_G1_V1	LR_G2_V1	LG_G2_V1	LR_G3_V1	LG_G3_V1	LR_G4_V1	LG_G4_V1
		_	LR_G1_V1 LR_G1_V2	LG_G1_V1 LG_G1_V2	LR_G2_V1 LR_G2_V2	LG_G2_V1 LG_G2_V2	LR_G3_V1 LR_G3_V2	LG_G3_V1 LG_G3_V2	LR_G4_V1 LR_G4_V2	LG_G4_V1 LG_G4_V2
			LR_G1_V2 LR_G1_V3	LG_G1_V2 LG_G1_V3	LR_G2_V2 LR_G2_V3	LG_G2_V2 LG_G2_V3	LR_G3_V2 LR_G3_V3	LG_G3_V2 LG_G3_V3	LR_G4_V2 LR_G4_V3	LG_G4_V2 LG_G4_V3
U2	2	_	LR_G1_V4	LG_G1_V3 LG_G1_V4	LR_G2_V3 LR_G2_V4	LG_G2_V3 LG_G2_V4	LR_G3_V4	LG_G3_V4	LR_G4_V3 LR_G4_V4	LG_G4_V3
					LR_G2_V4 LR_G2_V5					
		5 6	LR_G1_V5 X	LG_G1_V5 X	X	LG_G2_V5 X	LR_G3_V5 LFOFREQ_O4	LG_G3_V5 LFOFREQ_O5	LR_G4_V5 LFOFREQ_O6	LG_G4_V5
		_	X	X	X	X	<del>-</del>	LFOFREQ_010		
		_	LR_G1_V6	LG_G1_V6	LR_G2_V6	LG_G2_V6	LR_G3_V6	LG_G3_V6	LR_G4_V6	LG_G4_V6
		1	LR_G1_OPN2	LG_G1_OPN2	LR_G2_OPN2	LG_G2_OPN2	LR_G3_OPN2	LG_G3_V0 LG_G3_OPN2		LG_G4_V0
		2	LG_CTRL	X	LR_CTRL	χ	LG_TIME	L_CMDS	LR_TIME	L STATE
		_	L_GROUP	L_MUTE	L_RESTART	L_SOLO	L_PLAY	L_RELEASE	L_RESET	L_PNLOVR
U3	3	_	LR_G1_S1	LG_G1_S1	LR_G2_S1	LG_G2_S1	LR_G3_S1	LG_G3_S1	_	LG_G4_S1
		_	LR_G1_S2	LG_G1_S2	LR_G2_S2	LG_G2_S2	LR_G3_S2	LG_G3_S2		LG_G4_S2
		_	LR_G1_S3	LG_G1_S3	LR_G2_S3	LG_G2_S3	LR_G3_S3	LG_G3_S3	LR_G4_S3	LG_G4_S3
		_	LR_G1_NOISE	LG_G1_NOISE				LG_G3_NOISE		
		0	X	X	X	X	X	L_CH3NORM	L_CH34FREQ	
		1	X	X	L_EG	L_LFO	L DACOVR	L_UGLY	L_CH3FAST	X
		_	L NFMED	L_NFHI	L_KSR	L_SSGON	L_SSGINIT	L SSGTGL	L_SSGHOLD	L LFOAM
		_	L_NFSQ3	L_NFLO	L_NMPLS	L_NMWHT	X	X	X	X
U4	4	_	PSGVOL_015	<del>-</del>	PSGVOL_013	PSGVOL_O12	PSGVOL_011	PSGVOL_010	PSGVOL_09	PSGVOL_08
		_	PSGVOL_00	PSGVOL_01	PSGVOL_O2	PSGVOL_O3	PSGVOL_04	PSGVOL_05		PSGVOL_07
							PSGFREQ_011			
			PSGFREQ_00	PSGFREQ_01	PSGFREQ_02	PSGFREQ_03	PSGFREQ_04			PSGFREQ_07
				RELRATE_014		RELRATE_012		RELRATE_O10		
		1	RELRATE_O0	RELRATE_01	RELRATE_O2	RELRATE_O3	RELRATE_O4	RELRATE_O5	RELRATE_O6	RELRATE_O7
		2	CSMFREQ_015	CSMFREQ_014	CSMFREQ_013	CSMFREQ_012	CSMFREQ_011	CSMFREQ_010	CSMFREQ_09	CSMFREQ_08
	5		CSMFREQ_00	CSMFREQ_O1	CSMFREQ_02		CSMFREQ_04	CSMFREQ_05		
U5		4	DECLVL_015	DECLVL_014	DECLVL_013	DECLVL_012	DECLVL_011	DECLVL_010	DECLVL_09	DECLVL_08
		5	DECLVL_00	DECLVL_01	DECLVL_02	DECLVL_03	DECLVL_04	DECLVL_05	DECLVL_06	DECLVL_07
		6	DEC2R_O15	DEC2R_O14	DEC2R_O13	DEC2R_O12	DEC2R_O11	DEC2R_O10	DEC2R_O9	DEC2R_O8
		7	DEC2R_O0	DEC2R_O1	DEC2R_O2	DEC2R_O3	DEC2R_O4	DEC2R_O5	DEC2R_O6	DEC2R_O7
		0	DEC1R_O15	DEC1R_O14	DEC1R_O13	DEC1R_O12	DEC1R_O11	DEC1R_O10	DEC1R_O9	DEC1R_O8
		1	DEC1R_O0	DEC1R_O1	DEC1R_O2	DEC1R_O3	DEC1R_O4	DEC1R_O5	DEC1R_O6	DEC1R_O7
			ATTACK_015							ATTACK_08
U6	6	3	ATTACK_00	ATTACK_01	ATTACK_02	ATTACK_O3	ATTACK_04	ATTACK_05		ATTACK_07
		-	X	X	Х	X	DETUNE_O11	DETUNE_O10		DETUNE_O8
		5		X	X	Х	X	DETUNE_O5		DETUNE_O7
			HARM_O15	HARM_O14	HARM_O13	HARM_O12	HARM_O11	HARM_O10	HARM_O9	HARM_O8
		_	HARM_O0	HARM_O1	HARM_O2	HARM_O3	HARM_O4	HARM_O5	HARM_O6	HARM_O7
		_	OP1LVL_O0	OP1LVL_O1	OP1LVL_O2	OP1LVL_O3	OP1LVL_O4	OP1LVL_O5	OP1LVL_O6	OP1LVL_O7
			OP1LVL_O15	OP1LVL_O14	OP1LVL_O13	OP1LVL_O12	OP1LVL_O11	OP1LVL_O10	OP1LVL_O9	OP1LVL_O8
		2	OP2LVL_O0	OP2LVL_O1	OP2LVL_O2	OP2LVL_O3	OP2LVL_O4	OP2LVL_O5	OP2LVL_O6	OP2LVL_O7
U7	7	3	OP2LVL_O15	OP2LVL_O14	OP2LVL_013	OP2LVL_012	OP2LVL_O11	OP2LVL_O10	OP2LVL_O9	OP2LVL_O8
		4					COMMON ANOD			
		5					COMMON ANOD			
		6					COMMON ANOD	)E		
		7	0001141 00	00011/1/ 01		TAVE DIGIT CO		000114 05	000114 00	000114 07
		-	OP3LVL_O0	OP3LVL_O1	OP3LVL_O2	OP3LVL_O3	OP3LVL_O4	OP3LVL_O5		OP3LVL_O7
		-	OP3LVL_O15	OP3LVL_O14	OP3LVL_013	OP3LVL_012	OP3LVL_011	OP3LVL_O10		OP3LVL_O8
			OP4LVL_O0	OP4LVL_O1	OP4LVL_O2	OP4LVL_O3	OP4LVL_O4	OP4LVL_O5		OP4LVL_O7
U8	8	3	OP4LVL_O15	OP4LVL_O14	OP4LVL_O13	OP4LVL_O12	OP4LVL_011	OP4LVL_O10	OP4LVL_09	OP4LVL_O8
		_	X	X	X	X	LFOFDER 011	LFOFDER 010	LFOFDEP_06	<del> </del>
		_	X	X	X	X		LFOADER 010		
		6 7	X	X	X EREO		LFOADEP_O4 COMMON ANOD	LFOADEP_010	LEOADER_U6	FLOWDEL OR
		/			rkey	OLINCI DIGIT 4	COMMON ANUL	<u>'</u>		

SR	IDX	ВІТ	0	1	2	3	4	5	6	7		
		0	Х	X	Х	X	L_DACB9	L_DACENAB	LW46	X		
		1	LW45	LW48	LW51	LW49	L_KON1	L_KON2	L_KON3	L_KON4		
		2	FEEDBACK_011	FEEDBACK_O10	FEEDBACK_09	FEEDBACK_08	L_DACB5	L_DACB6	L_DACB7	L_DACB8		
U9	9	3	FEEDBACK_04	FEEDBACK_O5	FEEDBACK_6	FEEDBACK_7	L_DACB1	L_DACB2	L_DACB3	L_DACB4		
09	9	4	LW32	LW33	LW37	LW38	LW34	LW39	LW40	LW35		
		5	L_OUTL		LW24	LW25	LW26	LW27	LW28	LW29		
		6	LR_OP1	LG_OP1	LR_OP2		LR_OP3	LG_OP3	LR_OP4	LG_OP4		
		7	L_SELO1	L_CARRO1	L_SELO2	L_CARRO2	L_SELO3	L_CARRO3	L_SELO4	L_CARRO4		
		0		MAIN DIGIT 4 COMMON ANODE								
		1	MAIN DIGIT 3 COMMON ANODE									
		2			M	AIN DIGIT 2 CON	MON ANODE					
U10	10	3				AIN DIGIT 1 CON	MON ANODE					
010	10		L_RAM0			_	L_RAM4	L_RAM5	L_RAM6	L_RAM7		
			L_CHIP0	L_CHIP1		_	L_CARD3	L_CARD2	L_CARD1	L_CARD0		
			L_LOAD			_	L_NEW	L_DUPL	L_DELETE	L_PASTE		
			L_PROG	X	L <b>–</b>	_	L_MDLTR	L_VOICE	L_SAMPLE	L_CHAN		
		0	VGM COMMANDS MATRIX COLUMN 7: FM 4									
		1	VGM COMMANDS MATRIX COLUMN 6: FM 3									
		2	VGM COMMANDS MATRIX COLUMN 5: FM 2									
U11	11	3	VGM COMMANDS MATRIX COLUMN 4: FM 1									
		4	VGM COMMANDS MATRIX COLUMN 3: OPN2									
		5	VGM COMMANDS MATRIX COLUMN 2: TIME									
		6			VGM CO	MMANDS MATR	IX COLUMN 1: 0	TRL				
		7	X									
		0			VCM COM	X MANDE MATRIX	COLUMN 14. O	D4/NC				
		2				MANDS MATRIX						
		3				MANDS MATRIX MANDS MATRIX		<u> </u>				
U12	12	4				MANDS MATRIX		<u> </u>				
		5				MMANDS MATRI		<u> </u>				
		6				MMANDS MATR						
		7										
7 VGM COMMANDS MATRIX COLUMN 8: FM 5												

# **DIN Matrix Map**

SR	IDX	BIT	0	1	2	3	4	5	6	7		
		0	OP4LVL ENCODER A									
		1				OP4LVL E	NCODER B					
		2		LFOFDEP ENCODER B								
U13	1	3				LFOFDEP	ENCODER A					
		4				LFOADEP	ENCODER B					
		5				LFOADEP	ENCODER A					
		6	LFOFREQ ENCODER A									
		7	LFOFREQ ENCODER B									
		0	B_MENU	B_G1_V2	Χ	B_G2_V2	Χ	B_G3_V2	B_ENTER	B_G4_V2		
		1	B_SOFT1	B_G1_V3	B_SOFT2	B_G2_V3	B_SOFT3	B_G3_V3	B_SOFT4	B_G4_V3		
		2	B_SOFT5	B_G1_V4	B_SOFT6	B_G2_V4	B_SOFT7	B_G3_V4	B_SOFT8	B_G4_V4		
U14	2	3	B_MARKST	B_G1_V5	B_MOVEUP	B_G2_V5	B_MARKEND	B_G3_V5	B_MOVEDN	B_G4_V5		
014		4	Χ	B_G1_V1	X	B_G2_V1	X	B_G3_V1	X	B_G4_V1		
		5	Χ	B_G1_DAC	Χ	B_G2_DAC	X	B_G3_DAC	X	B_G4_DAC		
		6	B_SELO1	B_OUT	B_SELO2	B_ALG	B_SELO3	B_DACEN	B_SELO4	B_KON		
		7	Χ	Х	Χ	Χ	EB_OP1LVL	EB_OP2LVL	EB_OP3LVL	EB_OP4LVL		

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SR	IDX	BIT	0	1	2	3	4	5	6	7		
		0	Х	B G1 V6	Χ	B_G2_V6	Χ	B_G3_V6	Х	B_G4_V6		
		1	Х	B_G1_OPN2	Х	B_G2_OPN2	Χ	B_G3_OPN2	Х	B_G4_OPN2		
		2	Χ	B_G1_S1	Χ	B_G2_S1	Х	B_G3_S1	Х	B_G4_S1		
		3	Х	B_G1_S2	Х	B_G2_S2	Χ	B_G3_S2	Х	B G4 S2		
U15	3	4	Χ	B G1 S3	Χ	B_G2_S3	Х	B_G3_S3	Х	B G4 S3		
		_	Χ	B_G1_NOISE	Χ	B_G2_NOISE	Χ	B_G3_NOISE	X	B_G4_NOISE		
		6	B NSTYPE		B EG	B LFO	B_DACOVR	+	B_FAST	B CH3MODE		
			<del>-</del>	X	B KSR	B_SSGON	B SSGINIT	B_SSGTGL	B_SSGHOLD			
		0			_		ENCODER A	_	_	. –		
		1					ENCODER B					
		2		RELRATE ENCODER A								
		3	RELRATE ENCODER B									
U16	4	4				PSGFREQ	ENCODER A					
		5	PSGFREQ ENCODER B									
		6	PSGVOL ENCODER A									
		7				PSGVOL E	ENCODER B					
		0										
		1										
		2	DECLVL ENCODER B									
	_	3	DECLVL ENCODER A									
U17	5	4	DEC1R ENCODER B									
		5				DEC1R E	NCODER A					
		6	FREQ ENCODER B									
		7				FREQ EN	NCODER A					
		0				ATTACK E	NCODER B					
		1				ATTACK E	NCODER A					
		2				DETUNE I	ENCODER B					
U18	6	3				DETUNE I	ENCODER A					
010	0	4				HARM EI	NCODER B					
		5				HARM EI	NCODER A					
		6				OCTAVE I	ENCODER B					
		7				OCTAVE I	ENCODER A					
		0	OP2LVL ENCODER B									
		1					NCODER A					
		2				OP3LVL E	NCODER B					
U19	7	3					NCODER A					
	'	4					NCODER B					
		5					NCODER A					
		6					ENCODER B					
		7					ENCODER A					
		0					L ENCODER E					
		1					L ENCODER A	4				
		2					X					
U20	8	3					Χ			I= a= :=		
		_	B_CTRL	B_CMDDN	B_CMDUP	B_STATEDN		B_CMDS	B_STATEUP	B_STATE		
			B_LOAD	B_CROP	B_SAVE	B_CAPTURE	_	B_DUPL	B_DELETE	B_PASTE		
			B_GROUP		B_RESTART	<del>-</del>	B_PLAY	B_RELEASE	B_RESET	B_PNLOVR		
		7	B_PROG	EB_DATAWHL	B_VGM	B_SYSTEM	B_MDLTR	B_VOICE	B_SAMPLE	B_CHAN		

### 3D Printed Items

The buttons on MBQG\_FP consist simply of a 5mm tact switch and up to 2 3mm LEDs on the front panel board, and a 3D printed, transparent plastic button cap which sits loosely on top. It is held in by the front panel, its flanges, and the button and LEDs underneath.

MBQG\_FP also uses a number of LED pipes, which are 3D printed, transparent pieces which are held in the slots of the aluminum front panel by friction, and which are intended to cause the slot to light up uniformly when lit underneath by an LED. The original version used LED pipes for all the LED rings, but since this was extremely tedious, I recommend only using the LED pipes for the FM Widget and the DAC VU meter.

### Things You Should Know If Having These Printed

- You need 115 buttons and 26 LED pipes, assuming you're not using LED pipes for all the LED rings. However, especially if the 3D printer (machine and/or person) is inexperienced, you will need lots of extras. For the LED pipes, because they are friction-fit, buy at least double the number you will need; and for the buttons, at least 20 extra or so.
- The total cost to have these items printed should be roughly \$20-\$30 plus shipping. If someone is trying to charge you more than that, either there's an issue (like they got the scale wrong and think you want giant-sized parts), or they're trying to gyp you. If you try to get these printed by a commercial service (e.g. Ponoko), they will charge a minimum of \$1 per part and the result will be prohibitively expensive! Have them printed by a real person instead, either a friend with a 3D printer or possibly someone from the RepRap forums.

### Things You Need to Tell the Person Printing Them

- The scale in the STL files is 1 INCH, not 1 mm. The buttons should be about 1/2" or 12mm wide. (This is not intended as an engineering dimension, just as a sanity check-use the actual dimensions in the file.)
- **Update:** Smithy has added additional STL files in metric scale below.
- Either ABS or PLA transparent filament should work. I had the guy who made them for me do tests with both, and I liked the light-up appearance of the ABS better but the "off" appearance of the PLA better. But they were pretty similar.
- I had the guy who made them for me do tests with different fill rates, and if I remember correctly around 10% fill worked best. 100% fill would be needlessly expensive and would dim the LEDs.
- The buttons need to be printed with the flanges and the cutout down, and the beveled rectangular surface up. The LED pipes need to be printed with the flat surface down and the crown-shaped end up.

#### **Downloads**

(You must be logged in with your MIDIbox Forum account to access the downloads)

mbqg\_fp\_buttons.stl

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mbgg fp ledpipes.stl

Additional files provided by Smithy:

Buttons in metric scale for 2mm Front Panel

LED pipes in metric scale for 2mm Front Panel

Buttons in metric scale for 3mm Front Panel

LED pipes in metric scale for 3mm Front Panel

## **Assembly Guide**

Once you have your front panel PCB, your aluminum front panel, and all the other parts, here's some tips for the assembly process.

- 1. Begin by soldering all the SMD shift registers and resistor packs. The pads aren't very big (if I had known, I would have made them bigger...), and I had a lot of issues with bad connections because a leg which looked soldered wasn't actually attached. If you have access to solder paste and a heat gun, use that. If not, apply solder to two corner pads on the board, place the chip on and melt those two legs into the solder to connect them. Adjust the position so that all the pins line up correctly. Then solder the rest of the legs, making sure to press down firmly with the iron on each leg just before applying the solder, in hopes that the leg will conduct heat to the copper and then when you apply the solder it will flow across the two.
- 2. Solder the diodes, the two discrete resistors, the through-hole resistor packs, and the ceramic capacitors.
- 3. Solder all the tactile switches. Only solder two pins of each switch to start, and make absolutely sure every single button is seated fully before soldering the remaining two pins. If the switch isn't seated fully, the 3D printed button will bind and it may prevent the front panel from going together well.
- 4. Solder all the LEDs which are under buttons or LED pipes. Make sure each is also fully seated, and ideally, pointing as close to straight up as possible. Again, the panel won't go together right if any are sticking out, and buttons may bind if the LEDs under them are a little tilted.
- 5. For each region of LEDs which stick through the front panel: Insert the LEDs into the board. Stick a couple screws in the area up through from under the board (backwards). Drop a 1/4" nylon standoff/spacer and a thin washer on top of each, and then slide the front panel down onto the screws. Secure them with a nut. Now flip over the assembly and drop/push each LED into the hole in the aluminum. Hold up the assembly and make sure all the LEDs are pushed in uniformly. Solder the LEDs.
- 6. For the above step, if these are LEDs around an encoder, instead of securing the front panel with screws while soldering, solder in the encoder before you begin the process, and then use the encoder (with its nut) to hold the front panel to the aluminum while pushing in and soldering the LEDs. Make sure of course that the encoder is seated fully! If the encoder's mounting tabs have trouble going through the mounting holes, bend them a bit with pliers-they will eventually fit smoothly. Make sure to use plenty of solder (and plenty of heat) on the mounting tabs.
- 7. For the LED displays, do a similar process to with the LEDs to ensure they fit correctly in the front panel and are flush with its surface. I used a small piece of wood to hold the displays flush with the surface while soldering them-"pushed in all the way" will not be flush with the surface, it will be below the surface.

8. Make sure to mount the electrolytic capacitors behind the front panel, i.e. on the opposite side from all the other components.

### **Final Assembly**

Once you have finished the board and tested it on its own, it's time to put it all together.

- 1. Insert all the LED pipes in the aluminum. May take elbow grease as the aluminum "cuts" plastic off the sides of them to fit.
- 2. Insert long (~5cm) M3 or 4-40 screws through all the holes in the aluminum, in the correct direction. Sit the front panel on your table with the screws sticking up (back side up).
- 3. Lay all the 3D printed buttons in the appropriate cutouts, making sure to get the LED cutout pointing in the correct direction.
- 4. Add a thin flat washer and a 1/4" nylon standoff/spacer to each screw.
- 5. Slip the front panel PCB down over all the screws. The encoders will hold it up against the table through the holes.
- 6. Loosely cap each screw with a nut.
- 7. Pick up the aluminum so that the front panel PCB slips down into all the holes. Press the PCB where necessary and ensure that the LEDs are in their holes and everything is tightly together.
- 8. Loosely tighten all the nuts.
- 9. For each screw, loosen and remove the nut, then take another screw and put its tip against the tip of the screw sticking through the assembly. Slide the two screws down through the assembly, so that you have now exchanged the original long screw pointing correctly with a screw pointing backwards (out the front of the panel). Then, take your screw of final length, push it against the tip of the backwards screw, and slide them through, so the screw of final length is in its final position. Add a small lockwasher and the nut, and tighten. The purpose of this is to exchange the long screw for a shorter screw without risking the washer and spacer getting dislodged.
- 10. Make sure none of the nuts you use are big enough that they touch any of the soldered connections, especially the ones in the middle of the voice selection buttons.
- 11. Once all the screws are in place, flip over the panel and add the washer and nut to each encoder.
- 12. Finally, hand-tighten all the screws between the screw head in front and the nut in back.

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