## **MSX-EQ PSG Spectrolyzer for MSX**



Developer: Pyhesty [RBSC]. Copyright (C) 2022

Русская версия находится здесь: MSX-EQ PSG Spectrolyzer для платформы MSX

The MSX-EQ PSG Spectrolyzer is a simple cartridge for the MSX platform that visualizes the spectrum of notes played by the programmable sound generator, such as the AY-3-8910 or YM2149 (PSG). The cartridge board is intended for the standard MSX cartridge slot. The board shows the effect of measuring the signal's level, in which each reproduced frequency (or frequency range) corresponds to one of 9 vertical LED indicators.

The MSX-EQ cartridge is based on the PLD Altera EPM7128, that has 128 logical units. The PLD intercepts PSG port I/O, identifies the played note/frequency and displays its representation on the dedicated LED indicator. The cartridge doesn't need any special setup. It can be installed into any standard MSX slot that allows an unobstructed view of the cartridge's LED indicators.

The cartridge visualizes the played notes/frequencies in games and demos in real time. After a note/frequency fades out, the LED indicators automatically switch off.

The cartridge may be assembled in 2 different ways:

- 1. With discrete LED elements simple, but allowing various color combinations
- 2. With LED assemblies the so-called "bars", mostly single-colored

The following color combinations are possible (those were tested and were found suitable for the project, however other color combinations are possible):

- One color LEDs or LED assemblies: blue, red or green
- Multi-colored LEDs or LED assemblies: blue with red or green with red (red LEDs are placed on top)

# Circuit



A13	Конп.	Цепь
	26	A13
A1	27	A1
A0	28	A0
A3	29	A3
A2	30	A2
A5	31	AS
A4	32	A4
D1	33	D1
D0	34	DO
D3	35	D3
D2	36	02
D5	37	05
D4	38	D4
D7	39	D7
D6	40	D6
GND	41	GND
CLK	42	CLOCK
GND	43	GND
1	44	SW1
→sv	45	+5V
0000	46	SW2
>5V	47	+5V
+1	48	+12V
SND1	49	SOUND_IN
-1	50	-12V
	~	- 12.4

-A+		K-18 K0 /	A+ K-18 K1 /	- A+
4 A+	2	K-17 R0 6	4 A+ 7 K-17 R1 6	4 A-
5 A+	Ň	K- 16 R0 5	SA+ K-16 R1 5	SA.
6 A+		K- 15 R0 4	6 A+ K- 15 R1 4	6 4.
7 A+		K-14 R0 3	7 A+ K- 14 R1 3	7 4-
8 4+		K-13 R0 2	8 A+ K-13 R1 2	8 A+
9 A+		K- 12 R0 1	9 A+ K- 12 R1 1	9 4.
10		K-11 R0 0		10
A+	LEDx10		ELDATO	A+
-1 <sub>A+</sub>	DA2	K-20 R0 9	Lp 4 1 A+ DA5 K-20 R1 9	Lp 7 1A+
-2 A+		K-19 R0 8	2 A+ K-19 R1 8	2 A+
3 4+		K-18 R0 7	A+ K-18 R1 7	3A+
4 A+	72	K-17 R0 6	4 A+ 7 K-17 R1 6	4 A+
5 A+	-F¥	K-16 R0 5	SA+ K-16 R1 5	SA.
6 A+		K-15 R0 4	6 A. K- 15 R1 4	6 A+
7 A+		K-14 R0 3	A+ K-14 R1 3	7 4+
8 A+		K-13 R0 2	8 A+ K-13 R1 2	8 A+
9 A+		K- 12 R0 1	9 A+ K-12 R1 1	9 A+
10 A+		K- 11 R0 0	10 11 R1 0	10 A+
	LEDx10	-	LEDATO	A*
A+	DA3	K-20 R0 9	Lp 5 A+ DA6 K- 20 R1 9	Lp 8 A+
-4 A+		K-19 R0 8	ZA+ K- 19 R1 8	- A+
34+		K-18 R0 7	А+ К- <sup>18 RI 7</sup>	-3A+
4 A+	12	K-17 R0 6	4 A+ 7 K-17 R1 6	4 A+
5 A+	-EH	K-16 R0 5	A+ K-16 RI 5	5 A+
6 A+		K-15 R0 4	6A+ K-15 R1 4	6 A+
7 A+		K-14 R0 3	7 A+ K-14 R1 3	7 A+
8 A+		K-13 R0 2	8 <sub>A+</sub> K-13 R1 2	8 A+
9 A+		K-12 R0 1	9 A+ K- 12 R1 1	9 A+
10 A+	LEDx10	K-11 R0 0	10 A+ LEDx10 K-11 RI 0	10 A+
_	LEDXIU		LEDXID	

K-20 R0 9 Lp 3 A+ K-19 R0 8 2 A+

DA4 K-20 R1 9 K-19 R1 8

R2 6

R2 :

11 R2 0

20 R2 9

19 R2 8 R2 7 R2 6 R2 5

> R2 2 R2 1

R2 0

R2 9 R2 8 R2 7 17 R2 6

R2 4 4 R2 3 R2 2

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LEDx1

DA8

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10 A+ LEDXI

4 A-5 A-6 A-7 A-8 A-9 A-10 A-Å

#### **MSX-EQ PSG Spectrolyzer Cartridge** Copyright (c) 2021-2022 RBSC **Developer: Pyhesty**

4	cfg1 6	1/0 1/	045 Lp 5	LED2 2 56	1/0 GNO_10	95 GND
4	cfg2 7		64 LED1 9	LED2 1 55	1/0 1/0	94 D2
4	8	I/O GND_	043 GND	LED2 0 58	1/o i/o	
4	Lp 0 9	1/0 1/	42 LED1 8	GND 55	GND.10 1/0	
I	LED0 6 10		61 Lp 4	Lp 7 60		
1	GND 11	GND_ID I/	040 LEDI 0	Lp 8 6	1/0 DE2/GCLK2	
1	LED0 5 12			TCK 63	TEK GELRA	
1	LED0 4 13	I/O GND_IM	T B8 GND	63	1/0 OE1	88 A2
1	LED0 3 14	1/0 I/	0 37 LEDI 1	64	I/O GELK	87 CLK
1	TMS 15	TMS I/	36 LEDI 2	/SLTSL 65	I/O GND_INT	86 GND
1	LED0 2 15	1/0 I/	035 LEDI 3	5V <del>&lt; 60</del>	VCC.ID I/O	
1	LED0 1 17	1/0 VCC_	0 <sup>B4</sup> →5V	/IORQ 67	1/0 1/0	84 A0
1	5V <del>&lt; 18</del>	VCC_I0 I/	033 LEDI 4	/RD 66	1/0 1/0	
1	LED0 019	1/0 1/	32 LED1 5	/WR 69	1/0 VCC.JO	82 >5V
1	Lp 1 20	1/0 1/	0 <sup>31</sup> LED1 6	/RESET 70	1/0 1/0	81 A13
4	21	1/0 1/	0 30 LEDI 7	A15 7	1/0 1/0	80 A12
4	LED0 7 22	1/0 1/	029	A9 72	1/0 1/0	
4	LED0 8 23	1/0 1/	0 28	TDO 73	TDD 1/0	78 A7
4	LED0 9 24	1/0 1/	0 <sup>27</sup> Lp 3	GND 74	GND_IO I/O	77 A6
4	Lp 2 25	1/0 GND_	0 26 GND	A10 75	1/0 1/0	76 A11
4		EPM7128		•	EPM7128	
4		R1		R11	R21	
-	LED2 0 1k		D1 0 1k	R1 0 LED0		0 TCK
ł	LED2 1 1k	R2 R2 1		R12 R1 1 LED0		I GND
-		R3		R13	R23	TDO
•	LED2 2 1k		D1 2 1k	R1 2 LED0		
	LED2 3 1k	R4 R2 3 L	2D1.3 1k	R14 R1 3 LED0	R24 R24 R0	3 TMS
		RS		R15		11
	LED2 4 1k		DI 4 1k	R1 4 LED0		4
	LED2 5 1k	R6 R2 5 L	2D1.5 1k	R16 R1 5 LED0	R26	5
		R7		R17	R27	TDI
	LED2 6 1k		2D1 6 1k	R1 6 LED0		6 GND
	LED2 7 1k	R8 R2 7 Li	2D1 7 1k	R18 R1 7 LED0	7 1k R28	7
		R9		R19	R29	
	LED2 8 1k		2D1 8 1k	R1 8 LED0		8 TCK 1k
	LED2 9 1k	R10 R2 9 L	D1 9 1k	R20 R1 9 LED0	19 1k R30	9 TDO 1k
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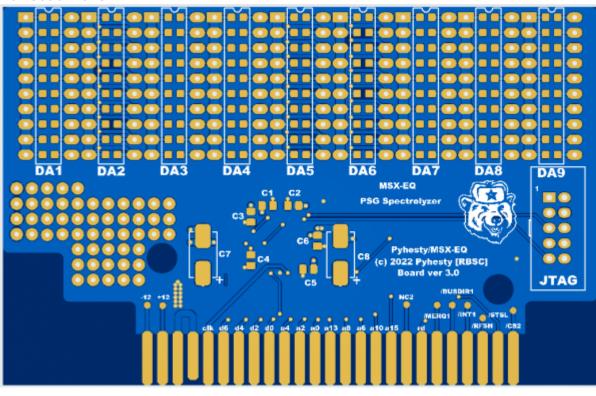
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LED

8	TCK	1k		GND
9	TDO	1k	R32	>sv
	TMS F	1k	R33	
	TDI		R34	>5V
		1k	R35	>sv
	cfg0	1k	R36	GNE
	cfg1	1k	R37	GND
ų,	cfg2	1k	-	GND

D4

#### Front side of the PCB:



#### Gerber format files

All parts for assembling the MSX-Eq cartridge can be purchased from varios sellers on AliExpress:

Part	Value	Count	Note
C1C6	100nF	6	C0805
C7C8	47uF 10v	2	CPOL-EUSMCB SMC_B
DA1DA9	LEDs	9	2010BB DIP-8

Part	Value	Count	Note
D1	EPM7128STC100	1	TSOP-100
R1R37	1k	37	R0805
XP2	PLD10	1	PIN-10
MSXSLOT	EDGE-CONNECTOR	1	50-pin slot

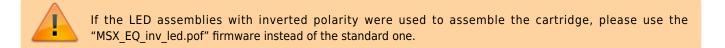
LED assemblies

### Firmware uploading

The freshly-assembled MSX-EQ cartridge needs the firmware to be uploaded into the PLD chip. For updating/uploading the firmware into the cartridge you will need:

- 1. Quartus II Web Edition (Free) 15.0 software
- 2. Byte Blaster or USB Blaster programmer (can be purchased on Ebay or AliExpress)

The procedure is simple — supply 5v onto the cartridge board, connect the USB Blaster to the JTAG connector's placeholder (mind the orientation of the connector!). Auto-detect the Altera chip with Quatrus software and then upload the POF file from the "Firmware" folder into the PLD chip.



#### **Cartridge case**

Any factory-made MSX cartridge manufactured from semi-transparent or transparent plastic is suitable for the MSX-EQ cartridge board.

For example, the following quality MSX cartridge cases can be obtained from Overrich (South Korea) and Retro Game Restore (Taiwan):

- https://retrogamerestore.com/store/msx\_cart\_shell/
- https://www.msx.org/news/en/black-white-and-transparent-msx-cartidge-cases-overrich

Also, there's a 3D model of the cartridge case. The case should be printed with semi-transparent filament.

3D model of the cartridge case files:

- Top
- Bottom

#### **Visual Effects**

You can check how the cartridge visualizes various PSG effects by watching these videos:

- Games
- Demo 1
- Demo 2

# Disclaimer

All files of the MSX-EQ project are available in the RBSC's Github repository: Ohere.

Link to the official website

The RBSC provides all the files and information for free, without any liability. The provided information, software or hardware must not be used for commercial purposes unless permitted by the RBSC. Producing a small amount of bare boards for personal projects and selling the rest of the batch is allowed without the permission of RBSC.

When the sources of the tools are used to create alternative projects, please always mention the original source and the copyright!

## Links

Discussion on msx.org

MSX Spectrolyzer - New flashy project from RBSC

http://sysadminmosaic.ru/en/msx/msx-eq/msx-eq

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