

# ES9038Q2M Dual Mono II

## DAC HAT

### user's manual

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## A. Introduction

ES9038Q2M Dual Mono II is the third-generation audiophile grade core ESS DAC board. Based on the latest ESS SABRE32 reference DAC technologies, it can provide the highest possible sound quality and performance for audiophile DIYers at reasonable cost. User can run this DAC at either default ASRC mode or the advanced SYNC clock mode when works with a FifoPi.

## B. Highlighted Features and Specifications

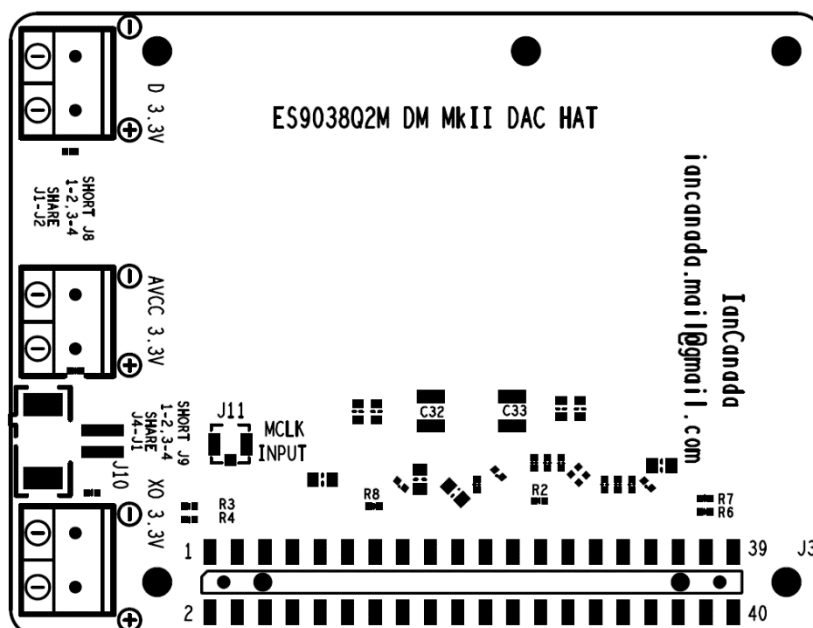
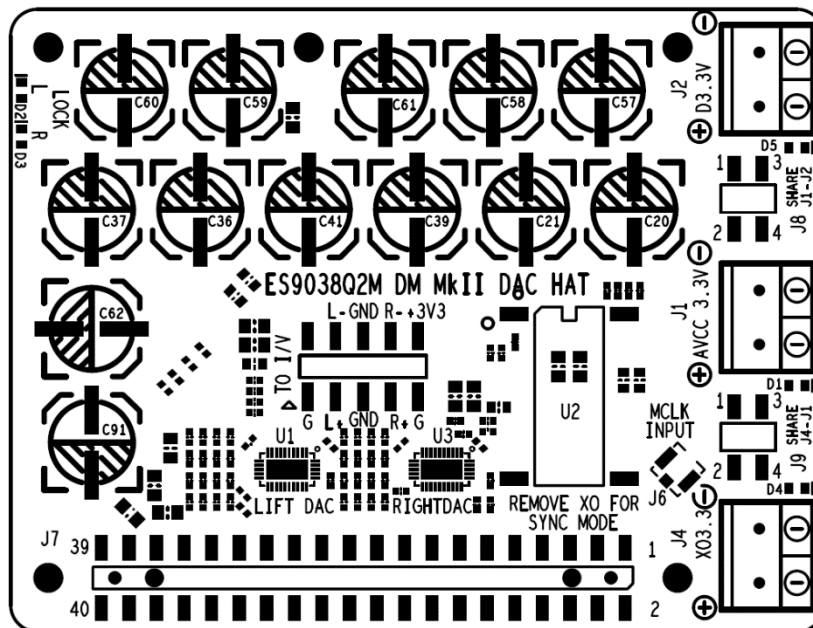
- 32bit SABRE32 DAC true dual mono architecture
- Supports up to 768KHz 16/24/32bit PCM, native DSD1024, and DSD256 via DoP and S/PDIF
- SYNC and ASRC dual clock mode
- External synchronous clock range from 22.5792MHz to 98.3040MHz. Or 100MHz internal asynchronous clock.
- Control and register settings by external ESS controller or MonitorPi Pro
- Controller operates in isolated mode when used with FifoPi to eliminate ground loop and EMI noise
- Raw balanced current output enables use of a variety of external output stages such as the Transformer I/V, the standard OPA I/V or the OPA861 zero feedback balanced I/V
- Dual mono configuration can provide 389 Ohm ultra-low output impedance to get much higher dynamic output current than the normal single chip configuration
- Direct 3.3V power inputs ready for ultracapacitor power supply or LifePO4 battery power supply
- Independent lock LED indicators for both left and right DAC chips
- Can automatically switch between PCM, DSD, DoP and S/PDIF
- XO socket design makes it possible to swap/upgrade to better local clock
- Very easy to switch to SYNC modem by just removing local XO from the socket and plugging an U.FL MCLK cable
- DIY friendly with many modification and upgrading opportunities

## C. ES9038Q2M Dual Mono II new improvements

- Bigger PCB size and bigger inner grounding shield areas
- Enhanced low noise filtering networks for local power supply to improve the sound quality
- Moves power supply connects to the side edge of the PCB for a more organized configuration
- With power supply configuration jumpers can either share one good ultra-low ESR power supply (such as a UcPure III 3.3V) or have separated AVCC, DVCC and VCCA voltage rails.

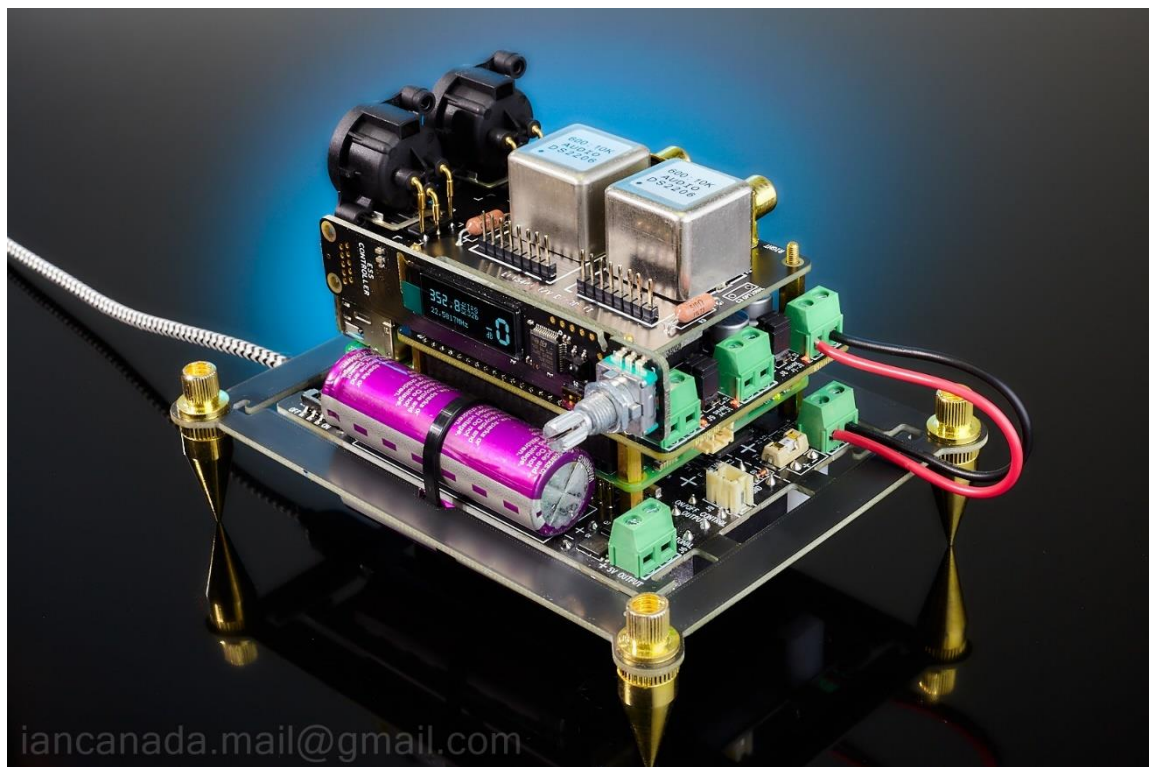
- Two high quality MCLK U.FL connectors pre-installed at both top and bottom side of the PCB, which not only makes the installation much easier but also makes it possible to use a shorter coaxial MCLK cable
- Can use Audiophonics I-Sabre as Linux driver for better performance when uses the new MonitorPiPro as the controller
- Better manufacturer quality

## D. PCB Layout



## E. Getting started with the default low-cost ASRC mode DAC

1. Install a RaspberryPi to a PurePi power supply (Optional but recommended)
2. Install the ES9038Q2M Dual Mono II on top of the RaspberryPi using 11mm standoffs. Connect two wires to the J2 of the DAC from the high quality 3.3V battery output J2 of the PurePi.
3. Install a low-cost transformer I/V output board or other I/V board on top of the DAC using 13mm standoffs.
4. Install an ESS Controller or a MonitorPiPro in to GPIO connector J7.
5. Install a micro-SD card loaded with your preferred player software such as Volumio into your RaspberryPi.
6. Turn on power supply. DAC information should be displayed on the OLED screen. Turn the volume to 0dB.
7. In the software player's configuration dialog, select Audiophonics I-Sabre as I2S device. And also enable the DoP for DSD. Restart the player if required.
8. Play music in the software. The corresponding music format should be displayed on the OLED screen of the ESS controller or the MonitorPi Pro.
9. Enjoy the music.



## F. Jumpers

### J8:

Short 1-2 and 3-4 to connect J1 and J2 together (default)

Open 1-2 and 3-4 to leave J1 and J2 independent

### J9:

Short 1-2 and 3-4 to connect J1 and J4 together (default)

Open 1-2 and 3-4 to leave J1 and J4 independent

## G. Connectors

**J1: 3.3V/50mA DC power input for AVCC**

**J4, J10: 3.3V/50mA DC power input for VCCA**

**J2: 3.3V/100mA DC power input for DVCC**

By default, J8 and J9 are all jumped to make J1, J2 and J4 bridged together to share a same power supply. In this case, we can connect only one low-noise higher quality 3.3V power supply to either of them. Linear power supply is OK. But the direct-connected ultracapacitor or LifePO4 battery power supply, such as PurePi 3.3V output, LifePO4Mini 3.3V and a UcPure 3.3V, are highly recommended to get better sound quality.

J1, J2 and J4 can also be powered by three independent 3.3V power supplies if both J8 and J9 keep open without jumpers installed.

J10 is reserved for testing. Please leave it unconnected for normal applications.

**MAINTAINING CORRECT POLARITY!!!**

**J6, J11: External MCLK input (u.fl coaxial cable socket)**

When operating the ES9038Q2M DM II in SYNC clock mode, connect the external MCLK signal from a FifoPi or similar synchronous MCLK source using a u.fl coaxial cable. **Local XO U2 must be removed** from the socket in this mode.

J6 and J11 are equivalent to each other. You can use either of them. But J11 is recommended because it located at bottom side of PCB so a short coaxial cable can be used for an easier installation.

\*Note: DO NOT connect J6 and J11 when operating in ASRC mode (default).

### J5: Fully balanced ES9038Q2M DM II raw current output

Connect an output stage board as below:

pin number	Descriptions
1	NC
2	RaspberryPi 5V, internally connected to RaspberryPi GPIO pins 2 and 4
3	L+, Left positive current output
4	L-, Left negative current output
5	GND
6	GND
7	R+, Right positive current output
8	R-, Right negative current output
9	NC
10	AVCC (ES9038Q2M AVCC 3.3V voltage rail)

### 40 pin GPIO connectors

pin number	J3 40 PIN GPIO socket connector to board below (RaspberryPi, IsolatorPi I/II, FiFoPi, or similar)	J7 40 PIN GPIO connector to HAT on top of 9038Q2MPi
1,17	3.3V from preceding board	3.3V from preceding board
2,4	5V from preceding board	5V from preceding board
6,9,14,20, 25,30,34, 39	GND	GND
3	I2C DA	I2C DA
4	I2C CL	I2C CL
27	ID DA	ID DA
28	ID CL	ID CL
12	SCK input	SCK from preceding board
35	LRCK/D1 input	LRCK/D1PIN from preceding board
40	SD/D2 input	SD/D2 PIN from preceding board
All other pins	same pin from preceding board	same pin from preceding board

40PIN GPIO connector note: All input/output signals are LVTTTL (3.3V) logic level except power and ground.

### U2: Local XO socket

A 100MHz XO was installed in this socket for default ASRC mode. Local XO can be upgraded by swapping to a higher quality low-phase noise XO.

**Local XO must be removed** from the socket when connecting a U.FL MCLK cable to J6 or J11 from FifoPi for SYNC mode (better sound quality).

## H. LED indicators

LED	Description	On Indicates...
D2	LOCKL	Left ES9038Q2M DAC U2 is locked to input music signals (green or red)
D3	LOCKR	Right ES9038Q2M DAC U6 is locked to input music signals (green or red)
D1	AVCC POWER	AVCC power applied
D4	VCCA POWER	VCCA power applied
D5	DVCC POWER	DVCC power applied

## I. How to produce the best sound quality from your ES9038Q2M Dual Mono II DAC

### Run your DAC in SYNC clock mode

We prefer running this DAC with a synchronous MCLK than the default ASRC mode. SYNC mode has better sound quality because of the bit-perfect processing. To do that, switch to SYNC clock mode by:

1. Installing a FifoPi under the ES9038Q2M DM II DAC (see FifoPi user's manual for installation and configuration details).
2. Make sure you have a pair of really nice clocks installed into the FifoPi. The phase noise performance of these clocks is very important to the sound quality and sonic signature. SC-Pure 45.1584/49.1520 MHz clocks are highly recommended for upgrade. Please note that SC-Pure clocks have higher profile than the supplied XOs so a GPIO spacer KIT may need to be installed between FifoPi and the DAC.
3. Remove local XO from socket U2.
4. Connecting the MCLK signal from the FifoPi to J11 or J6 of the ES9038Q2M DM II DAC using a u.fl coaxial cable. Cable length should be as short as possible.
5. Setting DPLL bandwidth to lowest level 1 for both PCM and DSD in the ESS Controller, at the "DPLL Bandwidth" setting panel (see ESS Controller manual for configuration details).
6. Power up and enjoy the music.

After performing the above steps, your ES9038Q2M DM II now is using an MCLK that is synchronous to the music signal and is largely bypassing the DPLL.

Further gains can be made by stopping the DPLL and enabling True Sync mode. But as a non-official supported feature, there are limitations to True Sync mode with the ES9038Q2M:

- It supports PCM format very well. DSD and DoP may not be supported when using 22.5792MHz or lower frequency MCLK.
- There could be click sound when switching between PCM and DSD music.
- MCLK has to be 128FSR

If you do not follow these limitations, True Sync mode does not work properly. Also, once you have enabled True Sync mode on the 9038Q2MPi, the lock LEDs stay on continuously.

Enable True Sync mode on your 9038Q2M by:

1. Selecting “True SYNC with DPLL stopped” in the ESS Controller at the “Normal/True SYNC mode” setting panel.
2. Setting both PCM bandwidths to “No band width 0”.

See ESS Controller manual for configuration details.

### **Isolate your ES9038Q2M DM II from the ESS Controller**

ESS Controller contains a micro-processor. It generates EMI noise that can impact sound quality. Connecting the ESS Controller through an isolator eliminates any direct electronic connections between ESS controller and ES9038Q2M DM II and prevents this noise from reaching the DAC. The ES9038Q2M DM II grounds will be cleaner when configured this way.

To run the ESS Controller in isolated mode, you need to use a FiFoPi under the ES9038Q2M DM II DAC and connect the ESS Controller to the non-isolated GPIO connector of the FiFoPi.

### **Power your 9038Q2MPi directly from 3.3V ultra capacitor or LiFePO4 battery power supplies**

We have found using a directly-connected passive (no LDO or other active components on the output) 3.3V ultra capacitor or LiFePO4 battery power supply to be a significant improvement over most traditional power supplies. UcPure MkIII 3.3V with 3000F ultracapacitors is highly recommended for sound quality because it's so far the best low noise high dynamic power supply. The LifePO4 Mini 3.3V and the PurePi are also good power supply solutions. A UcConditioner 3.3V can also be help to improve battery power supply performance.

MonitorPi Pro is recommended as the DAC controller because it has a MUTE output which can be used to enable the SYNC charge function when works with PurePi II or UcPure MkIII power supplies.

### **Select an I/V output board(s) that matches your preferred listening style**

Which output board is used makes a significant contribution to both the sound quality and sonic signature produced from your ES9038QMPi. The standard op-amplifier I/V board (and what opamps you use in the board), OPA861 I/V board, OPA1632 I/V board, a discrete I/V board, Transformer Output board, and so on, will all sound different. Also whether you use them in single-ended or balanced mode will also impact the sound quality and sonic signature. Please choose the output board best suited to your system and your personal preferences. Also use the balanced XLR outputs if you can in your system. In most cases, we have found the balanced XLR output produces better overall sound quality than the single ended output.

I/V output boards with feedback normally have good measurement performance. For example, the I/V STD. However, the passive transformer I/V and the zero feedback OPA861 I/V can have better listening experience. Based on the real listening test, the best sound quality achieved by an OPA861 I/V with two UcPure 5V power supplies so far.



### **Experiment with the settings of your ES9038Q2MP Dual Mono II using the ESS Controller**

Many of ES9038Q2MP Dual Mono II settings can be programmed using the ESS Controller. Some that make a difference sonically include DPLL bandwidth for both PCM and DSD format, the seven preset FIR filters, OSF bypassing, IIR bypassing. Using the guidelines in the ESS Controller manual to safely set these settings, feel free to experiment and find the best settings for your ES9038Q2MP Dual Mono II setup and your system based on listening.

### **Use a decent pre-amplifier with balanced XLR inputs for the volume control**

The ES9038Q2MP Dual Mono II DAC has very good digital volume control. However, a decent pre-amplifier with balanced XLR inputs would be still highly recommended to keep the best sound quality. You must set the controller volume to 0dB in this case.

1. Can make good use of the higher quality balanced outputs
2. Keep the DAC running at full scale
3. Without break the bit-perfect

## J. ES9038Q2M Dual Mono II SYNC clock mode DAC project examples

### 1. Full function high-quality Raspberry Pi DAC

#### Configurations:

#4B ES9038Q2M Dual Mono II

#7A Transformer I/V or #6A I/V STD or #6B OPA861 I/V

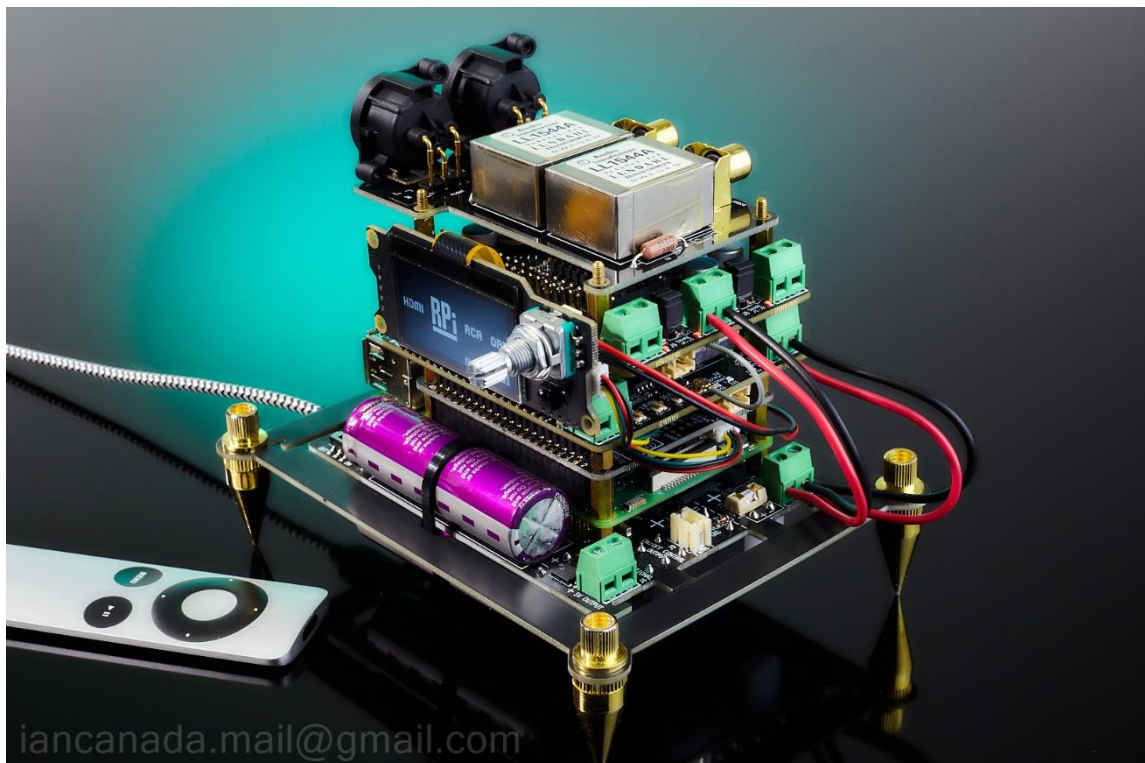
#1D FifoPiQ7

#49B MonitorPi Pro

#19C ReceiverPi Pro II (has I2S over HDMI, RPi, RCA and OPT inputs)

#48B PurePi II

RaspberryPi (optional)



#### Installations:

- Install the boards as the picture
- Connect 3.3V wires from J2 of UcPure to both J5 of FifoPi clean side and J1 of the ES9038Q2M DM II DAC
- Connect U.FL coaxial cable from MCLK of FifoPi to J11 of the ES9038Q2M DM II DAC
- Connect the control cable from J6 of the MonitorPi Pro to J13 or the ReceiverPi Pro II
- Connect SYNC charging control cable from J5 of the MonitorPi Pro to J10 of the PurePi II

### **Possible upgrade:**

- Upgrade FifoPi Clocks to SC-Pure
- Add a UcConditioner 3.3V to improve 3.3V power supply
- Upgrade the output board to OPA861 I/V

## **2. Raspberry Pi free audiophile grade multi-input standard ESS DAC**

### **Configurations:**

#4B ES9038Q2M Dual Mono II

#7A Transformer I/V (Bisesik) or #6B OPA861 I/V

#1D FifoPiQ7

#49B MonitorPi Pro

#19C ReceiverPi DDC (has USB, I2S over HDMI, RPi, RCA and OPT inputs)

#48B PurePi II

RaspberryPi (Can also be included as optional)



**Installations:**

- Install the ReceiverPi DDC on to PurePi through an GPIO female to male connector and 17mm standoffs. Install a Amanero Combo384 or compatible USB interface on to the bottom side of the ReceiverPi DDC using a 12mm standoff. And then install the other boards using 13mm standoff as in the picture.
- Connect 3.3V wires from J2 of UcPure to both J5 of FifoPi clean side and J1 of the ES9038Q2M DM II DAC
- Connect U.FL coaxial cable from MCLK of FifoPi to J11 of the ES9038Q2M DM II DAC
- Connect the control cable from J6 of the MonitorPi Pro to J7 of the ReceiverPi DDC
- Connect the SYNC charging control cable from J5 of the MonitorPi Pro to J10 of the PurePi II

**Possible upgrade:**

- Upgrade FifoPi Clocks to SC-Pure
- Upgrade the 3.3V power supply to a PurePi MkIII 3.3V
- Upgrade the output board to OPA861 I/V

**Note:**

This configuration is recommended. It's not only because of the full range of inputs but also because there would be less EMI noise without the Raspberry Pi. And this configuration is very flexible, both Raspberry Pi and PC can also be connected through the USB input. Higher frequency native DSD such as DSD256 and DSD512 can also be achieved.

**3. ES9038Q2M DM MKII best sound quality flagship configuration****Configurations:**

#4B ES9038Q2M Dual Mono MKII DAC DAC

#6B OPA861 I/V

#1D FifoPiQ7 with SC-Pure 45.1584 (#80A) and 49.1520 (#80B) MHz clocks

#32B LinearPi Solo 5V with #25B UcConditioner 5V

#41C UcPure MkIII 3.3V for both Q7 and DAC (two UcPure3.3V could be even better)

#41C 2\*UcPure MkIII 5V for I/V

#49B MonitorPiPro as controller

#19C ReceiverPi Pro II with controller

#35B StationPiPro (optional)

USB streamer (Amanero or compatible, optional)

RaspberryPi 4



## K. History

Oct 15, 2023 V1.0b released

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