

Instruction of LX8201 Driver Board

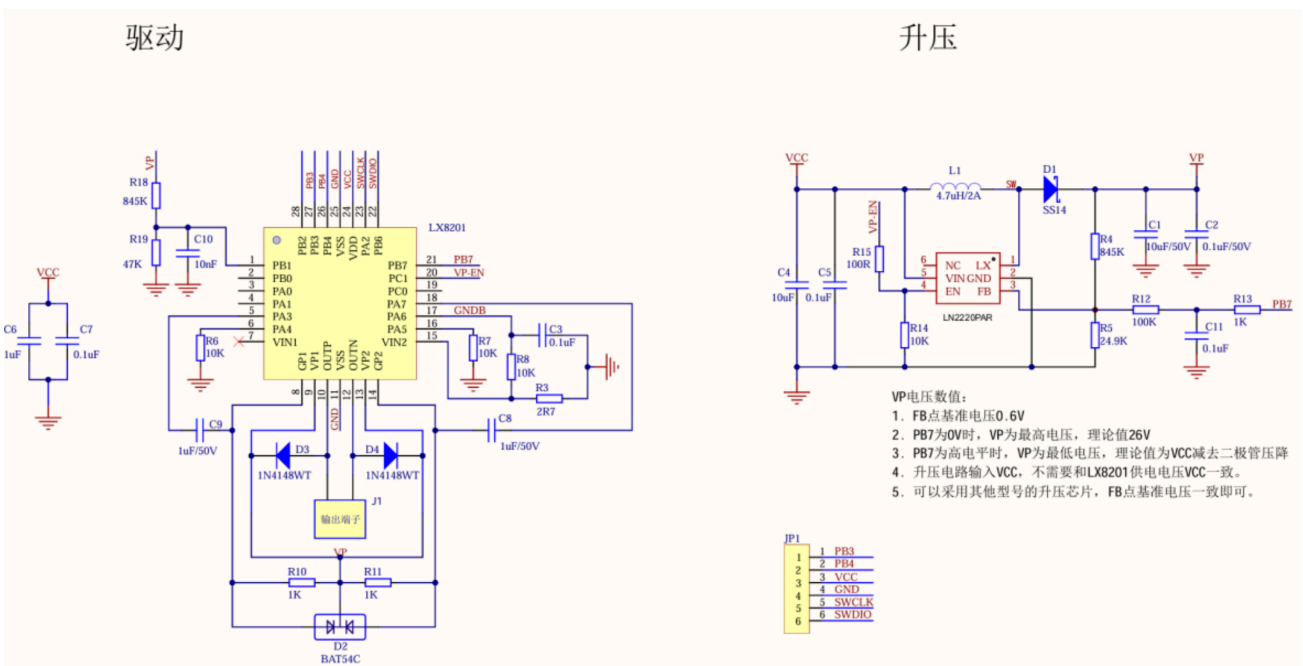
1. Overview

The LX8201 is a dedicated low-power piezoelectric ceramic driver IC from LOXIM Technologies. It is designed to drive piezoelectric elements typically like vibrating mesh nebulizer or piezo air pump/fan at the frequency range of 17.5 KHz to 250 KHz with nominal power less than 2.5W.

This Driver Board serves as a standard application circuit so that customers can rapidly develop and implement the hardware driver circuit for specific products.

2. Standard Driver Board Circuit

The LX8201 utilizes a hardware configuration where "VP is software-defined", meaning the operating voltage (VP) can be adjusted via software program.



- The peripheral circuits for pins 5 to 18 must not be modified. Among these, D3 and D4 are optional components intended to protect against high voltage residual from the piezoelectric ceramic element. This is commonly required in piezoelectric air pump applications, whereas for vibrating mesh applications, they can generally be omitted.
- VP-EN is fixed to pin 20 and is active-high. If this configuration is altered, a customized driver library file is required.
- Principle of Software-Defined VP: The operating voltage (VP) is configured by adjusting the duty cycle of PB7 - the lower the duty cycle, the higher the voltage. And the actual voltage value of VP is monitored through PB1.
- **WARNING:** The range of VP is determined by the hardware circuit parameters. Please note that the maximum allowable VP for the LX8201 is 27V. Exceeding this limit poses a risk of chip damage.
- Electronic Parameters of the standard Driver Board circuit
 - Operating Voltage (VP): VCC to 26V, software-adjustable.
 - Operating Current (Cur): Maximum 100 mA.
 - Operating Frequency (Fre): 17.5 kHz to 250 kHz.
 - Operating Duty Cycle: 50% down to the configured minimum duty cycle, with adaptive adjust within this range.
 - Sleep Standby Current: Less than 20 μ A. (Current Breakdown: Approx. 2–3 μ A for the LX8201 chip, approx. 3–5 μ A across the two resistors at the FB node of the boost circuit, and approx. 3–5 μ A across the two resistors of the VP sampling circuit. Typical value is 10–12 μ A when VCC = 4V.

3. Major Check Points of Layout for Driver Board

4. Slave Control Modes of Driver Board

4.1 Slave Control Mode with IO

- The host MCU utilizes two IO pins connected to PB3/PB4 of the Driver Board. It is recommended to connect a 100Ω resistor in series between these IO lines.
- If configured as active high, the two IO pins of the host MCU must be equipped with pull-down resistors. The specific driving modes are mapped as follows:
 - Gear/Level 1: PB3 High + PB4 Low
 - Gear/Level 2: PB3 Low + PB4 High
 - Gear/Level 3: PB3 High + PB4 High
 - Pause: PB3 Low + PB4 Low (enters sleep mode after 2 seconds)
- Customers can refer to the GPIO mode in the LX8201 Standard Firmware Routine Document. The control mode in Firmware Routine is for reference only. Customers may develop the control scheme or implement alternative protocols based on specific requirements.
- Note: Ensure level adaptation between the host MCU and LX8201. LX8201 IOs can withstand a maximum voltage of 5.5V however, it is highly recommended to match them to the same level for better reliability.

4.2 Slave Control Mode with I2C

- The host MCU utilizes two IO pins connected to PB3/PB4 of the Driver Board. External pull-up resistors must be connected to these two IO pins of the host MCU.

- The two host MCU IOs communicate with LX8201 by simulating the I2C protocol. For specific protocol details, please refer to the I2C mode section in the LX8201 Standard Firmware Routine Document. This firmware routine example is for reference only. Customers can develop their own protocols as needed.
- Note: Ensure level adaptation between the host MCU and LX8201. LX8201 IOs can withstand a maximum voltage of 5.5V however, it is highly recommended to match them to the same level for better reliability.

5. Choices for Power Supply of VP

Power VP should be supplied to the VP1/VP2 pins of the LX8201 through the control of VP-EN pin. Regardless of the power supply configuration applied, the externally supplied VP must never be connected directly to the VP1/VP2 pins of the chip; otherwise, there is an immediate risk of burning out the IC.

5.1 VP Configured by Hardware

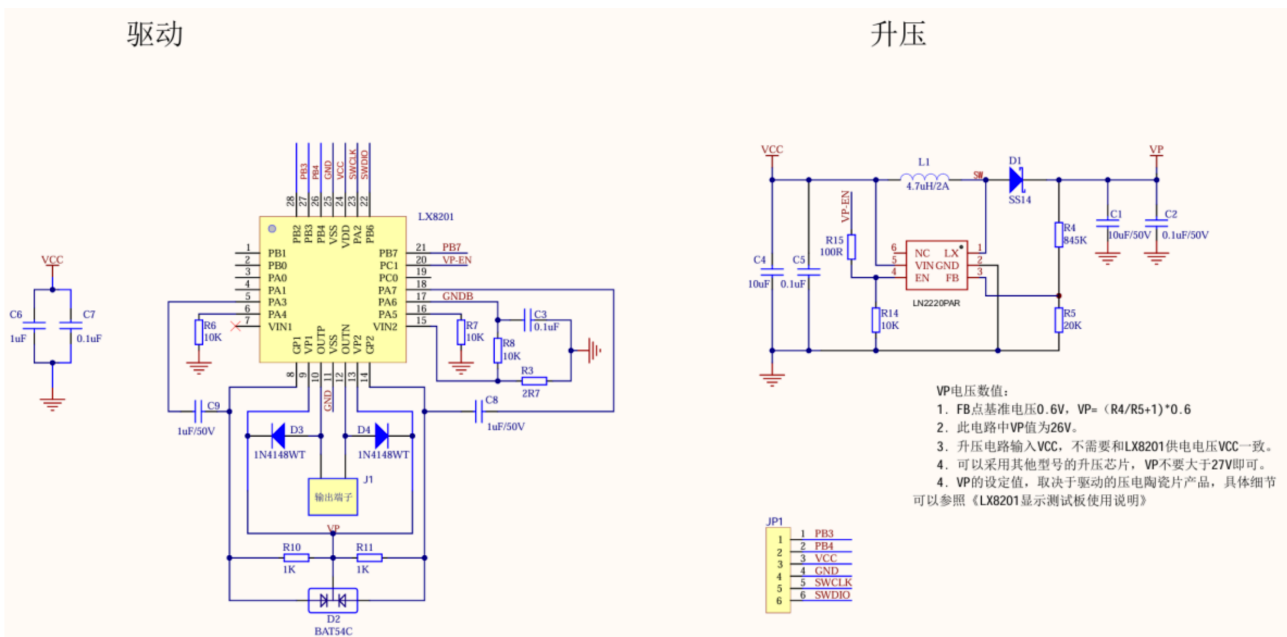
- In case of choice that VP is defined by hardware, the vol value passed to the lib must be set to 0, in the LX8201 Standard Firmware Routine Document.
- In this choice, VP is non-adjustable. It is recommended not to limit the minimum duty cycle, and the pwm value passed to the lib should be set to 10.
- The peripheral circuits for pins 5 to 18 must not be modified. Among these, D3 and D4 are optional components intended to protect against high voltage residual from the piezoelectric ceramic element. This is commonly required in piezoelectric air pump applications,

whereas for vibrating mesh applications, they can generally be omitted.

- VP-EN is fixed to pin 20 and is active-high. If modified, a customized driver library file is required.
- VP is determined by the resistors R4 and R5. The calculation formula is:

$$VP = \left(\frac{R_4}{R_5} + 1\right) \times 0.6 V$$

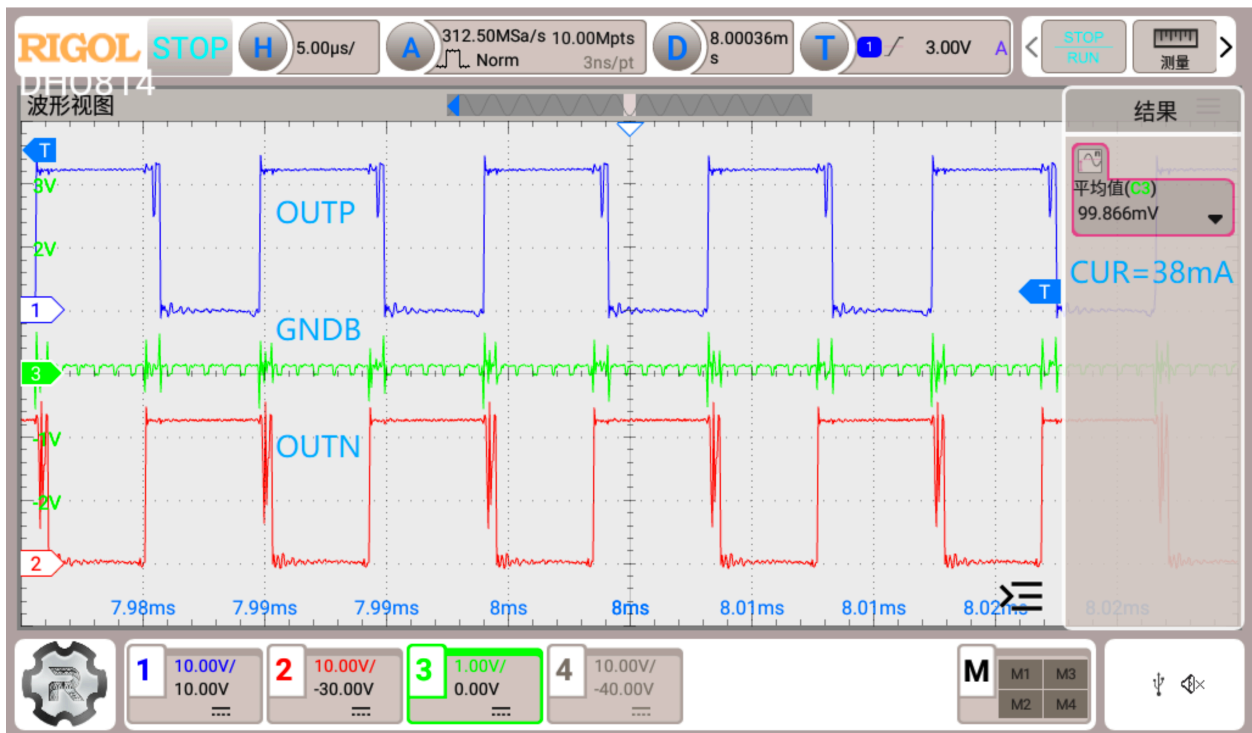
- **WARNING:** Please note that the maximum VP for the LX8201 is 27V. Exceeding this limit poses a risk of burning out the chip.
- Electronic Parameters of the Circuit:
 - Operating Voltage (VP): Determined by R4 and R5
 - Operating Current (Cur): Maximum 100 mA
 - Operating Frequency (Fre): 17.5 kHz to 250 kHz
 - Operating Duty Cycle: 50% down to the configured minimum duty cycle, adaptive within this range
 - Sleep Standby Current: Less than 10 μ A. (Specific breakdown: approx. 2–3 μ A for the LX8201, approx. 3–5 μ A across the two resistors at the FB node of the boost circuit. Typical value is 8 μ A when VCC = 4V).



5.2 External Direct VP Supply

- When selecting the hardware circuit version where VP is directly supplied by external, the vol value passed to the lib in the LX8201 Standard Firmware Routine Document must be set to 0.
- In this version, VP is non-adjustable. It is recommended not to limit the minimum duty cycle, and the pwm value passed to the lib should be set to 10.
- VP-EN is active-high and can be modified based on the actual hardware circuit design.
- Note that two capacitors, C1 and C2, must be connected to the VP side.
- The peripheral circuits for pins 5 to 18 must not be modified. Among these, D3 and D4 are optional components intended to protect against high voltage residual from the piezoelectric ceramic element. This is commonly required in piezoelectric air pump applications, whereas for vibrating mesh applications, they can generally be omitted.
- VP-EN is fixed to pin 20 and is active-high. If modified, a customized driver library file is required.
- VP is directly provided by the external power supply.
- **WARNING:** Please note that the maximum VP for the LX8201 is 27V. Exceeding this limit poses a risk of burning out the chip.
- Electronic Parameters of the Circuit:
 - Operating Voltage (VP): Provided by the external circuit
 - Operating Current (Cur): Maximum 100 mA
 - Operating Frequency (Fre): 17.5 kHz to 250 kHz
 - Operating Duty Cycle: 50% down to the configured minimum duty cycle, adaptive within this range.

■ OUTPUTN+GNDB



■ Waveform Measurement:

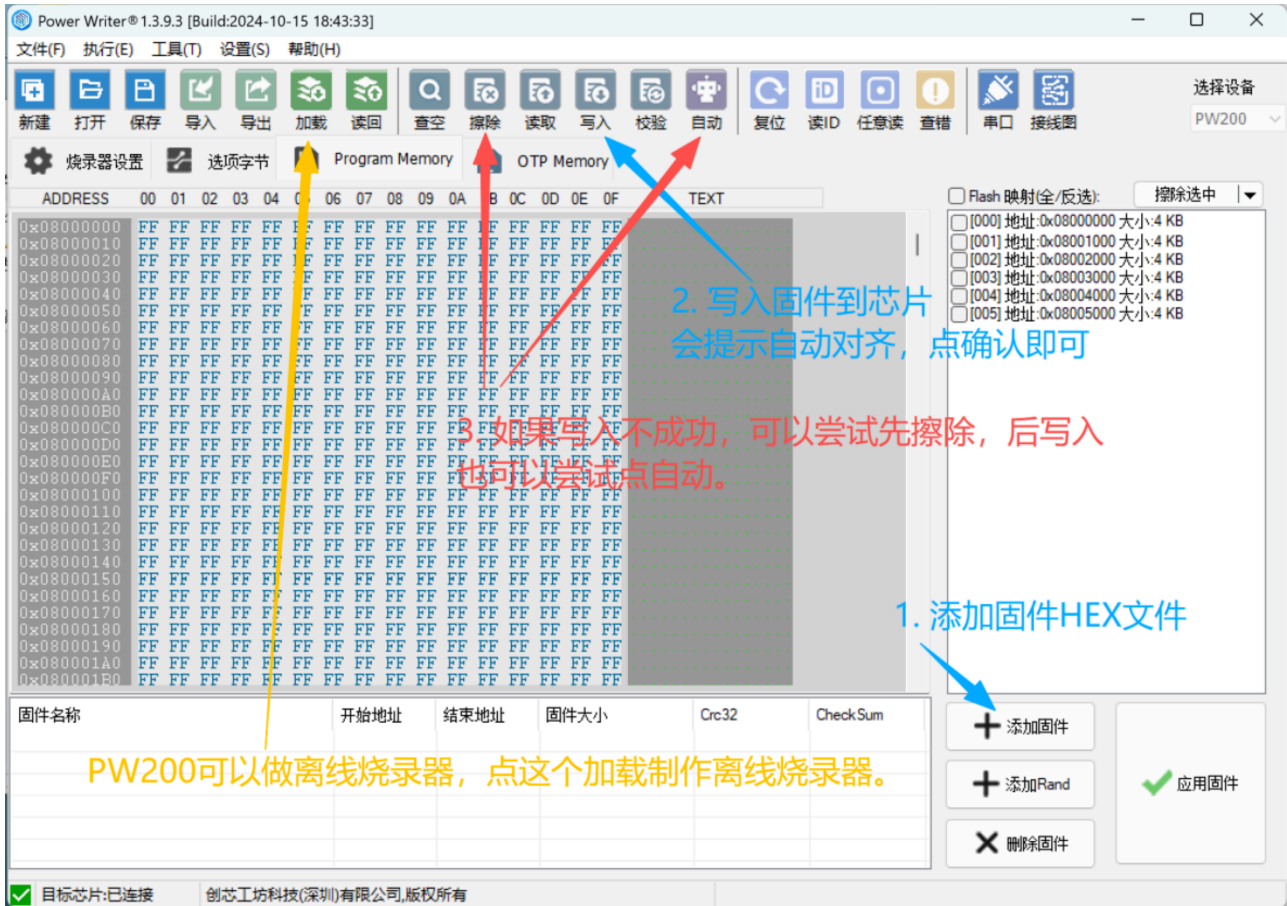
- The oscilloscope must use two independent channels to connect to OUTPUT and OUTPUTN respectively. Do not use only a single channel probe connected to OUTPUT with its ground clip connected to OUTPUTN. Neither OUTPUT nor OUTPUTN should be connected to ground during operation.
- **Note:** The ground clip of an oscilloscope probe can easily introduce abnormal spikes/glitches into the measured waveform. Please minimize interference from ground loops as much as possible during testing.

7. Firmware: Debugging and Flashing

- The debugging and flashing of firmware requires interfaces through connecting VDD-GND-SWDIO-SWCLK. It is recommended to retain these four onboard interfaces for debugging and flashing in case of need.

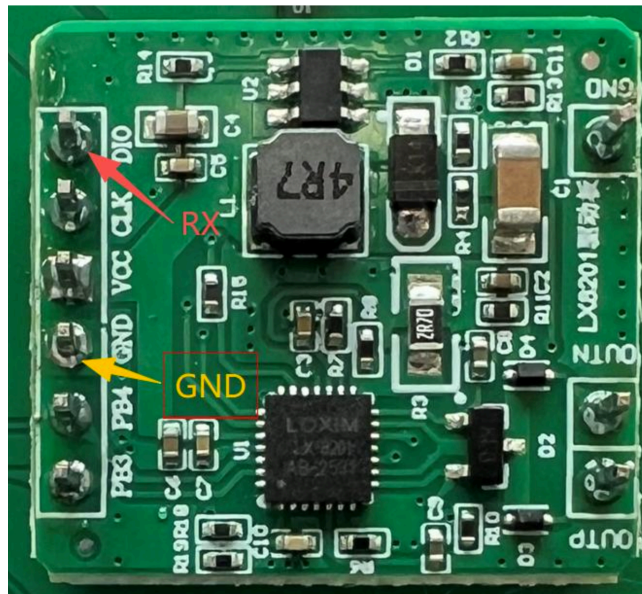
- Emulators such as DLINK or JLINK are not recommended. It is strongly advised that customers purchase the PW200 or PWLINK2 from ICWorkshop (www.icworkshop.com) and download the “PowerWriter” software.
- For details of user guide for PowerWriter software and PW200/PWLINK2, please get support from office ICWorkshop resources(www.icworkshop.com). Few highlight as below:
 - Vref must be connected to the chip's VDD.
 - The debug option in Keil software should be set to: CMSIS-DAP debugger. If performing online debugging, please ensure all serial port (UART) settings are disabled/unchecked, since the serial port pins are multiplexed with the flashing pins.
 - Refer to the configuration and flashing interface below.





8. Serial Port Data Report

- If UART0_EN is set to 1 in the LX8201 Standard Firmware Routine Document, the driver board will output real-time report logs via the serial port during operation.
- If the highest bit (MSB) of the Fre parameter passed to the lib in the LX8201 Standard Firmware Routine Document is set to 1, detailed data for frequency tracking will also be printed.
- Connect the RX pin of a USB-to-TTL serial tool to the DIO pin (the first pin of the 6-pin header, silkscreen printed on PCB) and connect to GND.



- Use a serial terminal assistant (software) to view the printed data, with the baud rate configured to 19200 and other parameters left at their default values.
- The serial output data includes: detailed frequency tracking data (if enabled) and operational status reports outputted every second.
- Tool: USB-to-TTL, reference below purchased on tmall.com.



- Software: The serial debugging software can be downloaded on the website, recommend UartAssist.