PUlaudio

April 2023
Product Highlight

New Transducer Products

Announcing a new addition to our popular 8mm series of electromagnetic and piezoelectric transducers – the SMT-8540-T!

Our transducer offerings range from 4mm to 68mm, with resonant frequencies between 800 Hz and 6 kHz. The SMT-8540-T is a top-firing, surface-mount electromagnetic transducer that delivers outstanding sound output in a compact package. Despite its small size, this transducer packs a punch, achieving an impressive 100dB (±15%) output at a resonance of 4 kHz!

Last year, we also released a range of surface mount transducers that are now qualified to operate under high temperatures up to 85°C with a current consumption 50% lower than traditional electromagnetic transducers. This advancement ensures reliable operation under harsh conditions while reducing power consumption.

An external circuit is required to drive transducers to their maximum potential, offering flexibility and customization for various applications. With easy installation on printed circuit boards (PCBs), our surface mount transducers eliminate the need for extra mounting hardware. Our family of transducers is ideal for various industries such as medical, industrial, security, and consumer applications. Featuring high efficiency, low current drain, low weights, and long lifespans, these devices meet the needs of nearly any situation!

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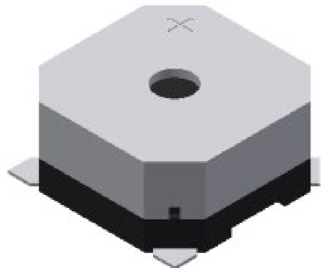
SMT-0840-T



Key Applications

- Consumer, Medical, Industrial Devices
  - E.g., Alarms, Alerts, Notifications
- Critical Security Alerts
- Space Constrained Applications
  - E.g., Wearables, Embedded Designs
- Noisy Environments
  - High SPL captures user attention

Highlights

- Surface Mount, Top Firing
- Reflow Solder Supported
- Small Footprint
- Achieves >100dB at 4kHz!

Key Features

Part	**Dimensions (mm)** *(L x W x H)*	**Weight (grams)**	**Voltage (V_{DC})**	**Current (mA)**	**F0 (Hz)**	**SPL (dB)** *(@10cm)*
SMT-0840-T ***NEW!***	8.5 x 8.5 x 4	0.6	5.0	150	4,000	>100

Values at rated voltage (resonant frequency, 1/2 duty, square wave)

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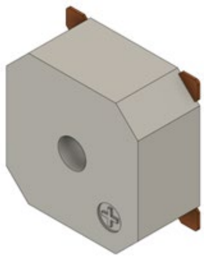
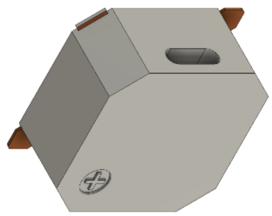
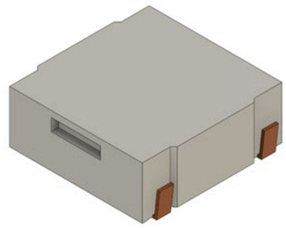
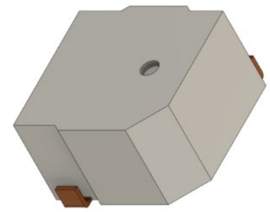
Low Current Transducers

Key Applications

- Portable, Battery-Driven Devices
  - E.g., GPS, Environmental Sensors, Activity Trackers
- Medical Diagnostic Monitors
  - E.g., Pulse Oximeters, Fall Detection, Glucose Monitors
- Security Devices
  - E.g., Glass Break Detectors, Motion Sensors, Alarm Systems

Highlights

- Qualified to 85°C
- Current consumption less than 45 mA
- Multiple Firing Positions

Key Features

Part	Dimensions *(mm) (L x W x H)*	Voltage *(V_{DC})*	Current *(mA)*	F0 *(Hz)*	SPL *(dB) (@10cm)*	Firing Position
SMT-0540-T-10-R	5 x 5 x 3	3.0	35	4,000	78	TOP
SMT-0827-S-10-R	8 x 8 x 3	3.6	45	2,731	82	SIDE
SMT-0927-S-14-R	8.5 x 8.5 x 3	3.6	45	2,731	87	SIDE
SMT-0927-T-3-R	8.5 x 8.5 x 3	3.6	45	2,731	87	TOP

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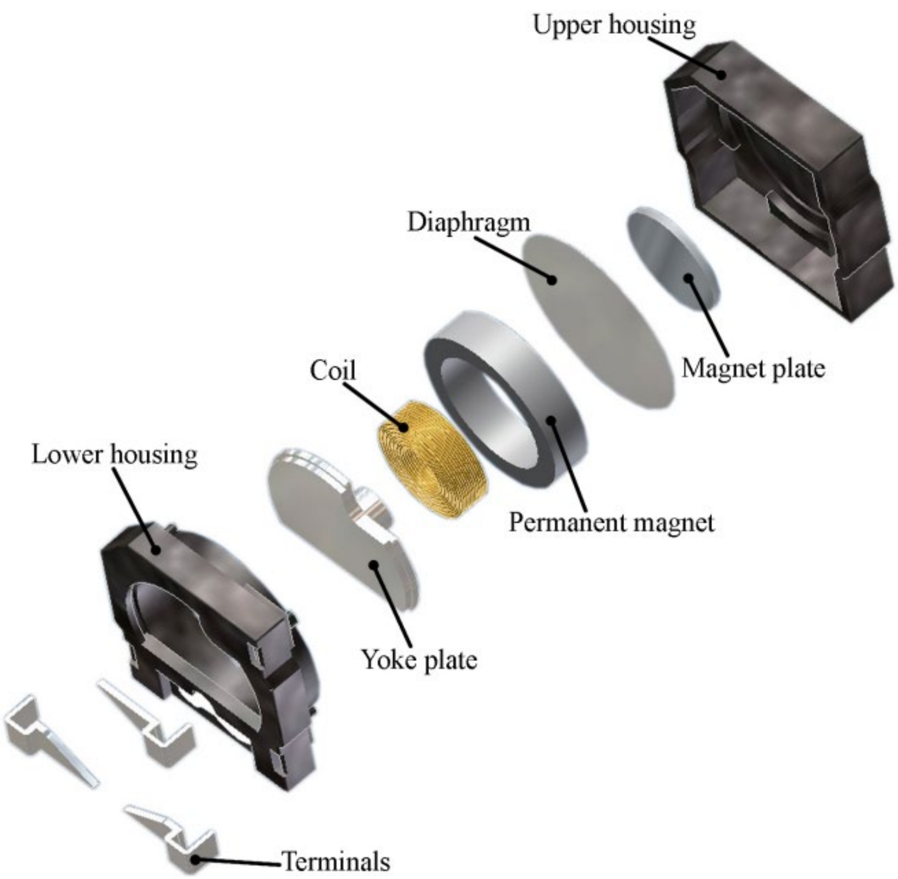
General Construction

Electromagnetic Audio Transducer

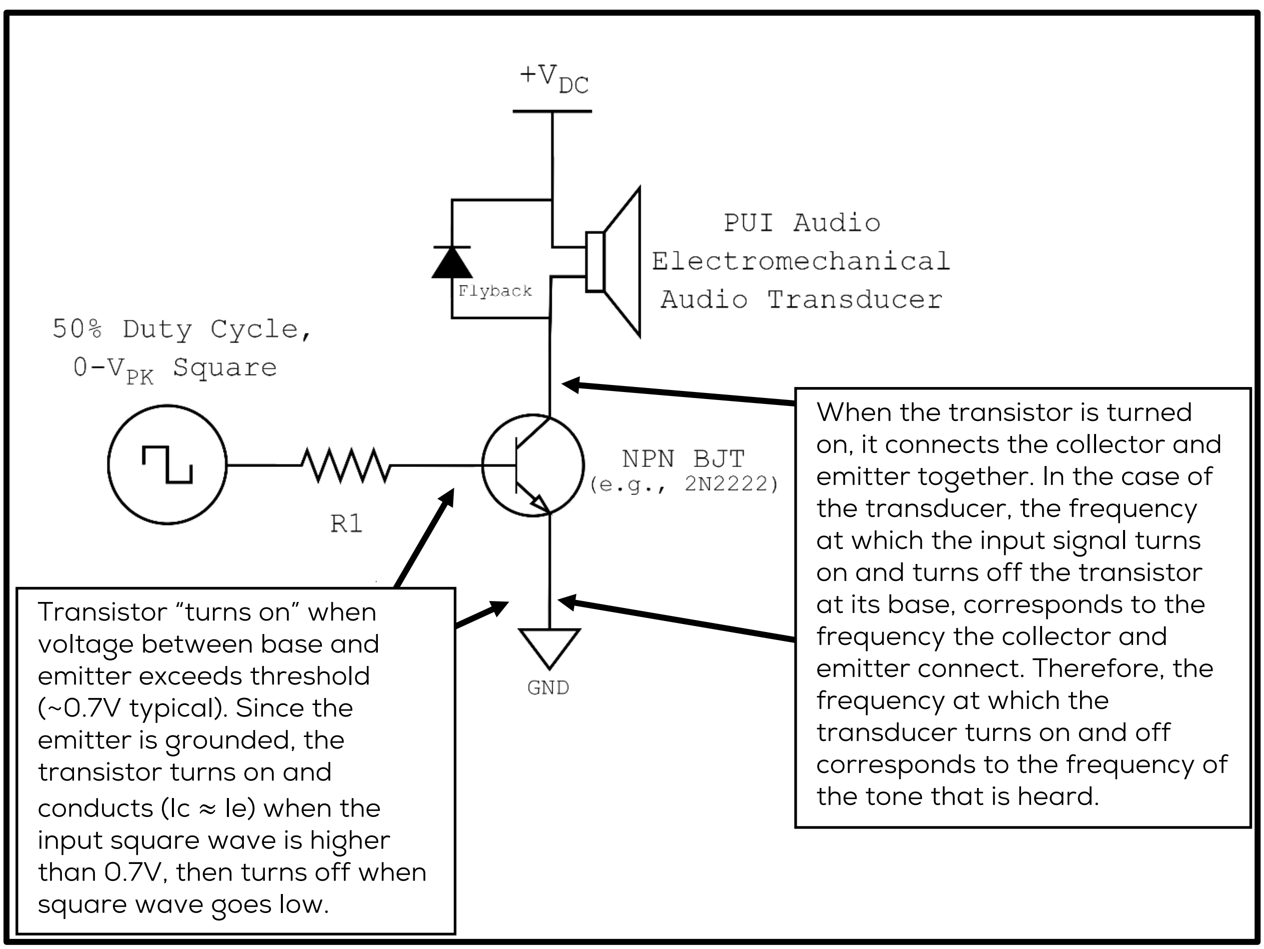


Electromagnetic audio transducers typically consist of the key components shown in Fig 1: a permanent magnet, coil, diaphragm, and housing. Applying an alternating voltage (AC) to the coil of the transducer causes AC current to flow through the coil, which in turn creates an alternating magnetic field. This magnetic field interacts with the permanent magnet's static magnetic field, causing the magnet plate to vibrate. The resulting movement of the diaphragm located between the two magnets produces sound.

DRIVE CIRCUIT

The drive circuit for an electromagnetic audio transducer depends on the driving signal's available current and voltage levels. If the signal has sufficient current and voltage to drive the transducer, it can be connected directly to a modulated DC voltage supply to control the sound output by modulating the positive voltage supply on/off rate.

However, designing a separate drive circuit is recommended if the available current output is limited. A typical design includes a fast-switching transistor in a low-side drive configuration. In this configuration, the transistor is connected between the ground and the transducer, and the signal is applied to the transistor's base. The transistor switches the current flow to the transducer, allowing the transducer to produce sound at the switching frequency. R1 is used to limit any current spikes, preventing damage to the microcontroller GPIO pin.



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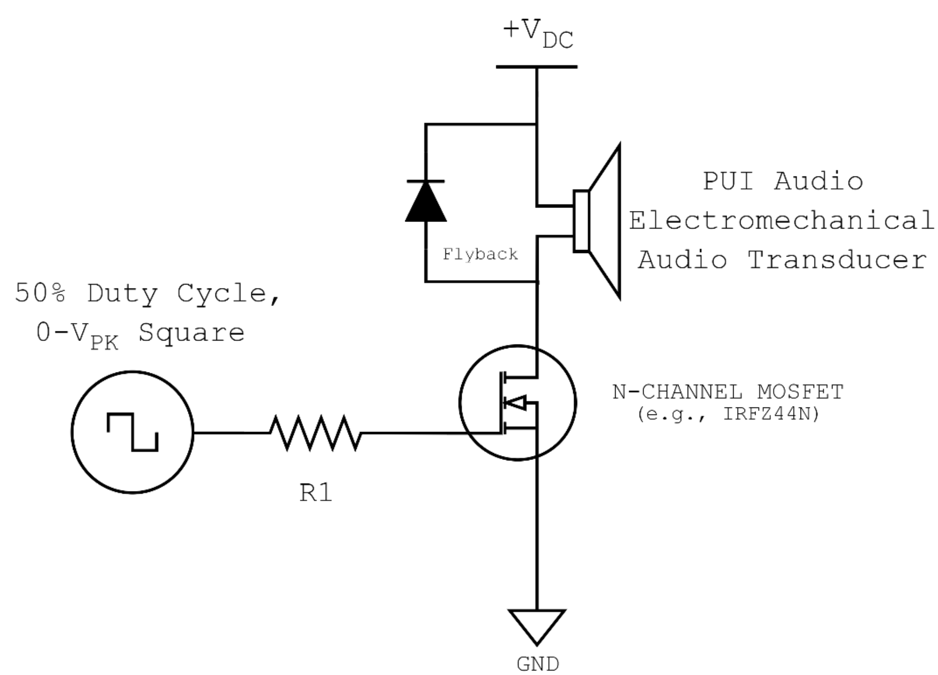
DRIVE CIRCUIT

Using a MOSFET instead of a BJT in circuits prioritizing efficiency can provide positive results. MOSFETs have a significantly lower on-resistance than BJTs, resulting in lower power dissipation and higher efficiency. Additionally, MOSFETs typically have a higher input impedance than BJTs, making them easier to drive from current-restricted sources such as microcontrollers.



To achieve the highest sound pressure level (SPL) from the transducer, it is recommended to drive the transducer with a 50% duty cycle, 0V-VPK square wave, where VPK is equal to the rated voltage of the transducer. Half-rectified sine waves may also be used to create softer, less harsh tones, but the SPL will decrease.

When designing a drive circuit for an electromechanical audio transducer, it is important to consider the power dissipation of the drive transistor, particularly if it is a small-signal BJT in a TO-92 package.

Power Considerations

The power dissipation of the drive transistor is a function of the transistor's operating voltage, current, and on-resistance. In a low-side drive configuration, the drive transistor is typically operated in the saturation region, where it acts as a switch and dissipates very little power. However, if the transistor is not fully saturated or is subjected to a high voltage or current, it can dissipate significant power and generate heat.

The transistor’s power dissipation can cause self-heating, which can affect the transistor's performance and reliability. As the transistor’s temperature increases, its characteristics may change, leading to variations in the drive signal and potentially damaging the transistor. Additionally, self-heating can cause thermal runaway, where the transistor's temperature rises uncontrollably, leading to failure.

The thermal resistance of the transistor package is another important factor to consider when designing the drive circuit. Thermal resistance represents the ability of the package to transfer heat from the transistor die to the surrounding environment. High thermal resistance can lead to a higher operating temperature and increased self-heating of the transistor.

To ensure the reliable operation of the drive circuit, it is important to select a transistor with a power dissipation rating that exceeds the expected power dissipation in the circuit. Additionally, the thermal resistance of the transistor package should be minimized by the proper selection of the package and proper layout of the circuit board to maximize heat dissipation. Finally, the operating temperature of the transistor should be monitored to ensure that it remains within the safe operating range. In addition to the transistor, other components in the drive circuit, such as resistors and capacitors, can also affect the circuit’s performance. The values of these components should be carefully chosen to ensure that the circuit operates as intended and that the power dissipation is within the safe limits of the components.

Conclusion

Transducer acoustic outputs with various SPLs and overall efficiencies are made possible using different drive circuits. The drive signal's waveform can be shaped, frequency shifted, or amplitude modulated to achieve the desired tonal quality. An estimation of SPL output can be made for certain strictly defined measurement conditions. However, one should always keep in mind that SPL measurement and prediction is complicated by the fact that the environment in which a device is measured greatly influences the final result.

View our available Transducer offerings!