

**DRIVING A PIEZOELECTRIC CELL WITH A RAIL TO RAIL OP-AMP**

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**INTRODUCTION**

The TS912 is an input/output rail to rail dual CMOS operational amplifier. It is able to operate with low supply voltage (2.7V) and to drive low output loads (600Ω).

As an illustration of these features, the following note is describing the TS912 behaviour when driving a piezoelectric cell.

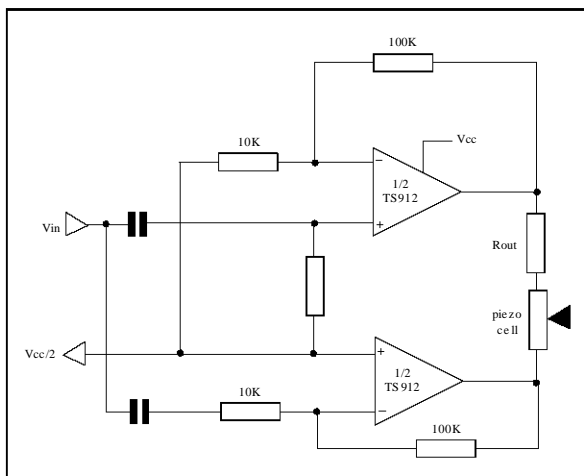
**APPLICATION CIRCUIT**

The TS912 is used in a single supply push-pull configuration as displayed below in figure1. The closed-loop gain value is 20dB. A small serial resistor Rout is placed in order to remove HF oscillations.

The piezoelectric speaker used as load has the following characteristics :

- Frequency range: 500Hz-20kHz
- Capacitance: 140nF at 120Hz
- Input voltage: 30vp-p max.

**Figure 1 : Electrical Schematic**



**CHARACTERIZATION**

The dynamic behaviour is displayed through the two following figures :

- Frequency response at VCC = 3V (figure 2). This application is particularly stable within the range of the piezo (the gain is dropping by only 2.5dB).
- Output swing versus supply voltage : the push-pull configuration is theoretically allowing a doubled output voltage amplitude versus VCC : the outputs on each side of the cell are rail to rail and phase opposite.

**Figure 2 : Frequency Response**

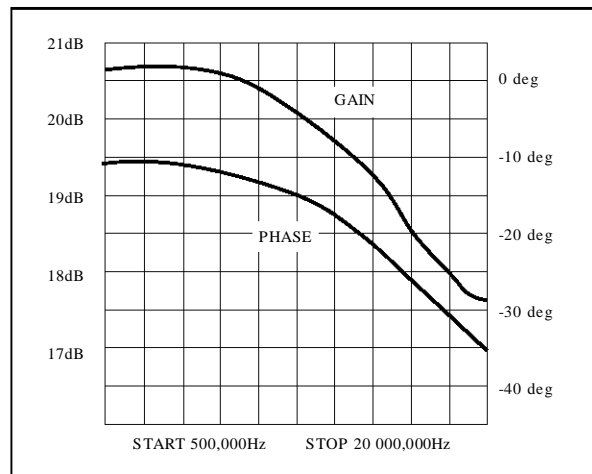


Figure 3 shows that this goal is highly dependant of the frequency ; for example the total output swing available at 2kHz is recovered as followed :

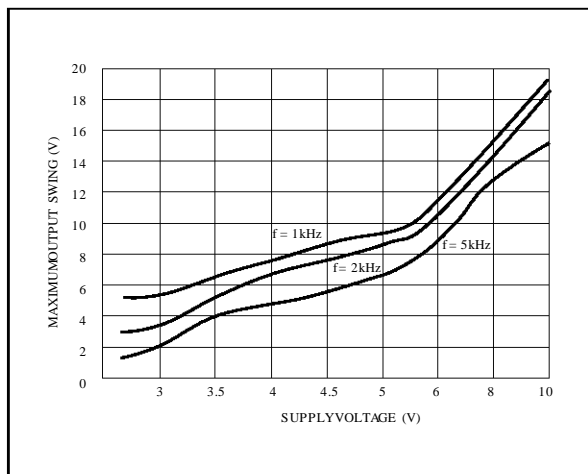
- VCC = 3V    Out.vol.=3.4Vpp    57% of 6vpp theor.
- VCC = 4V    6.6Vpp                82%
- VCC = 5V    8.7Vpp                87%
- VCC = 8V    14.6Vpp              91%

## APPLICATION NOTE

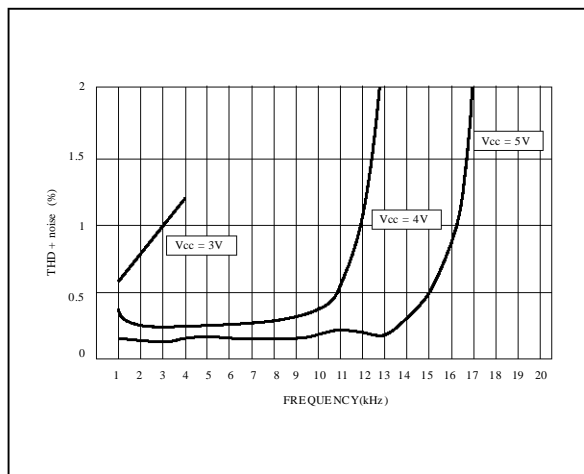
As a typical feature of any audio application, one may consider Total Harmonic Distortion (THD) which is here considered with power supply as a parametric value (Figure 4).

The piezo is then correctly driven with low voltage supply down to 4V

**Figure 3 :** Output Swing versus Supply Voltage



**Figure 4 :** Distorsion + Noise versus Frequency (Vo = 1Vrms)



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