Ritsumeikan University

# Acoustic Operational Amplifier Composed of Acoustic FET

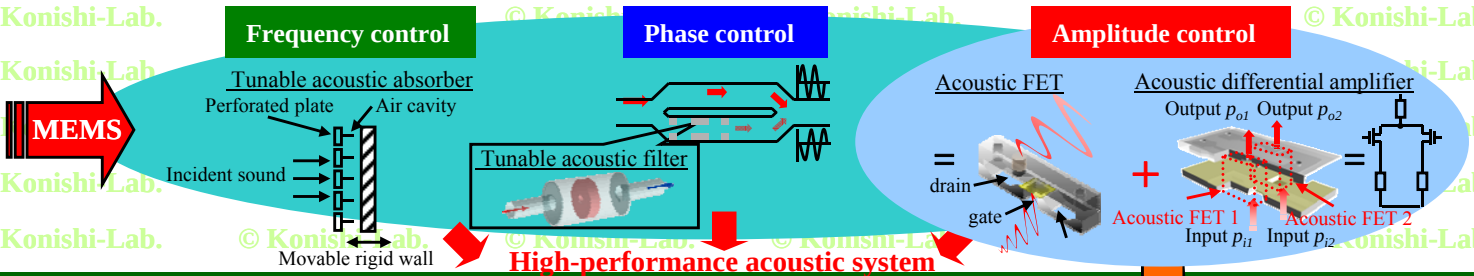


## Abstract

We present acoustic operational amplifier using acoustic FET. The acoustic operational amplifier is composed of acoustic common source FET circuit and acoustic differential amplifier. The acoustic operational amplifier has the function of controlling output sound pressure and performing an acoustic operation.

## Objective

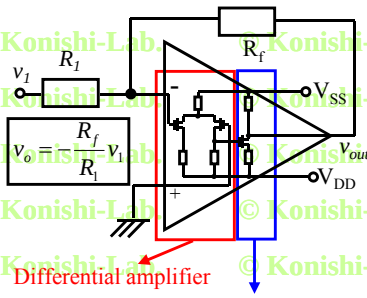
**Acoustic control**




## Acoustic Operational Amplifier

Integration

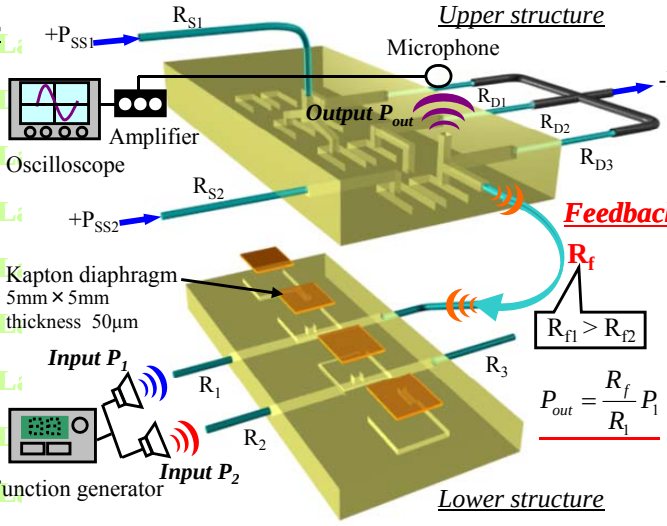
**Two stage operational amplifier**

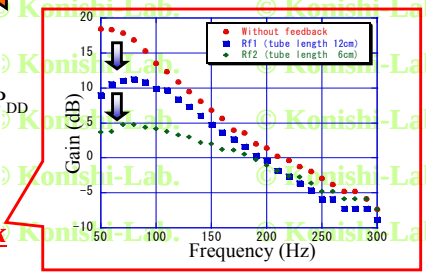



Differential amplifier

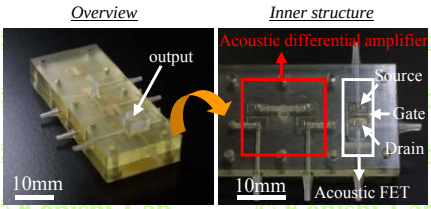
Common source circuit

Resistance R : tube
$R_{D1}$,$R_{D2}$,$R_{D3}$:φ0.3mm, length 5cm
$R_{s1}$,$R_{S2}$ : φ0.3mm, length 10cm
$R_{f1}$ : φ0.3mm, length 12cm
$R_{f2}$ : φ0.3mm, length 6cm



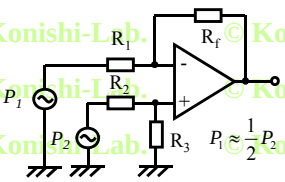




Gain vs Feedback resistance (Rf)




Fabricated acoustic structure

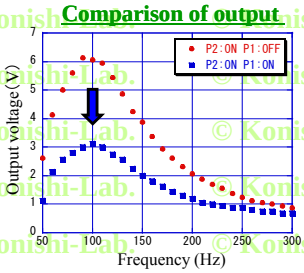
## Acoustic Subtracter



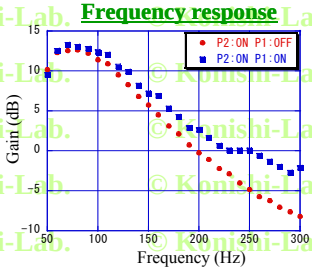

$P_{out} = \frac{R_f}{R_1}(P_2 - P_1)$ $\left(\frac{R_f}{R_1} = \frac{R_3}{R_2}\right)$

Condition
$R_1$, $R_2$ : φ1mm, length 2cm
$R_f$, $R_3$ : φ0.3mm, length 12cm
$P_{SS1}$ : 47.4kPa $P_{SS2}$ : 22.3kPa
$P_{DD}$ : -21.5kPa

**Comparison of output**

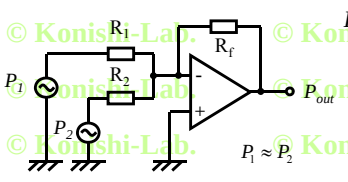



**Frequency response**




$P_{out}$ ↓ → *Acoustic subtraction*

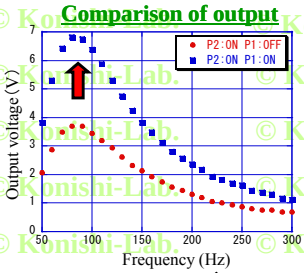
## Acoustic Adder



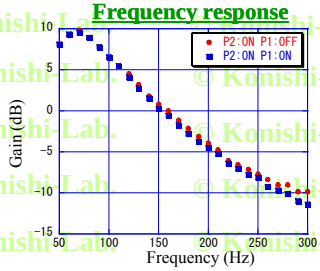

$P_{out} = \frac{R_f}{R_1}(P_1 + P_2)$ $(R_1 = R_2)$

Condition
$R_1$, $R_2$ : φ1mm, length 1cm
$R_f$, $R_3$ : φ0.3mm, length 12cm
$P_{SS1}$ : 37.6kPa $P_{SS2}$ : 27.6kPa
$P_{DD}$ : -15.6kPa

**Comparison of output**




**Frequency response**




$P_{out}$ ↑ → *Acoustic addition*

## Summary

We presented acoustic operational amplifier composed of acoustic FET. Output sound pressure of the operational amplifier could be controlled by changing acoustic feedback resistance. Acoustic subtracter and acoustic adder could perform successfully.