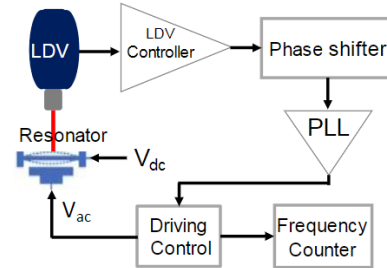


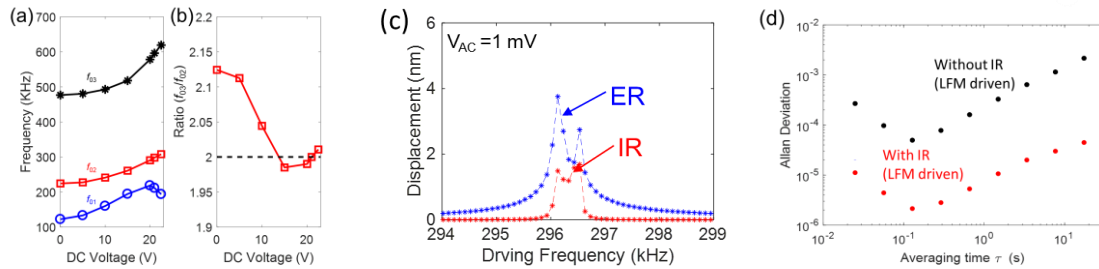
Supplementary Pages (Optional)



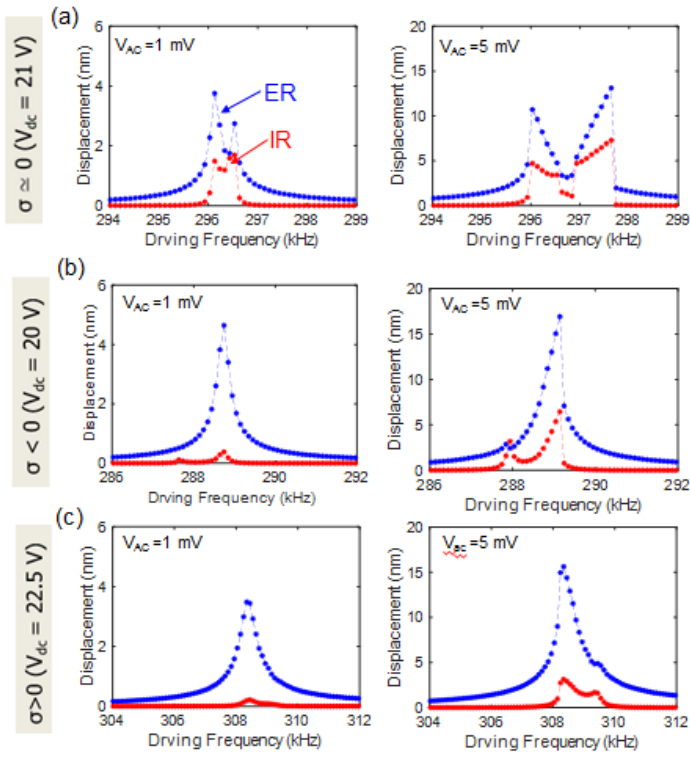
Supplementary Fig. 1: SEM image of doubly-clamped stepped MEMS resonator



Supplementary Fig. 2: Schematic of driving and sensing configuration of MEMS oscillator



Supplementary Fig 3: (a) Modal frequencies of first three flexural modes. (b) Ratio of 2nd and 3rd mode frequency. (c) M-shape amplitude resonant curve with IR condition (d) Allan deviation, 2nd mode was externally actuated and IR triggered, black dots: 2nd mode was externally actuated and IR not triggered.



Supplementary Fig. 4: Frequency responses when (a) $V_{DC} = 21\text{ V}$, (b) $V_{DC} = 20\text{ V}$ (c) $V_{DC} = 22.5\text{ V}$ Blue curve: externally resonated mode. Red curve: internally resonated mode.