

Low-Loss RF Filter Using MEMS Capacitance Switches

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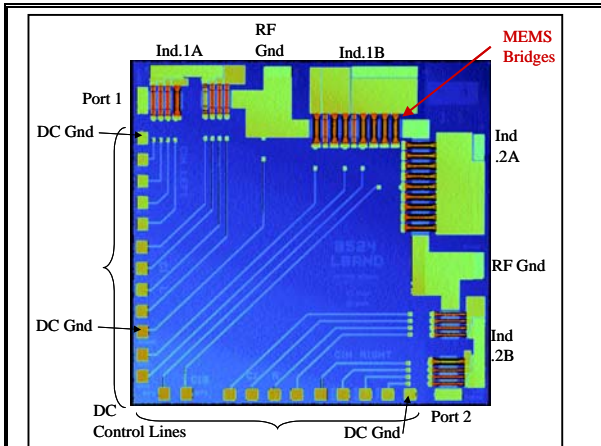
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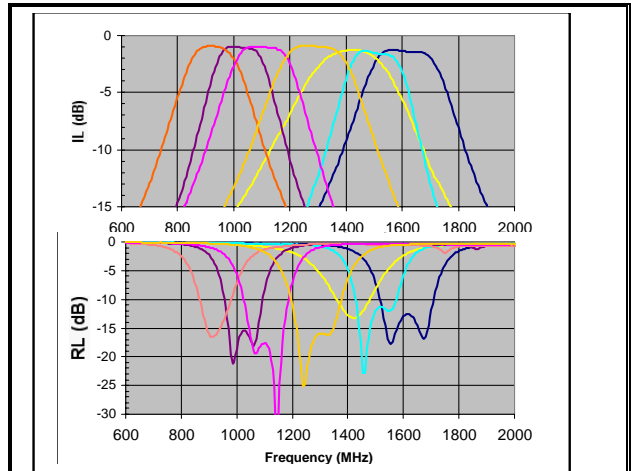
Many radio frequency communication systems require highly sensitive receivers. Low-loss, narrow-band preselector filters can improve the receiver sensitivity by rejecting interfering signals. An important part of the solution to this problem is tunable, low-loss bandpass and/or bandstop (notch) filters. The current two pole filter uses two fixed inductors and five tunable capacitor arrays. Each array consists of a four-bit set of MEMS capacitance switches. Our MEMS capacitance switch consists of a bottom electrode covered by a dielectric film and separated from the upper electrode by an air gap. When sufficient voltage is applied, the bridge snaps down to come into contact with dielectric, switching from a low to a high capacitance state. With five four-bit arrays that are independently addressable there are over 1 million possible states. Only a small subset of these produce the desired bandpass response. We show one octave tuning from 860 to 1750 MHz, with an insertion loss of 1 dB and a return loss of 13 dB. Our widest bandpass filters have a 3dB relative bandwidth of 42%, and the narrowest 7%. It is also possible to select a constant center frequency and vary the bandwidth. When two 10 dBm tones are placed into the widest pass bandwidth settings (40%), the third order intercept was typically +38 dBm. Placing one tone inside the pass band and examining the harmonic tone showed it to be at an impressive +82 dBm. When switching from all-off to all-on filter settings at atmospheric pressure, the RF response has a 10%-90% rise of 8 μ s, with a latency time of about 10 μ s before that transition. At c. 5 Torr abs. the switching time is about 2 μ s for both filter-on and filter-off with a latency of about 8 μ s for the filter-on time

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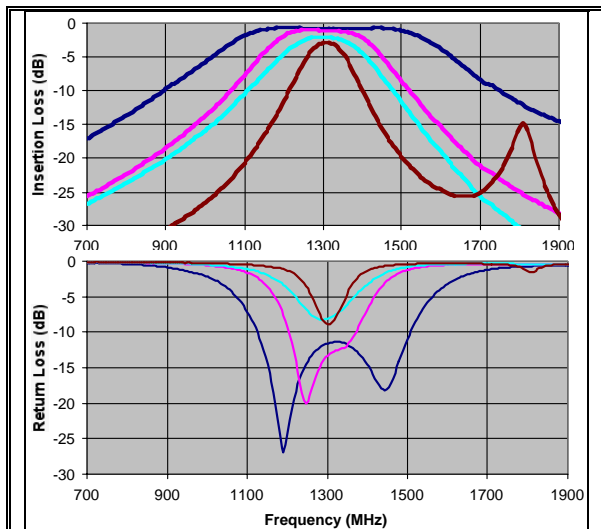
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Optical non-contact profilometer scan of a fabricated MEMS chip. All 34 of the MEMS air bridges have air gaps as denoted by their red color.



Insertion loss and Return loss of the filter, demonstrating a series of settings achieving a full octave of tuning range.



Insertion loss and Return loss of the filter, demonstrating a series of settings achieving narrower and broader pass bands at the same center frequency.