



EURIPIDES² PRAGUE FORUM | 2014

MiniMEMS

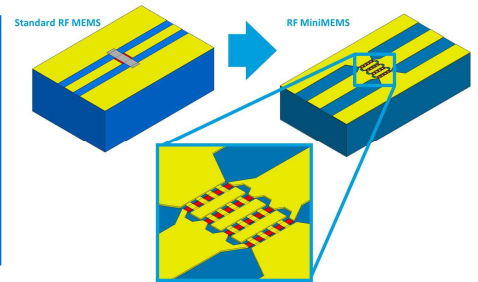
HIGH-RELIABILITY, HIGH-POWER & HIGH-SPEED RF TUNING APPLICATIONS
BASED ON MINIATURISED MEMS SWITCHED CAPACITORS



Abstract

MiniMEMS introduce a novel device of MEMS switched capacitor in RF tuning applications which greatly mitigates the effects of dielectric charging and temperature effects and allows switching times one order of magnitude below the state of the art. This new device is a highly miniaturised version of the standard capacitive MEMS switch, resulting in enhanced mechanical properties and consequently leading to high-reliability, high-power and high-speed capabilities.

	Component specifications	
	Standard MEMS	MiniMEMS Goals
Beam size	250x100 μm^2	20x10 μm^2
Gap	2 μm	0.25 μm
Capacitance ratio	30-150	3-30
Switching time	> 1 μs	200 ns
Reliability	< 10 ¹⁰ **	> 10 ¹¹
Power handling	< 5 W	5 W

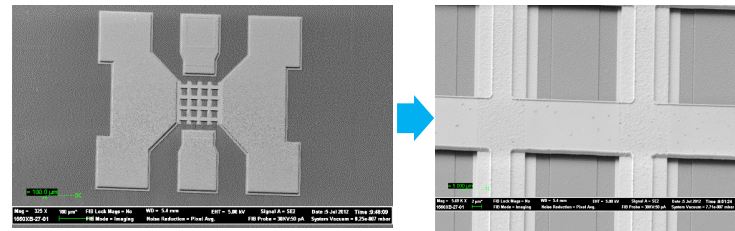


Objectives & Main achievements

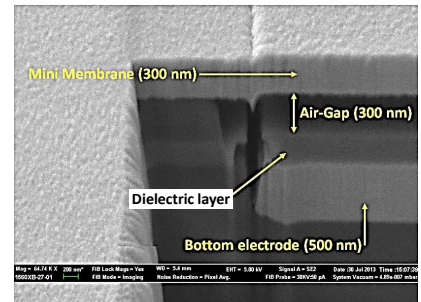
Development of the design methodologies and technological process to achieve the integration of the miniaturised switched capacitors in :

- tunable filters
 - phase shifters
- Demonstration of low cost and high yield**

 - Adaptive receiver
 - Reflect arrays antennas

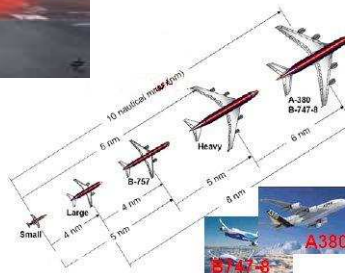
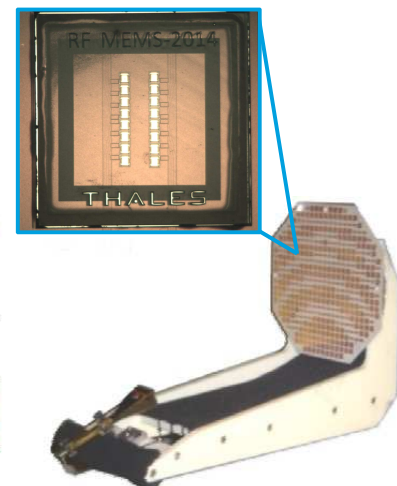


PARTIAL REFLECT ARRAY (IVA)		PARTIAL REFLECT ARRAY (TRA)		ADAPTIVE RECEIVER (TRA)	
(Working frequency: 9.3-9.8 GHz)		(Working frequency: 11 GHz)		(Working frequency: 11 GHz)	
Function level: Phase Shifter		Specifications: Phase Shifter		Function level: Tunable Filter	
Phase range	0-360°	Size	12 x 12 mm ²	Tuning range	200-500 MHz (5 bits resolution)
Phase increment	-3°	Phase increment	3 bits	Losses	3-5 dB
Insertion loss	<1 dB	Dispersions	Phase: 6° (rms) Amplitude: 0.8 dB (rms)	BW (3dB)	10 MHz (high-Q filter), 100-1000 MHz (medium-Q filter)
Switching time	<500 ns	Insertion loss	<0.8 dB	Selectivity	20 dB @ 28 MHz from f _c (high-Q), 20 dB @ 0.3-1 GHz from f _c (medium-Q)
Power handling	20 W (peak), 2 W (average)	Switching time	<500 ns	Size	2.4 x 1.1 cm ²
Reliability	>10 ¹¹ cyc.	Power handling	0.2 W (average) (4 W peak)	Power consumption	< 20 mW
System level: Partial Reflect Array		Specifications: Partial Reflect Array		System level: Adaptive receiver	
Size	~250 mm x 250 mm (corresponding approx. to 450 radiating elements and 15 phase shifters)	Size	Diam ~ 60mm for a hexagonal sub-array of 19 phase-shifters Total Diam ~ 200 mm (7-9 sub-arrays)	Integration	Hybrid Monolithic
Element	TBD	T ₁ range	-40°C/+60°C (storage: -55°C/+70°C)	Substrate	- GaN
Polarization	Two orthogonal polarizations with matching main lobes	Polarization	Linear	Tuning range	200-500 MHz (5 bits resolution) 200-500 MHz (5 bits resolution)
Side lobes	<-30 dB	Cross-pol.	<-20dB	Gain	13-15 dB 13-15 dB
Cross-pol.	<-35 dB			Noise Figure	3-4 dB 3-4 dB
				Limiter	Power handling: 2W Loss: 1 dB Gain: 19 dB Flat leakage: 20dBm
				LNA	Gain: 19 dB Flatness: 2 dB Noise figure: 2 dB Power consumption < 50 mW (5V)



Applications & Market fields

- Weather radars
- Wake vortex detection radars
- Air traffic management
- RF wireless communication systems, consumer electronics



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