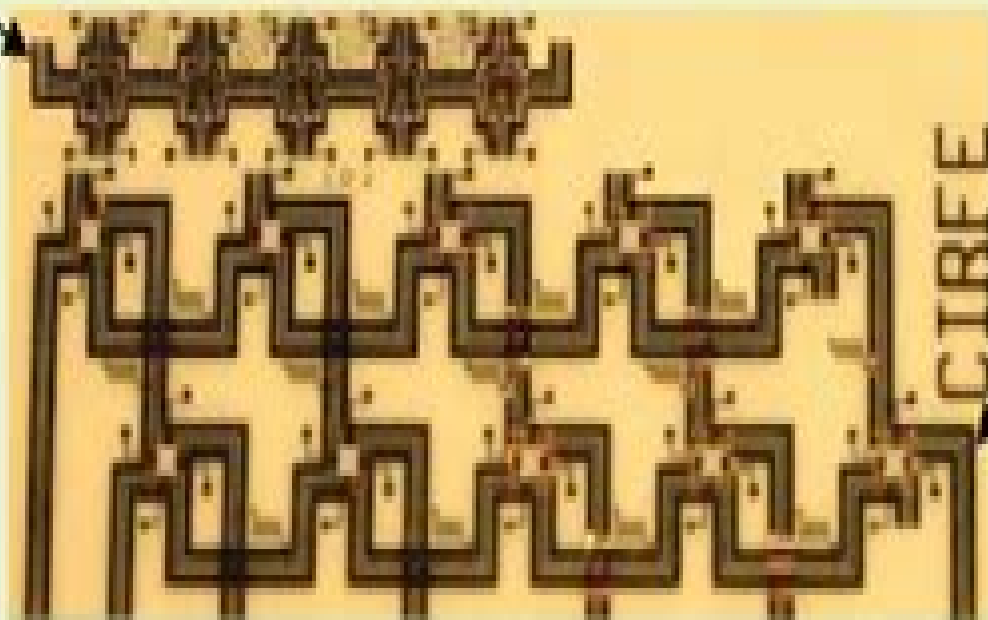


R-Type RF MEMS Switch Matrix

C-Type RF MEMS  
Switch Matrix



1.6 cm

**Figure 17** A comparison between two MEMS layouts

# Rf Mems Switches And Switch Matrices Ursi Home

**Prasad S. Sumant**



## **Rf Mems Switches And Switch Matrices Ursi Home:**

**Multi-Port RF MEMS Switches and Switch Matrices [electronic Resource]** Daneshmand, Mojgan, 2006      **RF MEMS Switches and Integrated Switching Circuits** Ai-Qun Liu, 2010-08-09 Microelectromechanical Systems MEMS stand poised for the next major breakthrough in the silicon revolution that began with the transistor in the 1960s and has revolutionized microelectronics MEMS allow one to not only observe and process information of all types from small scale systems but also to affect changes in systems and the environment at that scale RF MEMS Switches and Integrated Switching Circuits builds on the extensive body of literature that exists in research papers on analytical and numerical modeling and design based on RF MEMS switches and micromachined switching circuits and presents a unified framework of coverage This volume includes but is not limited to RF MEMS approaches developments from RF MEMS switches to RF switching circuits and MEMS switch components in circuit systems This book also Presents RF Switches and switching circuit MEMS devices in a unified framework covering all aspects of engineering innovation design modeling fabrication control and experimental implementation Discusses RF switch devices in detail with both system and component level circuit integration using micro and nano fabrication techniques Includes an emphasis on design innovation and experimental relevance rather than basic electromagnetic theory and device physics RF MEMS Switches and Integrated Switching Circuits is perfect for engineers researchers and students working in the fields of MEMS circuits and systems and RFs      **Fully Integrated BiCMOS High-voltage Driver Circuits for On-chip RF-MEMS Switch Matrices** Christian Wipf, 2019

**High-performance RF MEMS Circuits and Phase Shifters** Guan Leng Tan, 2002      **A Discriminating Discussion of RF-MEMS** Jacopo Iannacci, 2025-11-07 This book offers a unique bottom up perspective of a technology for the manufacturing of low complexity hardware components which elevates this to a key enabling technology of 6G and future networks This MEMS based technology enables the fabrication of highly miniaturized high performance widely tunable reconfigurable and frequency agile passives among which are low loss high isolation micro switches multi state RF power attenuators delay lines and impedance tuners high order switching matrices tunable filters and more The ultimate target of the book is increasing awareness of RF MEMS technology and its possibilities breaking the usual boundaries of the restricted scientific community dedicated to microsystems and engaging scientists developers and enthusiasts involved in other fields of technology This includes 6G and future networks as well as the unprecedented bottom up design and conceptualization approaches that will be crucial to turn such paradigms into reality The book addresses a broad audience both technical and non technical spread across multiple modern disciplines encompassing microelectronics micro technologies telecommunications RF and microwave engineering      **RF MEMS** Gabriel M. Rebeiz, 2004-02-06 Ultrasmall Radio Frequency and Micro wave Microelectromechanical systems RF MEMs such as switches varactors and phase shifters exhibit nearly zero power consumption or loss For this reason they are being developed intensively by corporations worldwide for use in

telecommunications equipment This book acquaints readers with the basics of RF MEMs and describes how to design practical circuits and devices with them The author an acknowledged expert in the field presents a range of real world applications and shares many valuable tricks of the trade      *Radio Frequency Micromachined Switches, Switching Networks, and Phase Shifters* Shibani Kishen Koul, Sukomal Dey, 2019-05-03 Radio Frequency Micromachined Switches Switching Networks and Phase Shifters discusses radio frequency microelectromechanical systems RF MEMS based control components and will be useful for researchers and R D engineers It offers an in depth study performance analysis and extensive characterization on micromachined switches and phase shifters The reader will learn about basic design methodology and techniques to carry out extensive measurements on MEMS switches and phase shifters which include electrical mechanical power handling linearity temperature stability reliability and radio frequency performance Practical examples included in the book will help readers to build high performance systems subsystems using micromachined circuits Key Features Provides simple design methodology of MEMS switches and switching networks including SPST to SP16T switches Gives an in depth performance study of micromachined phase shifters Detailed study on reliability and power handling capability of RF MEMS switches and phase shifters presented Proposes reconfigurable micromachined phase shifters Verifies a variety of MEMS switches and phase shifters experimentally      **Practical Guide to RF-MEMS** Jacopo Iannacci, 2013-08-12 Closes the gap between hardcore theoretical and purely experimental RF MEMS books The book covers from a practical viewpoint the most critical steps that have to be taken in order to develop novel RF MEMS device concepts Prototypical RF MEMS devices both including lumped components and complex networks are presented at the beginning of the book as reference examples and these are then discussed from different perspectives with regard to design simulation packaging testing and post fabrication modeling Theoretical concepts are introduced when necessary to complement the practical hints given for all RF MEMS development stages Provides researchers and engineers with invaluable practical hints on how to develop novel RF MEMS device concepts Covers all critical steps dealing with design simulation optimization characterization and fabrication of MEMS for radio frequency applications Addresses frequently disregarded issues explicitly treating the hard to predict interplay between the three dimensional device structure and its electromagnetic functionality Bridges theory and experiment fundamental concepts are introduced with the application in mind and simulation results are validated against experimental results Appeals to the practice oriented R D reader design and simulation examples are based on widely known software packages such as ANSYS and the hardware description language Verilog      *Stochastic Multiphysics Modeling of RF MEMS Switches* Prasad S. Sumant, 2010 Micro Electro Mechanical MEM devices like switches varactors and oscillators have shown great potential for use in communication devices sensors and actuators Electrostatically actuated switches in particular have been shown to have superior performance characteristics over traditional semiconductor switches However their widespread insertion in integrated electronics is critically dependent on a thorough

understanding of two broad issues manufacturing process variations and failure mechanisms Variations during fabrication lead to uncertain material and or geometric parameters causing a significant impact on device performance Such uncertainties need to be accounted for during the robust design of these switches In terms of failure mechanisms limiting the lifetime of MEMS switches dielectric charging is considered to be the most critical It can cause the switch to either remain stuck after removal of the actuation voltage or to fail to contact under application of voltage There is a need for accurate and computationally efficient multi physics CAD tools for incorporating the effect of dielectric charging In this work we have attempted to address some of the aforementioned challenges We have come up with new algorithms for improving the efficiency of coupled electro mechanical simulations done in existing commercially available software like ANSYS The gains in efficiency are accomplished through eliminating the need for repeated mesh update or re meshing during finite element electrostatic modeling This is achieved through the development of a map between the deformed and un deformed geometries Thus only one finite element discretization on the original undeformed geometry is needed for performing electrostatic analysis on all subsequent deformed geometries We have generalized this concept of mapping to perform stochastic electrostatic analysis in the presence of geometric uncertainties The different random realizations of geometry are considered as deformed geometries The electrostatic problem on each of these random samples is then obtained using the mapping and the finite element simulation on the mean geometry Statistics such as the mean and standard deviation of the desired system response such as capacitance and vertical force are efficiently computed This approach has been shown to be orders of magnitude faster than standard Monte Carlo approaches Next we have developed a methodology for the model order reduction of MEMS devices under random input conditions to facilitate fast time and frequency domain analyses In this approach the system matrices are represented in terms of polynomial expansions of input random variables The coefficients of these polynomials are obtained by deterministic model order reduction for specific values of the input random variables These values are chosen smartly using a Smolyak algorithm The stochastic reduced order model is cast in the form of an augmented deterministic system The proposed method provides significant efficiency over standard Monte Carlo Finally we have developed a physics based one dimensional macroscopic model for the quantitative description of the process of dielectric charging The fidelity of the model relies upon the utilization of experimentally obtained data to assign values to model parameters that capture the non linear behavior of the dielectric charging process The proposed model can be easily cast in the form of a simple SPICE circuit Its compact physics based form enables its seamless insertion in non linear SPICE like circuit simulators and makes it compatible with system level MEMS computer aided analysis and design tools The model enables the efficient simulation of dielectric charging under different complex control voltage waveforms In addition it provides the means for expedient simulation of the impact of dielectric charging on switch performance degradation It is used to demonstrate failure of a switch in Architect We conclude with a description of how this one dimensional model can be

combined in a detailed two dimensional coupled electro mechanical framework

**Design and Fabrication of Low Actuation Voltage K-band MEMS Switches for RF Applications** Sergio Pacheco,2004

**High Performance RF MEMS Metal-Contact Switches and Capacitive Switches** Chenhui Niu,2016 This dissertation presents designs fabrication processes and measurements of a series of high performance RF MEMS switches Chapter 2 presents a miniature RF MEMS metal contact switch based on a tethered cantilever structure The miniature size and the use of tethers result in an excellent biaxial residual stress and stress gradient tolerance The switch is built using thin metal process with a large biaxial stress and a high stress gradient 50 MPa and 105 MPa  $\mu\text{m}$  and works well under these conditions In the up state the switch capacitance is 9.4 fF and results in an isolation of 20 dB at 20 GHz In the down state the switch resistance is 3.6 ohm for a gold gold contact under 30 V actuation voltage The switch is compatible with CMOS back end processing With its miniature size the switch could be placed in arrays to achieve lower contact resistance and higher power handling Chapter 3 presents a multi contact mN force RF MEMS metal contact switch with a pull down voltage  $V_p$  of 45 V 50 V and an operation voltage of 60V 65V The switch gets a contact force of  $\approx 2.0$  mN under 65 V actuation voltage and a release force of  $\approx 1.2$  mN simulated The switch gets an on state resistance of  $\approx 1.8$  with Ru Au contact and an off state capacitance of 13.5 fF which results in a figure of merit of 24 fs In the temperature stability measurement the switch shows a change of 4V in pull down voltage and a change of 2V in release voltage from 25 C to 125 C In the high power handling measurement the switch demonstrates a reliability of 10 million cold switching cycles with 5 W RF power Chapter 4 first presents a high capacitance ratio  $C_r$  capacitive switch with continuous tuning capability after pull down The measured up state capacitance is 74 fF The pull down voltage of the switch is 30V 32V and there is an 8.4% linear tuning range from 33V to 40V actuation voltage The measured down state capacitance is 1296 fF under 40V actuation voltage resulting in a  $C_r$  of 17.5 Next a back to back switch using the high  $C_r$  switch is designed to improve IP2 without extra power supply The back to back switch shows an up state capacitance of 31fF a  $C_r$  of 19.7 and a 6.8% continuous tuning range from 34V to 40V The back to back switch shows a 14 dB higher OIP2 than the single switch does

**RF MEMS Switches with Novel Materials and Micromachining**

**Techniques for SOC/SOP RF Front Ends** Guoan Wang,2006 The third project presents an RF MEMS switch developed on a low cost flexible liquid crystal polymer LCP substrate Its very low water absorption 0.04% low dielectric loss and multi layer circuit capability make it very appealing for RF Systems On a Package SOP In chapter IV a capacitive RF MEMS capacitive switch on an LCP substrate and its characterization and properties up to 40 GHz is presented for the first time

RF-MEMS Switches Designed for High-Performance Uniplanar Microwave and Mm-Wave Circuits Lluís Pradell,2018 Radio frequency microelectromechanical system RF MEMS switches have demonstrated superior electrical performance lower loss and higher isolation compared to semiconductor based devices to implement reconfigurable microwave and millimeter mm wave circuits In this chapter electrostatically actuated RF MEMS switch configurations that can be easily

integrated in uniplanar circuits are presented The design procedure and fabrication process of RF MEMS switch topologies able to control the propagating modes of multimodal uniplanar structures those based on a combination of coplanar waveguide CPW coplanar stripline CPS and slotline will be described in detail Generalized electrical multimodal and mechanical models will be presented and applied to the switch design and simulation The switch simulated results are compared to measurements confirming the expected performances Using an integrated RF MEMS surface micromachining process high performance multimodal reconfigurable circuits such as phase switches and filters are developed with the proposed switch configurations The design and optimization of these circuits are discussed and the simulated results compared to measurements

*RF MEMS and Their Applications* Vijay K. Varadan, K. J. Vinoy, K. A. Jose, 2003-07-25

Microelectromechanical systems MEMS refer to a collection of micro sensors and actuators which can react to environmental change under micro circuit control The integration of MEMS into traditional Radio Frequency RF circuits has resulted in systems with superior performance levels and lower manufacturing costs The incorporation of MEMS based fabrication technologies into micro and millimeter wave systems offers viable routes to ICs with MEMS actuators antennas switches and transmission lines The resultant systems operate with an increased bandwidth and increased radiation efficiency and have considerable scope for implementation within the expanding area of wireless personal communication devices This text provides leading edge coverage of this increasingly important area and highlights the overlapping information requirements of the RF and MEMS research and development communities Provides an introduction to micromachining techniques and their use in the fabrication of micro switches capacitors and inductors Includes coverage of MEMS devices for wireless and Bluetooth enabled systems Essential reading for RF Circuit design practitioners and researchers requiring an introduction to MEMS technologies as well as practitioners and researchers in MEMS and silicon technology requiring an introduction to RF circuit design

*RF MEMS Switches and Phase Shifters for 3D MMIC Phased Array Antenna Systems* Yu Albert Wang, 2002

In order to incorporate the RF MEMS technology with the 3D MMICs technology a novel RF MEMS switch was designed and implemented in a 3D MMIC circuit environment RF MEMS switches possess many advantages compared to traditional solid state switches such as high electromechanical isolation and ultra low power consumption The novelty of this switch was that it was based on low temperature processing techniques Design equations for a shielded coplanar waveguide were derived for the switch Traditional lumped element capacitor model and this newly developed distributed transmission line models were compared against measured data to verify their validity While measurement results show good agreement with both models the distributed model consistently demonstrated better match than its lumped element counterpart Test and measurement results showed that a typical RF MEMS switch was capable of delivering less than 0.2 dB insertion loss and more than 14.1 dB isolation between input and output ports at X band 8 GHz 12 GHz This RF MEMS switch required only 12 V actuation voltage while it was capable of handling 2.88 W RF power before hot switching occurs Hysteretic phenomenon of RF MEMS switches

was observed release voltage threshold was found to be around 2V 4V much lower than the one required for pulling down the structure Switching speeds of RF MEMS switches with different beam strength were measured using a novel experimental setup utilizing couplers as bias networks The fastest switches demonstrated maximum switching speed of 3 571 kHz and more than 10 800 000 life cycles As the application of RF MEMS switches a 4 bit digital phase shifter was designed and fabricated 180 bit and 90 bits were realized using reflection type phase shifters while the 45 and 22 5 bits were achieved using loaded line type phase shifters A novel reflection type phase shifter loaded with multiple switch pairs was developed and was capable of delivering multiple phase shift angles within one circuit stage Phase shifter measurement results were consistent with simulated results

#### **Low Temperature Superconducting RF MEMS Devices** Sara Sharifian

Attar, University of Waterloo. Department of Electrical and Computer Engineering, 2014 Abstract Superconducting microelectronics technology SME has the potential of realizing high speed digital receivers capable of performing direct digitization of radio frequency signals with very low power consumption An SME receiver is implemented on a single chip using low temperature superconducting LTS Josephson junctions JJs The technology provides ultrafast digital switches and logic circuits along with high linearity analog to digital converters ADCs However SME technology offers limited choices for realizing reconfigurable analog front ends While a tunable inductor using a string of JJs or superconducting quantum interference devices SQUIDs can be realized using the SME technology the main problems with these tuning inductor elements are poor linearity performance and low power handling RF MEMS technology has the capability to offer highly linear and high power handling tuning elements such as switches and varactors To integrate a receiver with radio frequency RF front end on a single chip MEMS devices need to be fabricated using the same fabrication process as SME technology In this study a post processing technique is developed and optimized to release the MEMS parts of the SME chip while keeping the SME electronics intact Another challenge is to design MEMS structures that can handle extreme low temperature working environments For the first time superconducting niobium based RF MEMS dc contact switches capacitive contact switches and varactors are developed employing the SME technology operating at 4K The loss in all of the devices is extremely low and the quality factor is quite high when niobium superconducts The mechanical performance of the MEMS structures are investigated at liquid nitrogen and liquid helium temperatures of 77K and 4K respectively The deformation of the MEMS structures and material stiffness at cryogenic temperature are also investigated Additionally more advanced tunable RF circuits are developed fabricated and characterized implementing the primary devices Two types of MEMS capacitor banks are designed post processed and characterized using the dc contact and capacitive contact RF MEMS switches The capacitor banks show a very high quality factor at 4K As well a single port double throw switch is developed and measured as the building block for switch matrices showing extremely low insertion loss and tunable resonators are presented that implement both varactors and dc contact RF MEMS switches as the tuning elements The resonators are

extremely miniaturized with a size of  $\lambda/1600$  and tunable filters are developed and characterized using these resonators. While niobium based RF MEMS can be integrated within the niobium layers of the SME technology, designers often do not have the flexibility to select the thickness of the MEMS structural layers. Also, since the fabrication process of SME technology is not specifically designed for MEMS technology, there are limitations in designing more reliable RF MEMS devices. A novel niobium based micro fabrication process is developed to integrate gold based MEMS structures with niobium based RF circuits. This method benefits from the very low loss characteristic of superconducting metal niobium while implementing a more matured technology for MEMS structures. An 8 mask fabrication process is developed that allows the monolithic integration of superconducting niobium based RF circuits with gold based MEMS structures. By developing this fabrication method, many low loss and high quality factor tunable RF devices can be achieved. The challenge is to maintain the quality of the niobium metal layer so that there is no degradation in the critical temperature of the niobium after going through all of the 8 mask process steps. Niobium RF devices integrated with gold based dc contact and capacitive contact RF MEMS switches are fabricated and characterized on alumina substrates using the proposed fabrication process. All devices demonstrate insertion loss reduction due to the superconducting nature of niobium. The measurements of coplanar waveguide transmission lines and low pass filters demonstrate that the critical temperature of the niobium metal layer is not degraded during the process steps. A capacitor bank is designed, fabricated and characterized showing a very high quality factor. Finally, two types of niobium tunable bandpass filters are presented that employ gold based dc contact RF MEMS switches as the tuning elements.

*RF MEMS Circuit Design for Wireless Communications* Héctor J. de los Santos, 2002. This is the first comprehensive book to address the design of RF MEMS based circuits for use in high performance wireless systems. A groundbreaking research and reference tool, the book enables you to understand the realm of applications of RF MEMS technology, become knowledgeable of the wide variety and performance levels of RF MEMS devices, and partition the architecture of wireless systems to achieve greater levels of performance. This innovative resource also guides you through the design process of RF MEMS based circuits and establishes a practical knowledge base for the design of high yield RF MEMS based circuits. The book features exercises and detailed case studies on working RF MEMS circuits that help you decide what approaches best fit your design constraints. This unified treatment of RF MEMS based circuit technology opens up a new world of solutions for meeting the unique challenges of low power portable wireless products.

*Microelectromagnetic Systems (MEMS) Electrostatic Switching Technology for Microwave Systems* Richard E. Strawser, 2000-12-01. The development of microelectromechanical Systems (MEMS) switch technology and integration of this technology into radio frequency RF electronics has created numerous applications for both commercial and military systems. The incorporation of RF MEMS switches into microwave systems offers unprecedented reductions in insertion loss on resistance with extremely low switching power levels as compared with active devices such as field effect transistors (FETs).

and positive intrinsic negative PIN diodes Achievement of these performance improvements creates new opportunities for radar systems The overall objective of this research was the design fabrication and characterization of MEMS switches fabricated on gallium arsenide substrates with possible application into microwave systems

**High Performance RF MEMS Metal-contact Switches and Switching Networks** Chirag D. Patel, 2012 This dissertation presents the design and measurement of high performance RF MEMS metal contact switches capable of achieving mN level contact and release forces The switches are designed and demonstrated to be tolerant to a wide range stress effect and temperature Chapter 2 presents an electrostatic RF MEMS metal contact switch based on a tethered cantilever topology The use of tethers results in a design that has low sensitivity to stress gradients biaxial stresses and temperature A switch with a footprint of  $160 \times 190 \mu\text{m}^2$  and based on a surface micromachined  $8 \mu\text{m}$  thick gold cantilever with a Au Ru contact is implemented on a high resistivity silicon substrate and results in a total contact force of  $0.812 \text{ mN}$  at  $80-90 \text{ V}$  a restoring force of  $0.5 \text{ mN}$  a pull in voltage of  $61 \text{ V}$  an up state capacitance of  $24 \text{ fF}$  and an actuation time of  $6.4 \mu\text{s}$  The device achieves a switch resistance of  $2414 \text{ Ohms}$  to  $1806 \text{ Ohms}$  at  $90-100 \text{ V}$  in open laboratory environments unpackaged Chapter 3 presents a temperature stable metal contact RF MEMS switch capable of handling  $5 \text{ W}$  of RF power a second generation of the tethered cantilever topology The device achieves  $0.715 \text{ mN}$  of contact force for actuation voltages of  $80-90 \text{ V}$  with a restoring force of  $0.63 \text{ mN}$  Furthermore the device is insensitive to stress effects and temperature Temperature measurements showed excellent thermal stability no deflection in the beam and a change in pull in voltage of only  $4 \text{ V}$  from  $25-125 \text{ C}$  The switch was tested under prolonged  $24 \text{ hrs}$  high power RF conditions with excellent reliability Chapter 4 presents a compact RF MEMS metal contact switch based on a tethered cantilever topology and orthogonal anchors The switch is a medium force design capable of achieving  $0.38072 \text{ mN}$  of contact force for actuation voltages of  $90-100 \text{ V}$  and a restoring force of  $0.46 \text{ mN}$  simulated in a  $120160 \mu\text{m}^2$  area The pull in and release voltages are  $75 \text{ V}$  and  $70 \text{ V}$  respectively In the down state the switch resistance is  $12$  with a Au Ru hybrid contact In the up state the capacitance is  $16 \text{ fF}$  resulting in an isolation of  $20 \text{ dB}$  at  $10 \text{ GHz}$  and  $9 \text{ dB}$  at  $40 \text{ GHz}$  for an SPST configuration Furthermore the switch demonstrated a reliability of  $10$  million cycles  $1 \text{ W}$  cold switching and a power handling of  $5 \text{ W}$  For a series shunt configuration the switch achieves an isolation of  $55 \text{ dB}$  at  $10 \text{ GHz}$  and  $35 \text{ dB}$  at  $40 \text{ GHz}$  Compact SP4T and SP6T switching networks are also implemented The SP4T is  $850 \times 530 \mu\text{m}^2$   $850 \times 650 \mu\text{m}^2$  with bias pads the SP6T is  $850 \times 730 \mu\text{m}^2$   $850 \times 855 \mu\text{m}^2$  with bias pads Both designs achieve an isolation  $36 \text{ dB}$  and insertion loss  $0.3 \text{ dB}$  at  $3 \text{ GHz}$  Chapter 5 presents a mN level contact and restoring force RF MEMS metal contact switch exhibiting high reliability high linearity and high power handing for DC  $40 \text{ GHz}$  applications The device which is insensitive to stress and temperature effects achieves  $1.215 \text{ mN}$  of contact force per contact from  $80-90 \text{ V}$  and  $1.0 \text{ mN}$  of restoring force per contact The up state capacitance is  $8 \text{ fF}$  resulting in an isolation of  $46.31$  and  $14 \text{ dB}$  at  $1.6$  and  $40 \text{ GHz}$  respectively Measured results show switch resistances of  $1.2 \text{ Ohms}$  and a reliability of  $100$  million cycles at  $2.5 \text{ W}$  under cold switching at

100 mW under hot switching conditions in an unpackaged and standard laboratory environment Furthermore the device was tested under prolonged hold down conditions and demonstrated excellent RF power handling 10 W and DC current handling 1 A capability Finally SP4T and SP6T switching networks implemented with the metal contact switch are demonstrated

**Advanced RF MEMS** Stepan Lucyszyn, 2010-08-19 An up to date guide to the theory and applications of RF MEMS With detailed information about RF MEMS technology as well as its reliability and applications this is a comprehensive resource for professionals researchers and students alike Reviews RF MEMS technologies Illustrates new techniques that solve long standing problems associated with reliability and packaging Provides the information needed to incorporate RF MEMS into commercial products Describes current and future trends in RF MEMS providing perspective on industry growth Ideal for those studying or working in RF and microwave circuits systems microfabrication and manufacturing production management and metrology and performance evaluation

## **Rf Mems Switches And Switch Matrices Ursi Home** Book Review: Unveiling the Power of Words

In some sort of driven by information and connectivity, the ability of words has are more evident than ever. They have the capability to inspire, provoke, and ignite change. Such may be the essence of the book **Rf Mems Switches And Switch Matrices Ursi Home**, a literary masterpiece that delves deep into the significance of words and their impact on our lives. Compiled by a renowned author, this captivating work takes readers on a transformative journey, unraveling the secrets and potential behind every word. In this review, we will explore the book is key themes, examine its writing style, and analyze its overall affect readers.

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### **Rf Mems Switches And Switch Matrices Ursi Home Introduction**

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