# GaAs MMIC SWITCHES FOR HIGH VOLUME APPLICATIONS

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## ABSTRACT

A range of miniature, low cost MESFET switch MMICs have been developed to provide SPDT, SP4T, DPDT and signal transfer functions. The switches are primarily intended for high volume commercial applications below 4 GHz such as personal communications systems, microwave local area networks, land mobile satellite receivers, and television distribution systems. The performance levels achieved are also compatible with the demands of many military and space systems up to 6GHz.

## INTRODUCTION

GaAs MMIC FET switches are now well established for application in military and space systems. The characteristics of ultra fast switching speed, low DC power consumption, low video breakthrough and the ability to operate from DC to microwave frequencies are well known and give system designers considerable benefits over alternatives such as PIN diodes.

The market for MMIC switches for commercial applications is now also growing rapidly, particularly in the fields of personal communication, television distribution systems (DBS and cable) and microwave local area networks. In these markets the driving force is price with only small concessions being allowed in performance. The range of switches described here have been developed with the aim of providing the switching functions needed for these high volume applications at minimum cost and maximum performance. Function for function these are amongst the smallest MESFET switch chips currently produced and therefore offer the potential for very low cost high volume manufacture. Over 6000 die sites per 3 inch wafer have been achieved for the largest chip (SP4T) whilst the smallest SPDT chip has over 13000 sites per 3 inch wafer.

## SWITCH FET CHARACTERISATION

The switch designs all employ an optimised switching MESFET based on ion implemented material and process technology. The material implant and device geometry have been

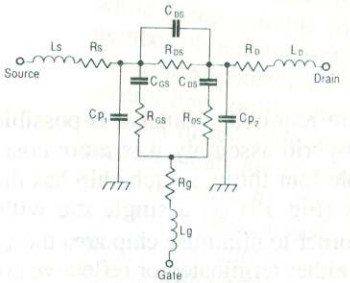



**Fig 1 Switch FET Equivalent Circuit**

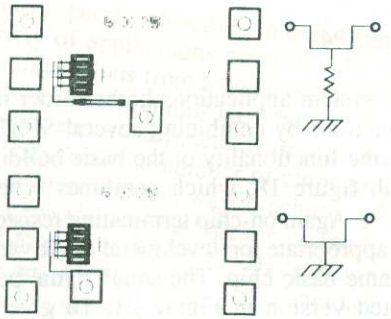


**Fig 2a RFOW Switch FET Test Configurations**

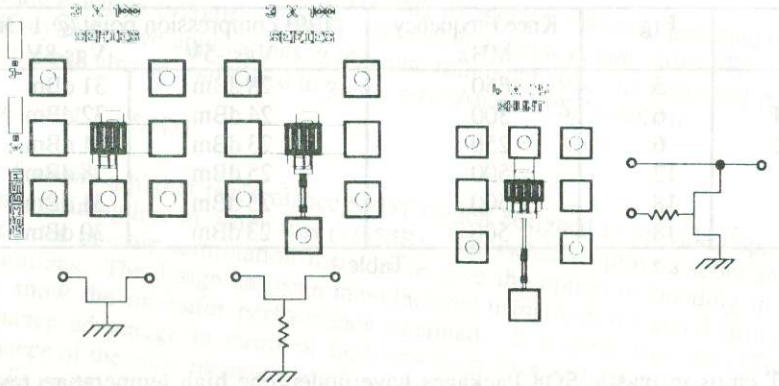
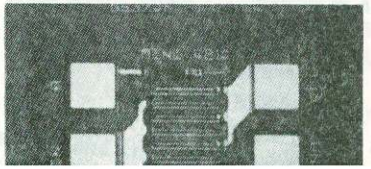
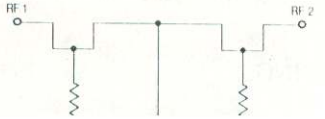


**Fig 2b RFOW Test Structures for Side-Fed Series and Shunt Switch FETs**





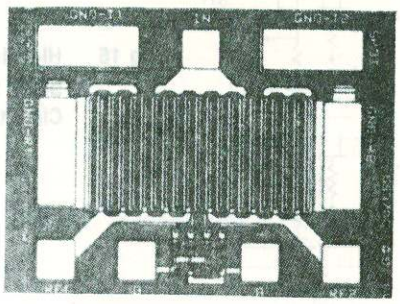


Fig 6 Low Loss 4GHz SPDT Switch MMIC
Die Size : 840x690µm

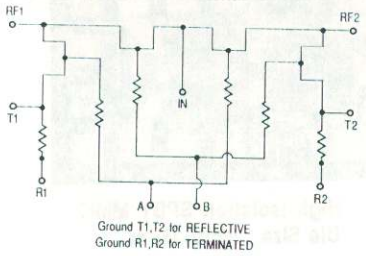



Fig 7 4GHz Low Loss SPDT Switch Circuit

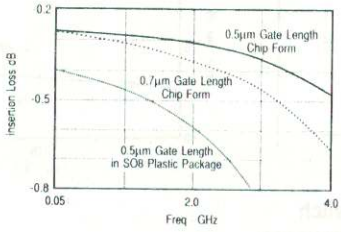



Fig 8 4GHz Low Loss SPDT Switch
Insertion Loss (Reflective)

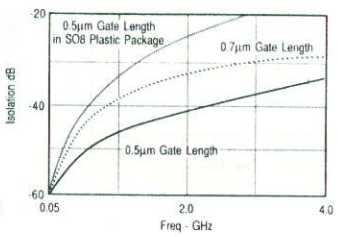



Fig 9 4GHz Low Loss SPDT Switch
Isolation (Reflective)

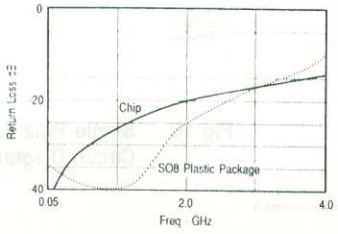



Fig 10 4GHz Low Loss SPDT Switch
Return Loss (ON-State)

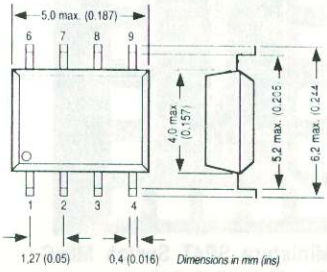



Fig 11 Surface Mount Plastic Package
Outline (SO8)

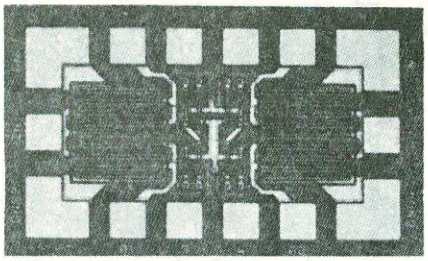


Fig 12 6GHz DPDT Switch MMIC
Die Size : 990x635µm

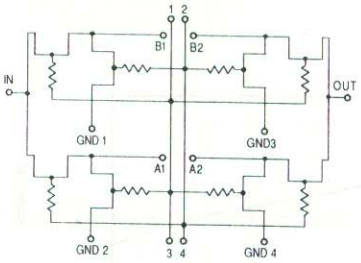



Fig 13 6GHz DPDT Switch Circuit

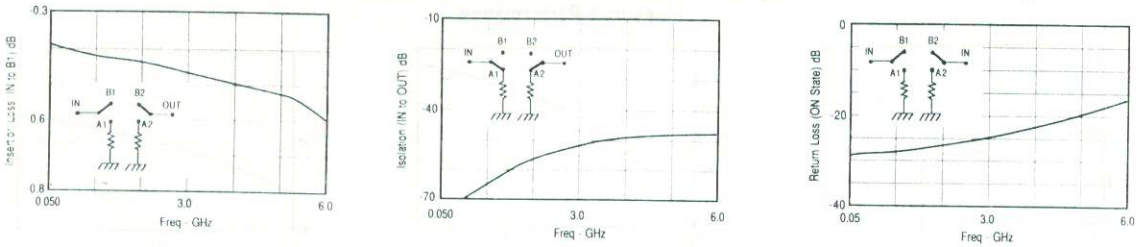



Fig 14 6GHz DPDT Switch Measured
Performance

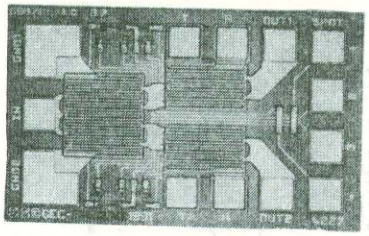
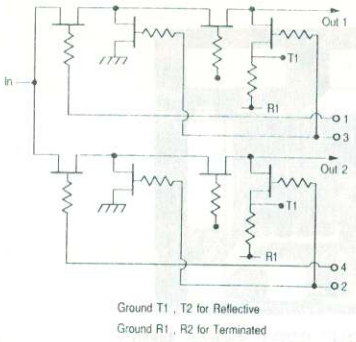


Fig 15 High Isolation SPDT MMIC
Die Size : 990x635µm




Ground T1 , T2 for Reflective
Ground R1 , R2 for Terminated

Fig 16 High Isolation 6GHz
SPDT Switch
Circuit Diagram

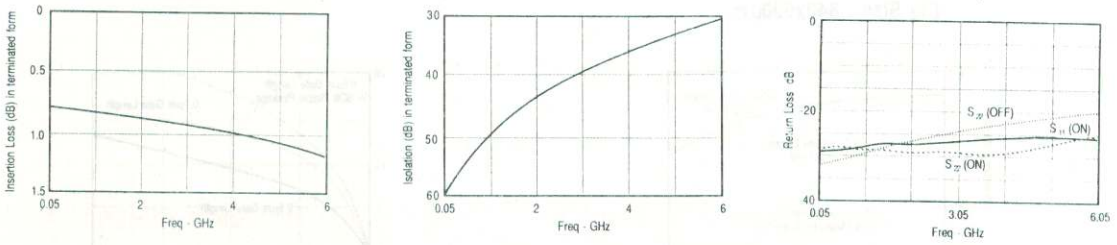



Fig 17 6GHz SPDT Switch
Measured Performance

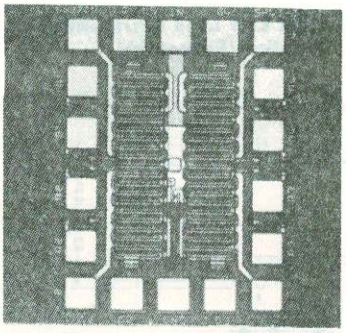


Fig 18 Miniature SP4T Switch MMIC
Die Size : 740x910µm

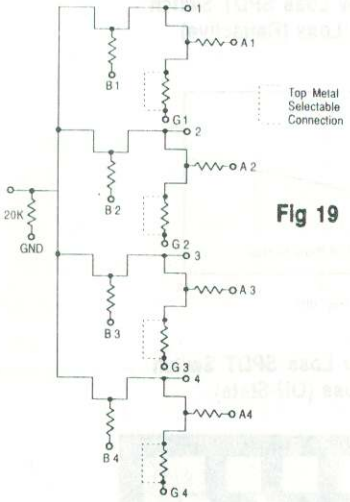



Fig 19 Single Pole Four Throw Switch
Circuit Diagram

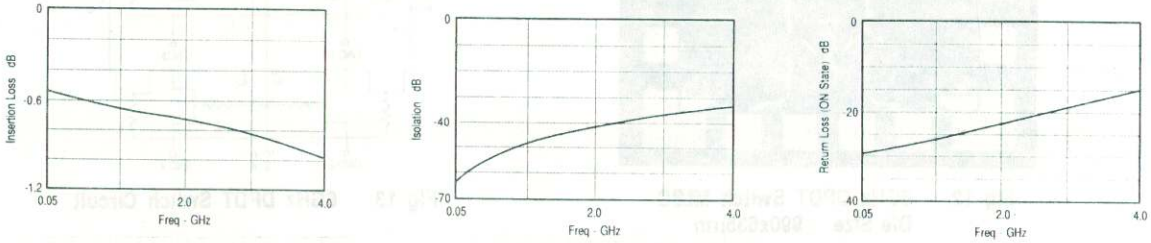



Fig 20 Miniature SP4T Reflective Switch
Measured Performance

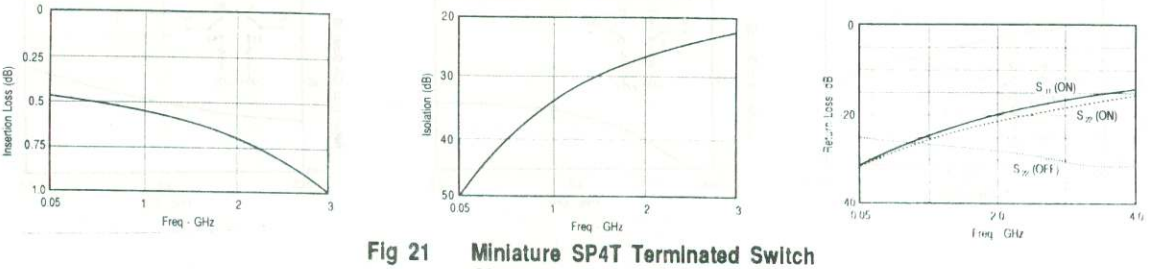



Fig 21 Miniature SP4T Terminated Switch
Measured Performance