

Chapter 2

3T and 4T RF MOSFET Layout and Application

2.1 Layout

The only layout difference between 3T and 4T devices is the common metal-3 layer for source and bulk terminals. As shown in Fig. 2-1, the left part is 4T device configuration because the source and bulk terminals are not shorted together through metal-3 layer. The right part, source and bulk connected by straight metal-3 line, is 3T device configuration.

In my research, I focus on 6 devices and 4 dummy pads. Three is 3T devices of different finger number; the other three is 4T devices. One of dummy pads is short pad layout which is de-embedded to metal-3. The rest of dummy pads are open pad layouts which are de-embedded to metal-1 and one-to-one with devices of three kinds of finger number (N_F). The Table 2-1 is the device layout list.

Table 2-1 The device layout list

3T $N_F=18$	4T $N_F=18$	Open (M1) $N_F=18$	
3T $N_F=36$	4T $N_F=36$	Open (M1) $N_F=36$	Short (M3)
3T $N_F=72$	4T $N_F=72$	Open (M1) $N_F=72$	

There is one thing noticeable. Because the test-key is designed for two-port measurement, the source and bulk terminals of 4T devices are grounded individually. The source and bulk terminals of 3T devices, of course, are common in metal-3 layer and grounded together.

2.2 Application

For two-port test-key, the source and bulk terminals of the MOSFET sample layout what foundries provide to customers are connected in the past years. The model card, therefore, is designed for this case. We have known that the performance of device would be affected by body bias seriously, but this kind of structure, 3T devices with 2-port pads, can not show us the information about body effect induced by body bias. Therefore, studying 3T devices clearly is essential and 4T devices research is also necessary for being used in circuit design field.

For circuit designers, the source and bulk terminals of MOSFET used in circuit do not have to always be connected. They have own purposes and usages of MOSFET. The model card constructed from 3T devices, therefore, would not exactly match the need of circuit designer.

Now, foundries tend to provide 4T MOSFET sample layout to customers directly. Of course, the model card is built for 4T devices to conform the practical design.

In my thesis, all devices are designed to 2-port test-key. We still can not force the bias on bulk terminal directly, but there is still something worthy to find out in 4T devices. This test-key is just a start and more precise ones will continuously designed for 3-port, even 4-port, measurement in the future.

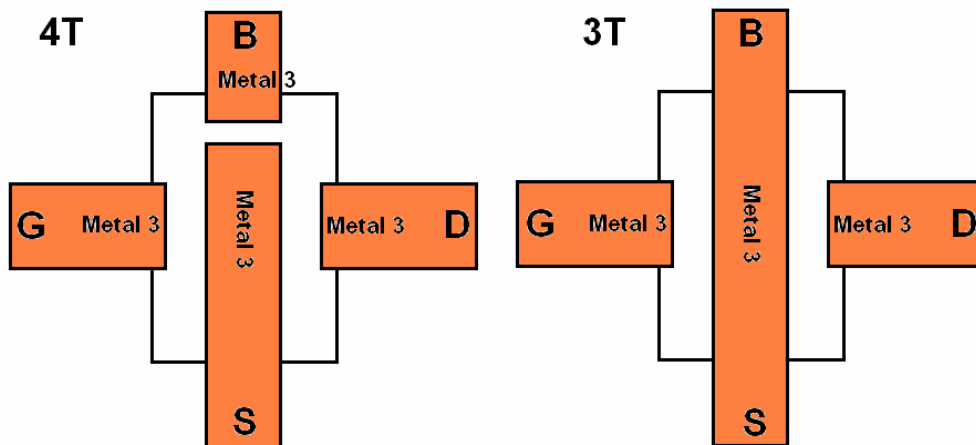


Fig. 2-1 The layout difference between 3T and 4T devices of metal-3 layer