Although resulting errors are very small, we have noted that accuracy depends strongly on the extrinsic parasitic extraction method used to obtain the extrinsic capacitances ($C_{pg}$ and $C_{pd}$) and resistances ($R_s$, $R_d$, and $R_f$).

4. CONCLUSION

We have presented a new methodology to determine the small signal equivalent circuit for microwave FET transistors. We have proposed a new set of simple equations to obtain the intrinsic transistor elements of the extended transistor model. These equations are based only on Y-parameters and on differential resistances $R_s$ and $R_d$. The proposed methodology to determine $R_s$ and $R_d$ includes the frequency effect in such way that measurements at very low frequencies are not required. Our method was implemented and the equivalent circuit elements for different microwave transistors have been presented. The validity of our method is certified by a direct comparison of measured S-parameters vs. model results, showing a very good agreement of a few percent up to 45 GHz.

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DESIGN OF A 3–10 GHZ UWB CMOS T/R SWITCH

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ABSTRACT: A 3–10 GHz broadband CMOS T/R Switch for ultra-wideband (UWB) transceiver is proposed. This broadband CMOS transmit/receive (T/R) Switch is fabricated based on the 0.18 μm 1P6M standard CMOS process. On-chip measurement of the CMOS T/R Switch is performed. The insertion loss of the proposed CMOS T/R Switch is about 3.1 ± 1.3 dB. The return losses at both input and output terminals are higher than 14 dB. It is also characterized with 25–34 dB isolation and 18–20 dBm input $P_{1dB}$. The broadband CMOS T/R Switch shows highly linear phase and group delay of 20 ± 10 ps from 10 MHz to 15 GHz. It can be easily integrated with other CMOS RFICs to form on-chip transceivers for various UWB applications. © 2007 Wiley Periodicals, Inc. Microwave Opt Technol Lett 50: 457–460, 2008; Published online in Wiley InterScience (www.interscience.wiley.com). DOI 10.1002/mop.23129

Key words: CMOS; transmit/receive (T/R) switch; ultra-wideband (UWB); lowpass filter

1. INTRODUCTION

Recently, GaAs technology has been extensively implemented in many RF/microwave switch modules. To consider the cost down and system integration, it is desirable to use standard CMOS process for implementation of high-performance wide band T/R switch. Several T/R switches using CMOS technology have been developed [1–7]. But they are all operated in narrow band. In general, CMOS RF switches are usually operated less than 3 GHz. For UWB radio frequency or higher frequency applications, most switches made by Pin Diode and GaAs are demonstrated.

An UWB 3–10 GHz CMOS RF SDPT Switch based on CMOS 0.18 μm process is proposed in this letter. The concepts of distributed circuit and ladder type low-pass filter are adopted to design the CMOS T/R switch. The proposed CMOS T/R switch has about 3 dB insertion loss and 28 dB isolation from 3 to 10 GHz. The input and output return losses are better than 14 dB. It also has highly linear phase and group delay. Compared with the GaAs switches, the CMOS switches not only...
provide good performance in very high frequency, but also can be easily integrated in a single chip with other RF components, digital and analog devices.

2. CIRCUIT DESIGN
A distributed topology was performed for the design of the switch, as shown in Figure 1. The first step is to design a 4-order Chebychev low-pass filter with a cut-off frequency higher than 10 GHz. The two shunt capacitances can be replaced by using two shunt transistors in the designed low-pass filter. Each shunt
transistor is separated by using lump inductor elements. These shunt NMOS transistors exhibit capacitance ($C_{ds}$) and provide a low impedance path at high frequency when it is in OFF state. The voltage-controlled circuit is also shown in Figure 1. The simulated performance of the low-pass filter is shown in Figure 2. From DC to 24 GHz, it has advantages of low insertion loss and high return loss. The next step is to combine the series FET with the designed low-pass filter shown in Figure 3. With high isolation between Tx and Rx, the transmission loss from input to output can be reduced. In this case, it is also observed that input $P_{1db}$ become lower when a good isolation is considered. Trade-off between isolation and input $P_{1db}$ can be evaluated by selecting the size of the series transistors. From simulation results, the optimal finger value 20 is achieved, as shown in Figure 3.

3. SIMULATION AND MEASUREMENT RESULTS

The chip micrograph of the distributed SDPT switch using 0.18 μm standard CMOS process is shown in Figure 4. The chip size is 0.755 × 0.830 mm². On wafer measurements of the broadband CMOS RF SDPT Switches are performed. As shown in Figure 5, the insertion loss of the proposed CMOS T/R Switch is about 3.1 ± 1.3 dB. The return losses at both input and output terminals are higher than 14 dB. It is also characterized with 25–34 dB isolation and 18–20 dBm input $P_{1db}$. The broadband CMOS T/R Switch shows highly linear phase and group delay of 20 ± 10 ps from 10 MHz to 15 GHz shown in Figure 6. The measurement results are found to be in good agreement with the simulation results. Table 1 summarizes the measurement results and the comparison with the previously reported works.

4. CONCLUSION

A distributed SDPT switch, fabricated on low-cost 0.18 μm standard CMOS process, for UWB wireless communications from 3 to 10 GHz has been presented. The developed switch achieves good insertion loss, high return loss, and high isolation over an extremely wide bandwidth from 10 MHz to 15 GHz. The T/R Switch shows highly linear phase and group delay, which is essential for time-domain UWB applications. It can be easily customized to integrate with other CMOS RF ICs to achieve fully integrated on-chip UWB transceivers, which comply with either Multiband-OFDM or DS CDMA UWB standard. Better performance may be expected if more enhanced CMOS.
or CMOS-related technologies, such as 0.13 μm CMOS, are used.

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DESIGN OF CAPACITIVE COUPLED RESONATOR MICROSTRIP FILTER

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ABSTRACT: A microstrip bandpass filter with a new type of capacitive-coupled resonator is presented. The filter is designed to be smaller compared with the same type of parallel-coupled bandpass filter. The filter is designed for a centre frequency of 2.5 GHz that lies in the S-band frequency range. The insertion loss at f_{0} is 2.4 dB and the measured 3-dB bandwidth is 8.6%. The agreement between the predicted and measured results is excellent, and even the circuit simulator gives a very good prediction for the filter characteristics. © 2007 Wiley Periodicals, Inc, Microwave Opt Technol Lett 50: 460–462, 2008; Published online in Wiley InterScience (www.interscience.wiley.com). DOI 10.1002/mop.23094

Key words: microwave filter; coupled resonator

1. INTRODUCTION

The microstrip resonator has been widely used to measure the dispersion, phase velocity, and effective dielectric constant in microstrip structures cause. Because of its high Q-factor and structural simplicity, it also finds broad applications in microwave and millimeter-wave circuits such as filters; duplexers, oscillators, mixers, couplers, and antennas [1]. Printed bandpass filters are widely used elements in various microwave subsystems due to their repeatability, reliability, and low price. Practically, their only "cost" is the occupied area on a printed board. Because of that many recent papers discuss various printed filter configurations having size reduction as one of the most important design goals [2]. A bandpass filter using microstrip ring resonators with 25%