

CMOS SWITCHES

VS.

PIN DIODE and GaAs SWITCHES

SWITCHES

– critical parameters to consider

- **Insertion loss:** The loss (S_{21}) through the switch when the path is ON (in dB).
- **Isolation:** The loss (S_{21}) through the switch when the path is OFF (in dB).
- **P1dB:** The maximum power that can be handled by the switch without compression
- **Linearity:** The immunity from distortion (cross modulation, harmonics, IM3, etc.)
- **Voltage control** (single control / dual control / level / dependency of P1dB versus V_{cont}) Voltage control parameters can be critical for some application
- **Switching speed**
- **Size**
- **Cost**

PIN DIODES - Technology - Advantages and Drawbacks

- A pin diode is a current controlled resistance. Basically, it's a semiconductor diode in which a high resistivity intrinsic I-region is sandwiched between a P and a N-type region. When no bias is applied, the diode behaves like a capacitance, when a biased is applied, the diode behaves like an inductor

■ Advantages

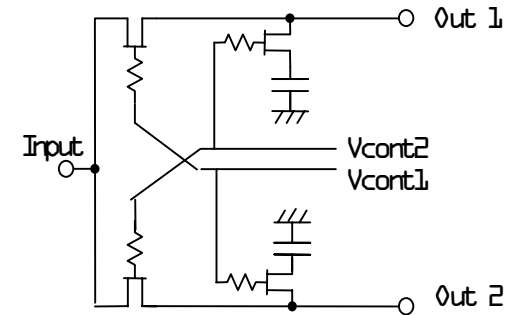
- Very good linearity
- Can be used for high frequency applications
- Can be used for very high power application

■ Drawbacks

- Large amount of DC power: the higher the DC power applied, the lower the insertion loss.
- Isolation specs are difficult to achieve
- Really complex circuitry
- External driver needed to control switching speed

GaAs IC switches - Technology - Advantages and Drawbacks

- A GaAs IC switch is an integrated circuit using FET transistors to achieve switching between multiple paths. It acts essentially as a voltage controlled resistor.



■ Advantages

- Broadband, usually from 500MHz to 4GHz, and also specially tuned for application at 5-6GHz
- Really low insertion loss: on the order of 0.25dB
- Really good isolation performances
- Low power consumption
- Small size
- Good switching speed performances

■ Drawbacks

- Cost
- Usually dual control (except uPG2012, uPG2012, uPG2015)
- Maximum control voltage - 6V

CMOS IC Switches – Technology – Advantages - Drawbacks

- **A CMOS IC switch is an integrated circuit using FET transistors to achieve switching between multiple paths. It acts essentially as a voltage controlled resistor.**
- **NEC's first CMOS switch is the **uPD5710TK****

■ Advantages

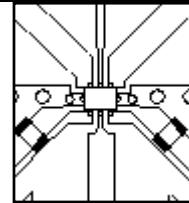
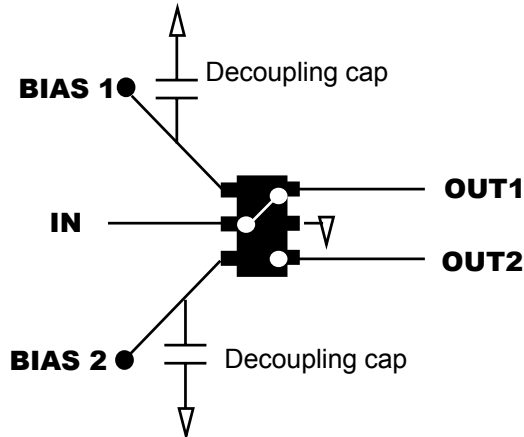
- Low cost
- Do not requires blocking capacitors (except when adjacent component has DC on the connecting pin)
- Can be used down to DC
- Single control
- Low power consumption, 0.01 uA typ
- Size: Our **uPD5710TK** comes in our smallest 6 Pin package:
1.5 x 1.3 mm, 0.55 mm height
- Low dependency of the P1dB versus control voltage
- Good switching speed, 30 ns typ

■ Drawbacks

- Limited in frequency – up to 2.5 GHz.
- Low power applications only – up to 21 dBm
- Maximum control voltage - 4.6V

■ CMOS

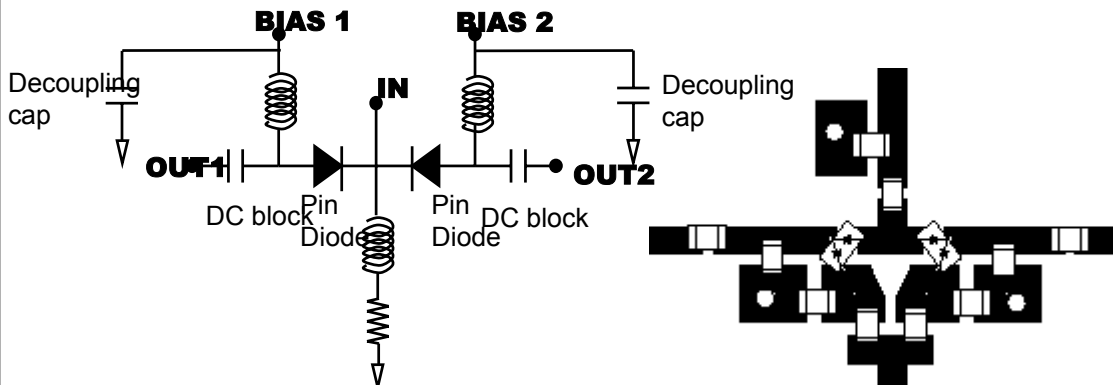
External components needed: 2 Decoupling caps



SIZE, SIMPLICITY of implementation and small number of **EXTERNAL COMPONENT** needed are **three strong advantages** of our **uPD5710TK CMOS switch**

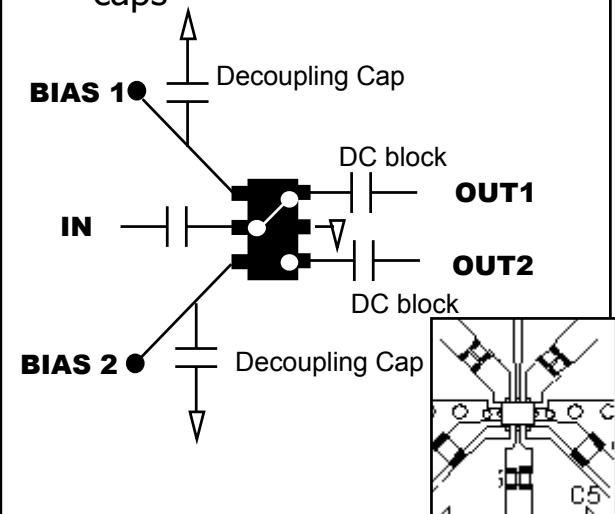
■ PIN DIODES

External components needed: 2 Decoupling caps, 3 bias inductor, 2 DC block caps

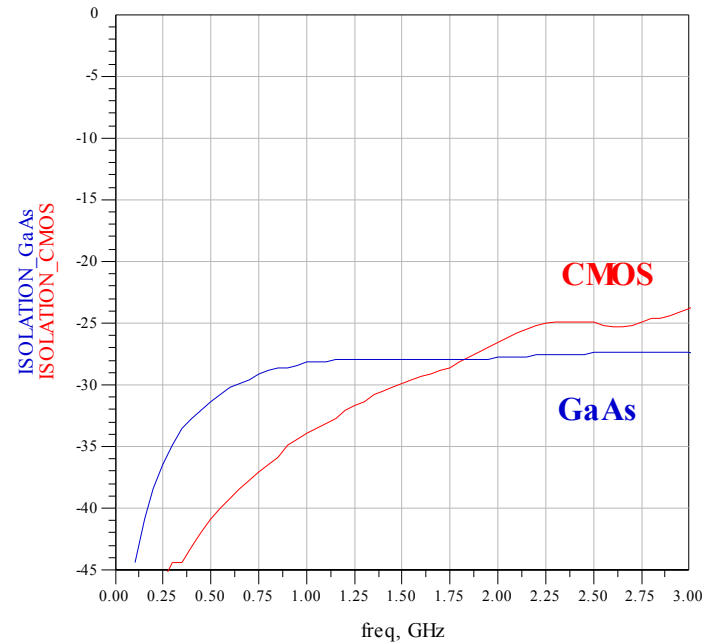
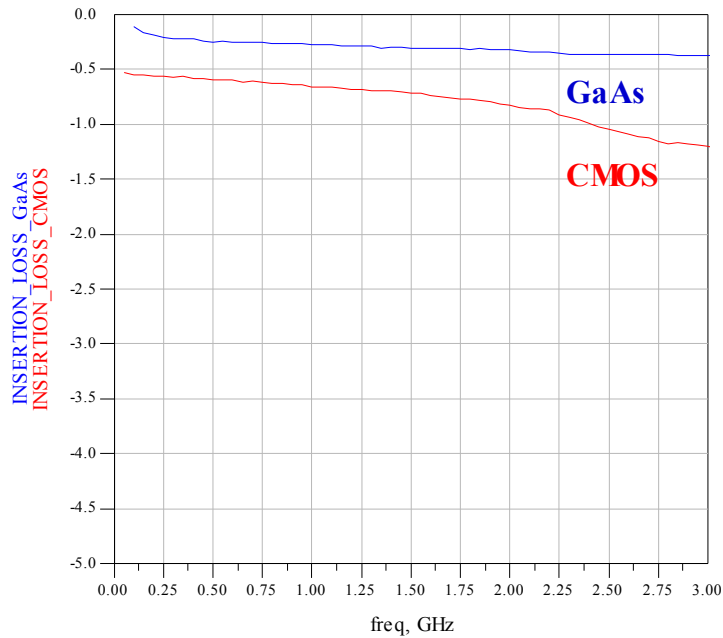


■ GaAs

External components needed: 2 Decoupling caps, 3 DC block caps



Typical Insertion Loss Performance for SPDT Switches



Our **uPD5710TK** has good performance and can compete with the GaAs switches for many applications up to 2.5GHz.