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 Vcont) Voltage control parameters can be critical for some application.
- **Switching speed**
- **Size**
- **Cost**
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
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
Typical Application Circuit for SPDT

- **CMOS**
  External components needed: 2 Decoupling caps

- **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

**SIZE, SIMPLICITY** of implementation and small number of **EXTERNAL COMPONENT** needed are three strong advantages of our uPD5710TK CMOS switch.
Our uPD5710TK has good performance and can compete with the GaAs switches for many applications up to 2.5GHz.