

## MicroNote #704

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## The Potential use of PIN Diodes in Hand Held Transceivers

The purpose of this Application Note is to discuss the potential use of PIN diodes in Hand Held Transceivers.

There are two major issues that dominate transceiver switch designs:

Issue One: The FCC requires at least 120 dB isolation between the transmitter output power and the receiver noise floor.

Issue Two: Single bias polarity switch designs (GaAs MESFETs) are preferred to dual bias polarity switch designs (PIN diodes, unless PIN diodes performance is needed.

Expanding on “One”, the issue is whether the transceiver is operated half-duplex or full-duplex, as required by its IS-XX specification.. The Duplex mode determines the manner in which the transmitter and receiver operate: Time Division Duplex (TDD) is essentially half duplex because that mode operates such the transmitter and receiver are assigned different time slots, so they do not operate simultaneously. Note the TDD is different from TDMA (an access protocol).

Extensive experience with GSM phones (TDMA – TDD modes) has indicated that the isolation provided by a duplexer, is necessary when a phone is operating in close proximity with one or more other phones.

Frequency Division Duplex (FDD) assigns the transmitter and receiver different frequencies that can be occupied simultaneously (full -duplex). In FDD networks, such as CDMA IS95, the receiver and transmitter function simultaneously, using separate radio channels [1]. Virtually all digital Cellular Phones are operated FDD and require a front end duplexer.

A duplex filter combines a transmit-band filter and a receiver-band filter. It has a single input port, attached to the antenna, and two output ports: transmit & receive. A Duplexer is a passive structure: it contains no semiconductor devices.

Duplexers have negative characteristics: the in-band insertion loss is ~ 2 dB, so transmitter power is reduced by 2 dB and receiver Noise Figure is increased 2 dB. The other issue

is size and cost. Duplexers are the largest component on the RF board, and the costliest. And they don't use PIN diodes!

The alternative to duplexers, it to use a PIN diode switch and place a 120 dB isolation filter at the receiver input port. This is done in mobile wireless units where space and power are not so critical.

### Reference

[1] *CDMA Mobile Radio Design*, John B. Groe & Lawrence E Larson, Artech House, 2000, Ch 7

