Chapter I
Wireless Systems Overview

ANALOG DEVICES

Transmitters Requirements
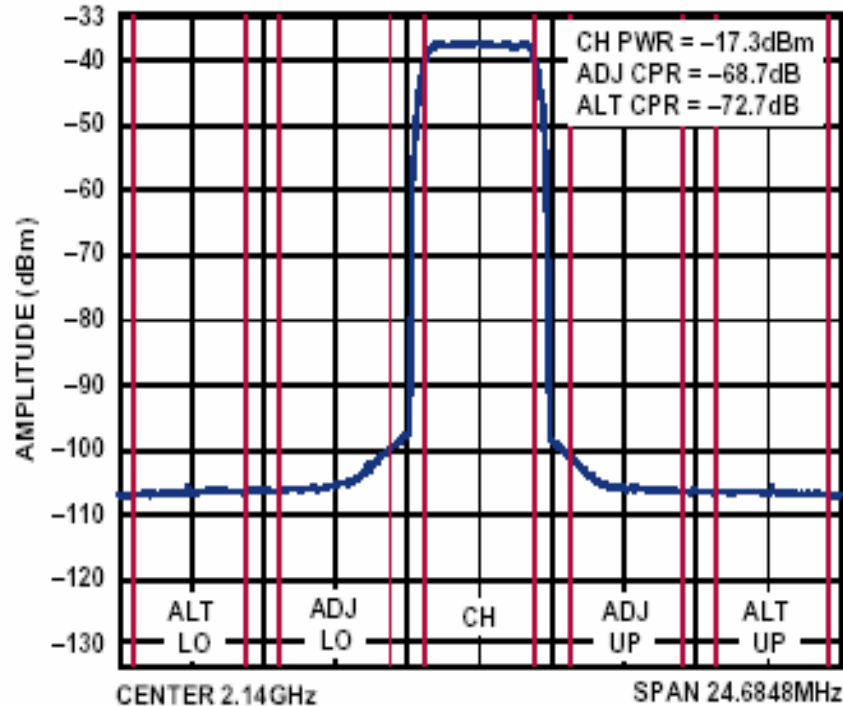
- ❑ **The modulated carrier must be transmitted with adequate power (anywhere from 100 mW to 500 W).**
- ❑ **The distortion and noise in adjacent spectrum must be below a certain minimum set by the standard and the customer's desired margin– this specification is called adjacent channel protection ratio or ACPR**
- ❑ **Component-level margin is a big selling point. Some customers want 10-20 dB of margin, especially for distortion specifications**

ANALOG DEVICES

Receivers must be very good Listeners.......even in the presence of large unwanted signals
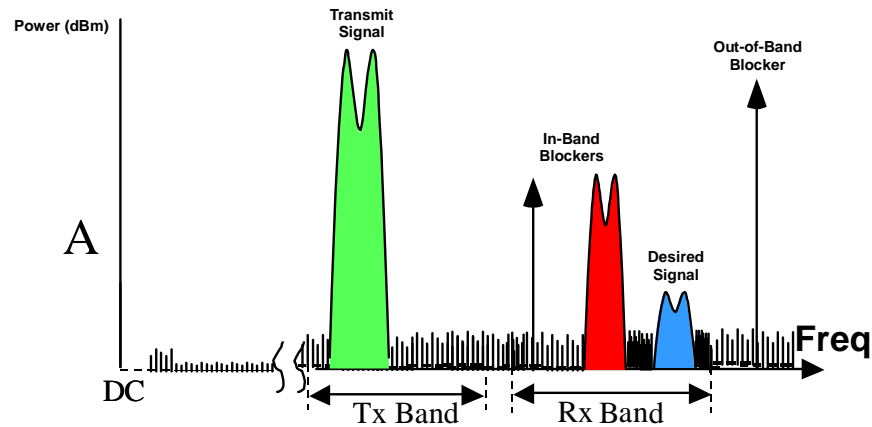
- In mobile wireless applications, the received signal voltage can vary in size by a factor of 1,000,000 (120 dB), depending on the proximity to the source
- Receivers must isolate and demodulate the desired signal, even in the presence of nearby signals (Blockers) that are up to 1 million times larger
- In-Band Blockers are generated by other users of the same standard or frequency
- Out-of-Band blockers Example: Co-located transceivers on one tower, cordless phones, WLAN Routers.

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Error Vector Magnitude - EVM
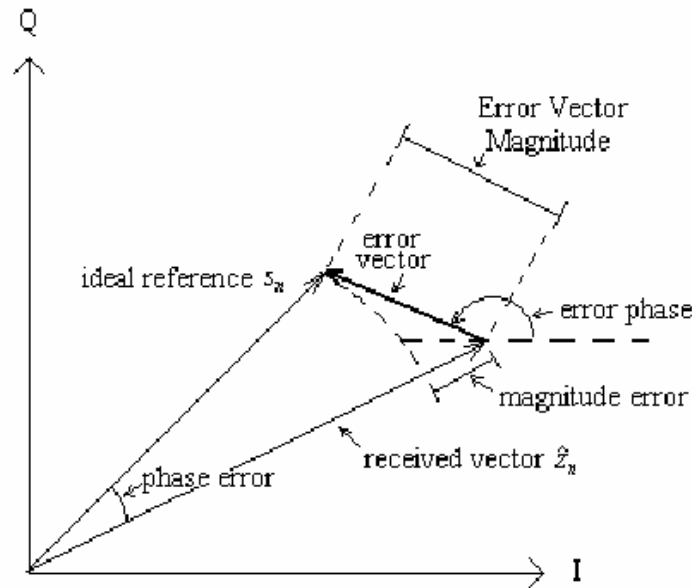
$$EVM = \sqrt{\frac{\text{Mean Error Vector Power}}{\text{Mean ReferencePower}}} \quad Unit(\%)$$

- ❑ **Noise and Imperfections in transmit and receive signal chains result in demodulated voltages which are displaced from their ideal location.**
- ❑ **Error Vector Magnitude expresses this dislocation**
- ❑ **Large EVM will result in Symbol/data Errors**
- ❑ **Higher Order Modulation Schemes → Symbols Closer Together → EVM More Critical**
- ❑ **Solution: Choose components with higher Signal-to-Noise Ratio. Choose Modulator and DeModulator products which have precise quadrature, low harmonics and low LO leakage**

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An IF-Based Wireless Transceiver
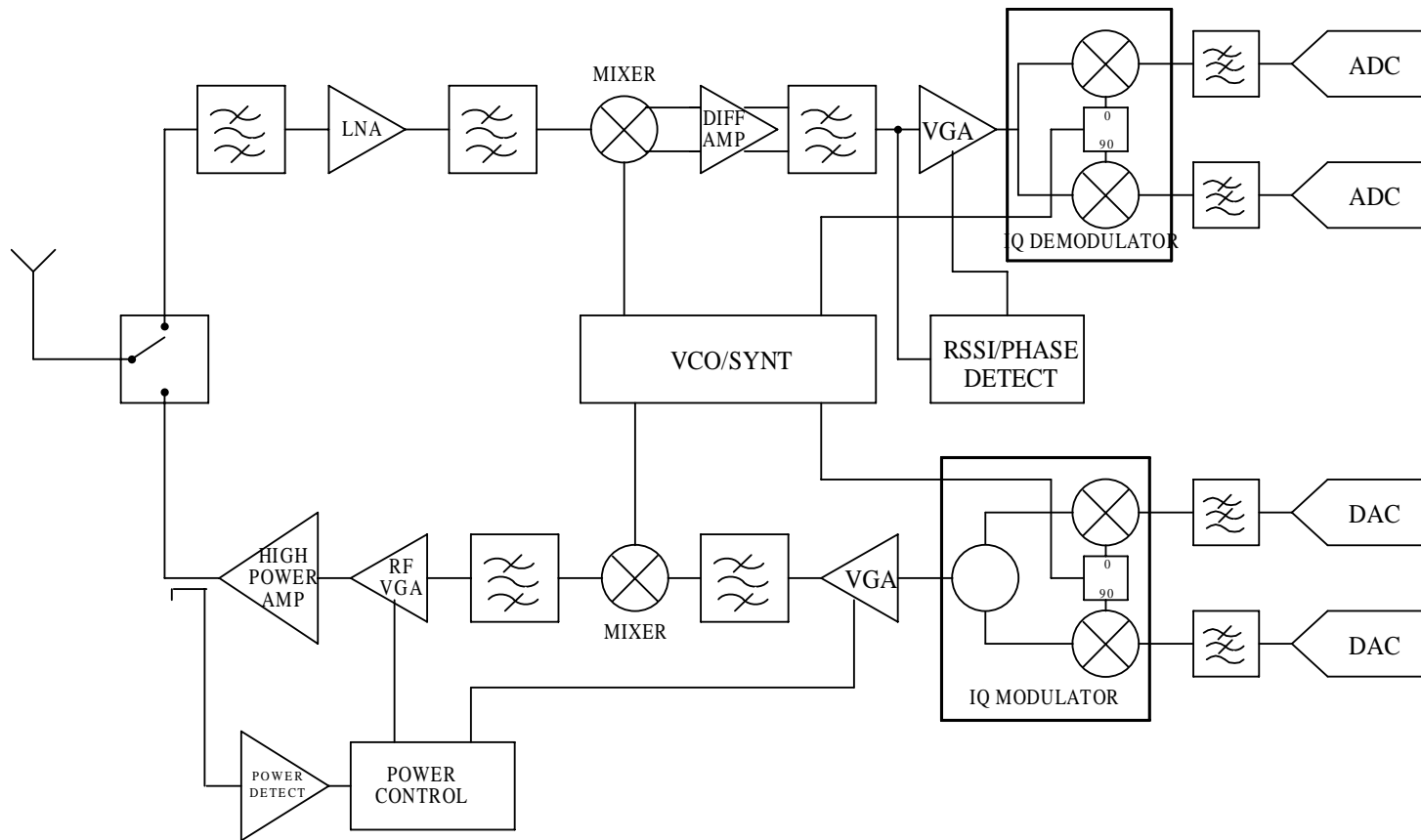
A Direct Conversion Wireless Transceiver
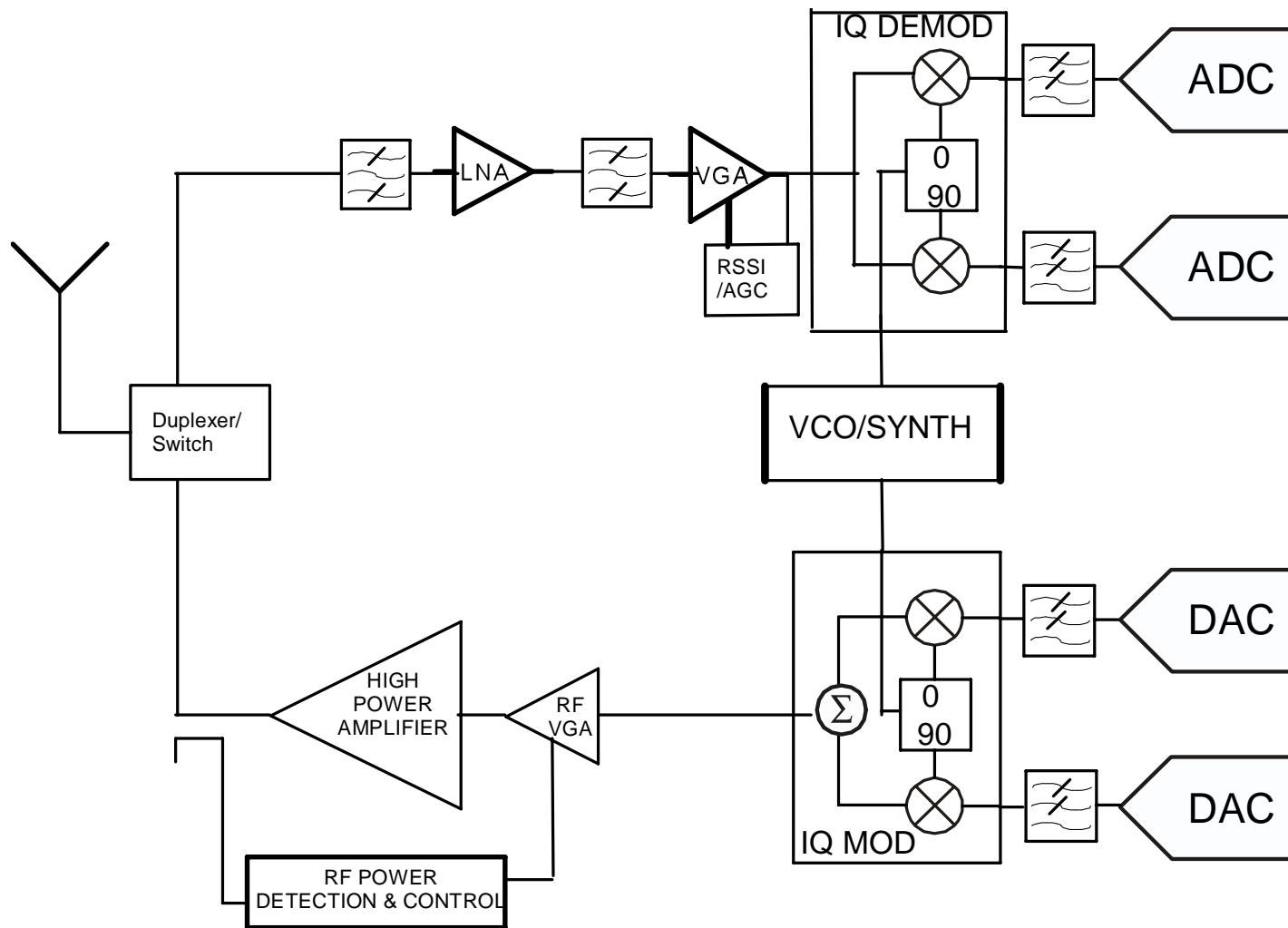
Transceiver Components

❑ **LNAs amplify the signal received at antenna while adding very little noise**

❑ **High Power Amplifiers drive the antenna**

❑ **Mixers Convert signal between Radio Frequency (RF) and baseband**

❑ **IQ Modulators convert baseband signals in Cartesian (X,Y) format to real Intermediate Frequencies or Radio Frequencies.**

❑ **Power Detectors measure and control received and transmitted RF power**

❑ **Filters remove unwanted signals**

❑ **Amplifiers amplify the received signal and compensate for the losses of other components**

❑ **Variable Gain/AGC adjusts gain of receiver to yield a fixed output power at baseband**

❑ **ADC samples spectrum either at Intermediate Frequency (IF) or at Baseband**

❑ **IQ Demodulator extracts I and Q baseband signals from RF or IF carrier**

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