

# Public Safety 800MHz Interference Measurements & Performance



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**MOTOROLA**

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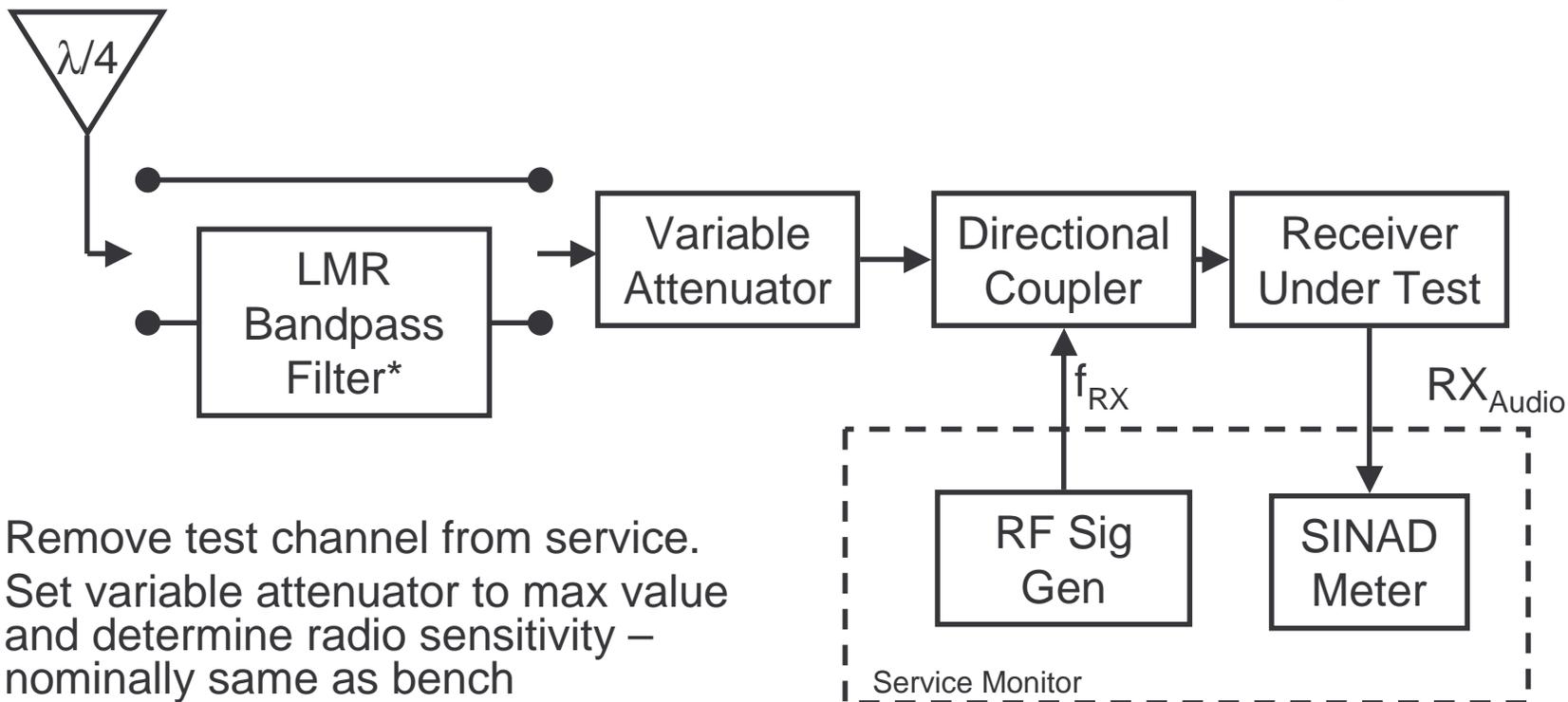
# Agenda

- Overview of Interference Mechanisms
- Interference Measurement Procedures & Analysis
- Receiver Performance in Interference Environment

# Types of Interference

- **IM - Intermodulation**
  - **Multiplication of signals other than the desired and local oscillator such that the products fall on the desired frequency**
  - **Interference power depends on order of IM product and IMR spec of the receiver**
- **OOBE - Out of Band Emission**
  - **Transmitter noise and site generated IM**
  - **Present at the antenna and can only be filtered at source**
- **Overload**
  - **An informal term often used to describe a scenario where a receiver is functioning other than expected, presumably due to excessive signal power at the receiver RF input port**

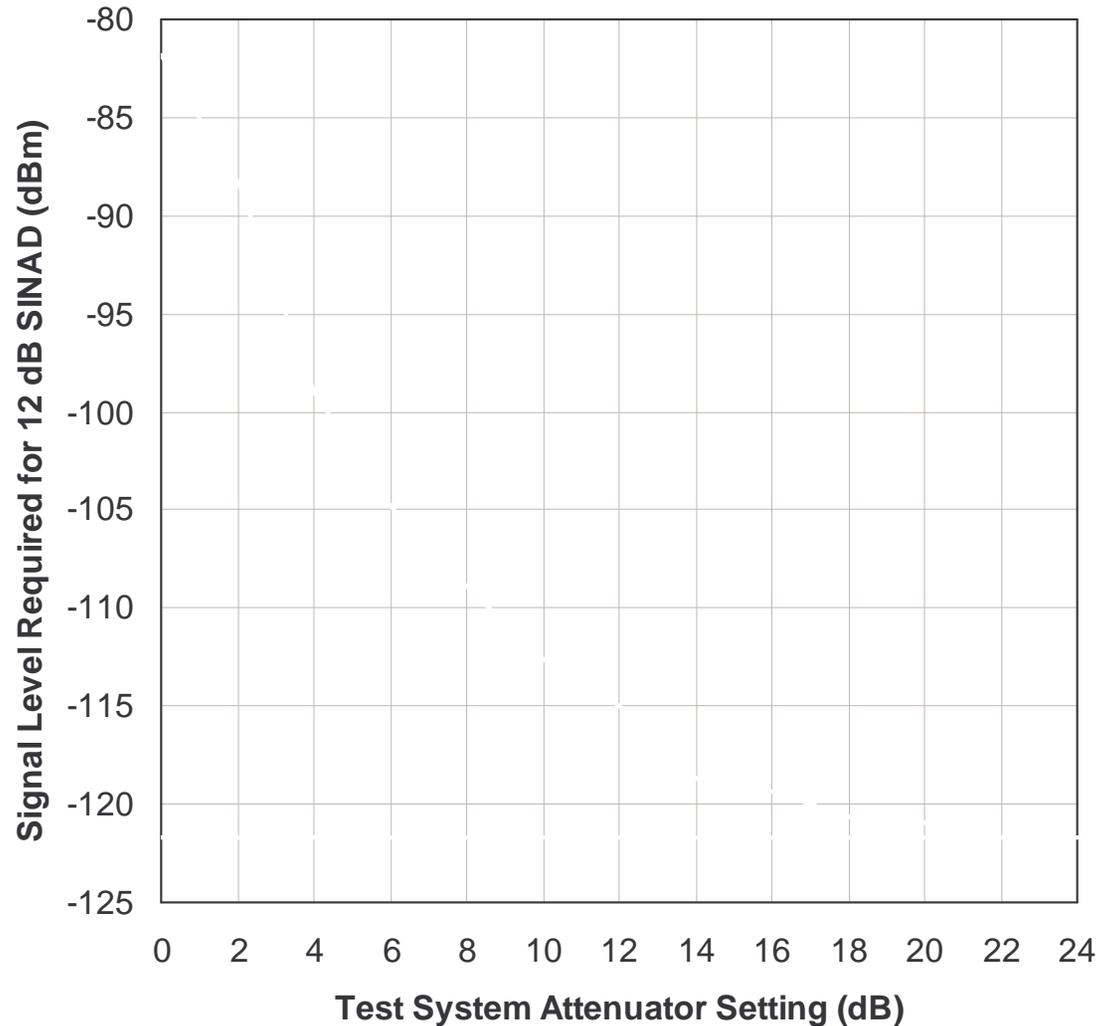
# Field IM & Noise Characterization Test System



- Remove test channel from service.
- Set variable attenuator to max value and determine radio sensitivity – nominally same as bench measurement.
- Measure desired signal strength to establish 12 dB SINAD for attenuator values of 0 dB to 24 dB.
- Insert land mobile bandpass filter to determine other service bands impact.

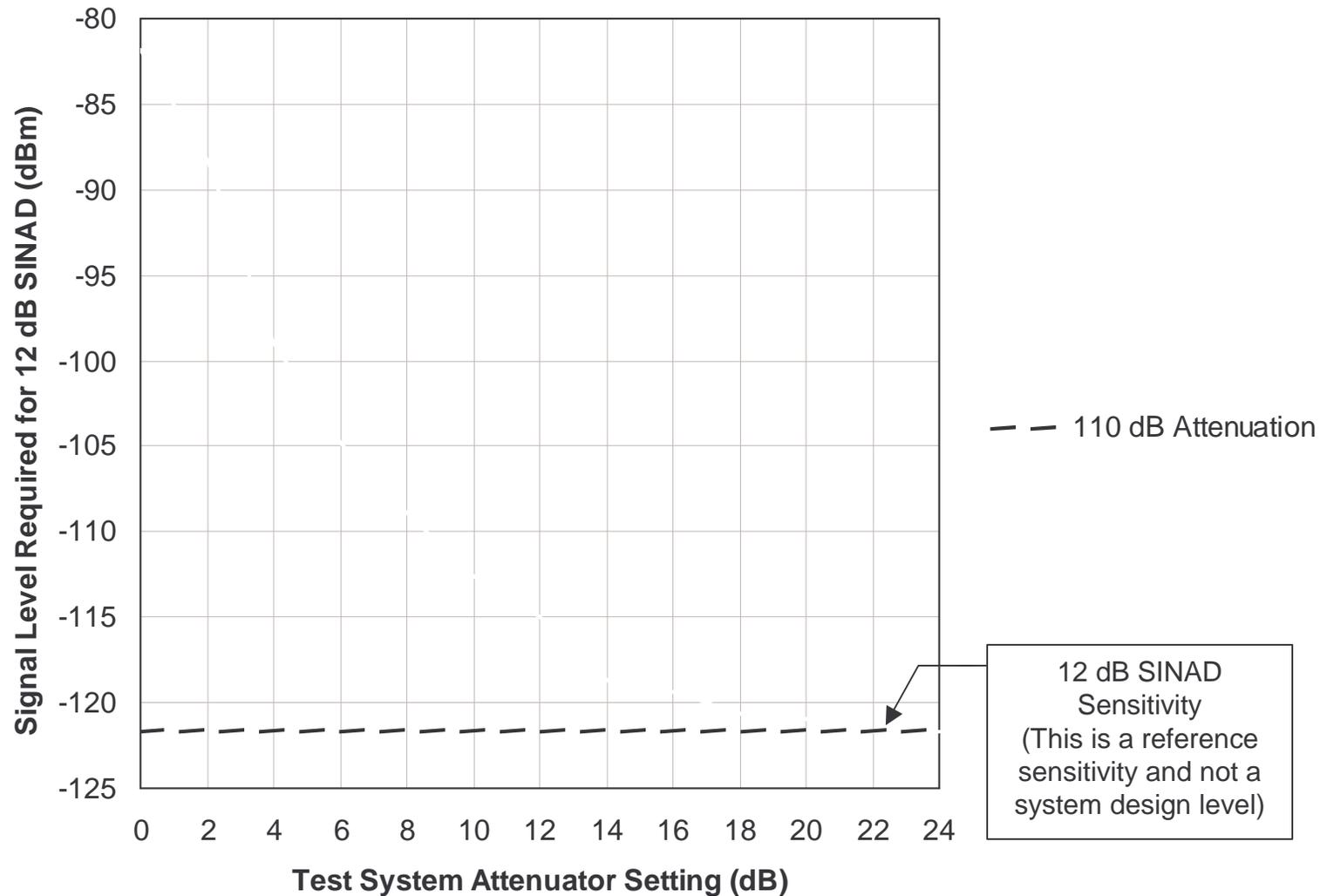
\*A narrower filter allows more precise identification of interferer

# Interference Evaluation Graph

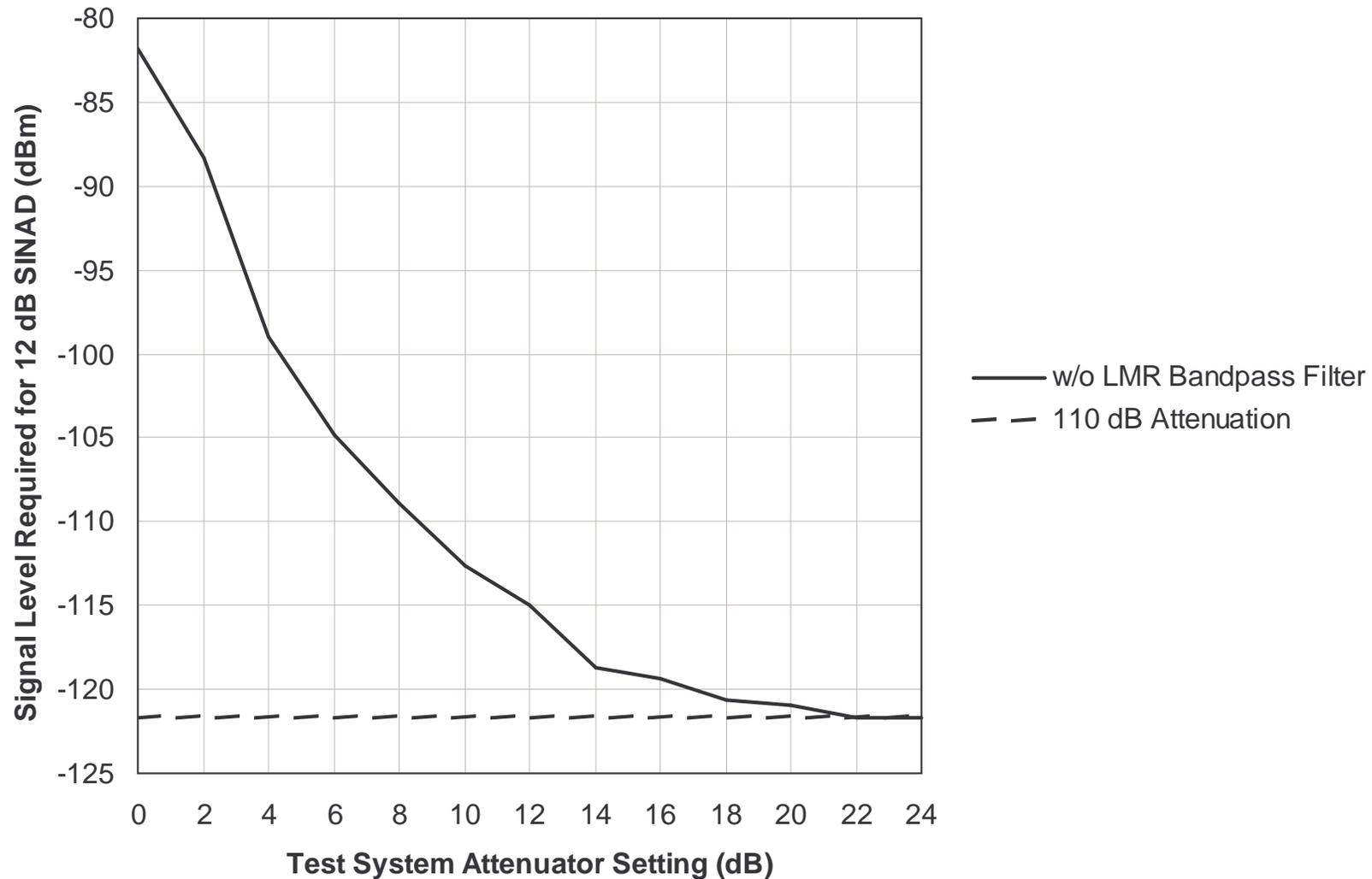


The data shown here was taken at 868.075 MHz at a Chicago area CMRS site with multiple operators using an XTS 5000 radio

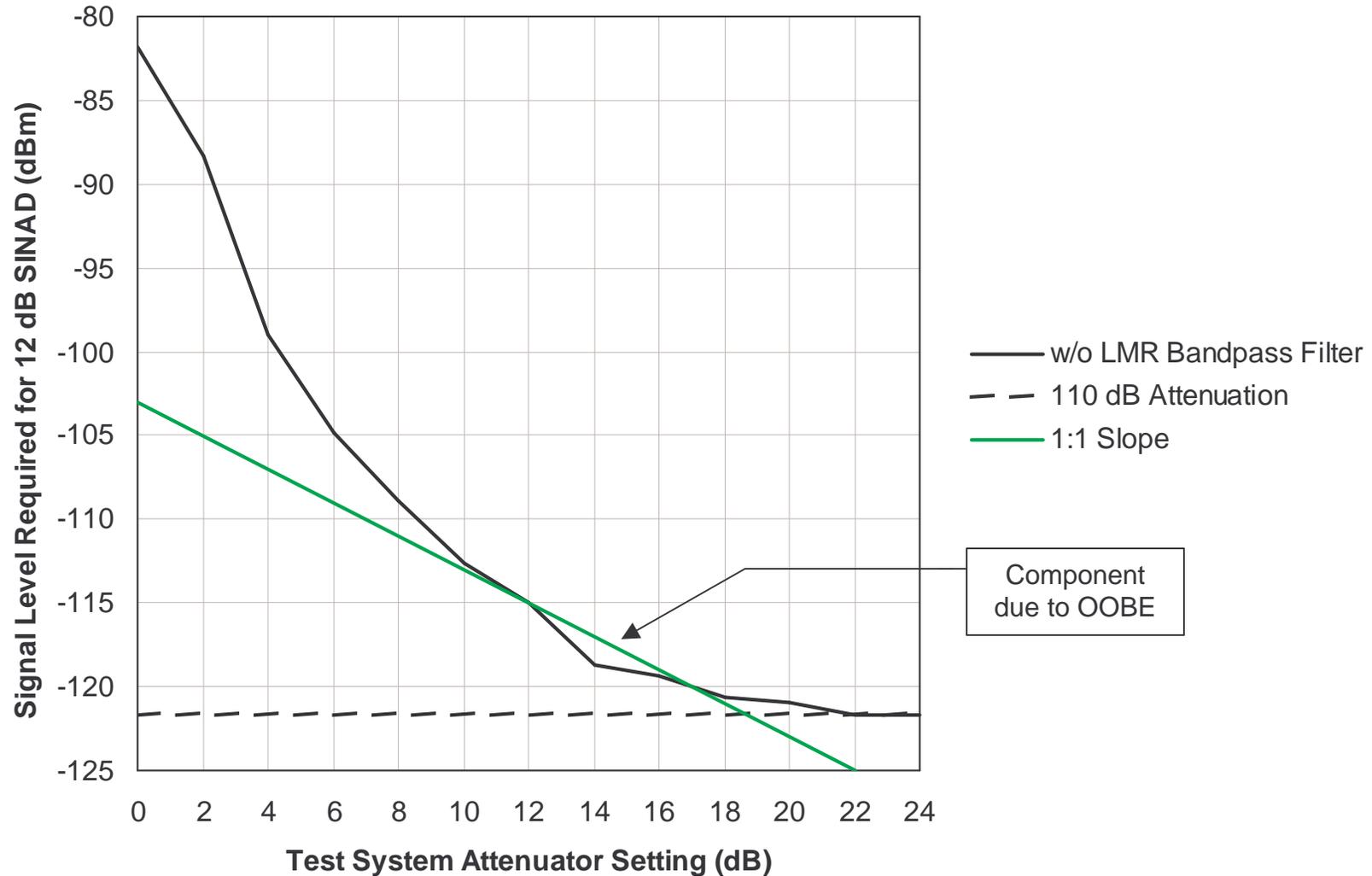
# Plotting the Receiver Noise Floor



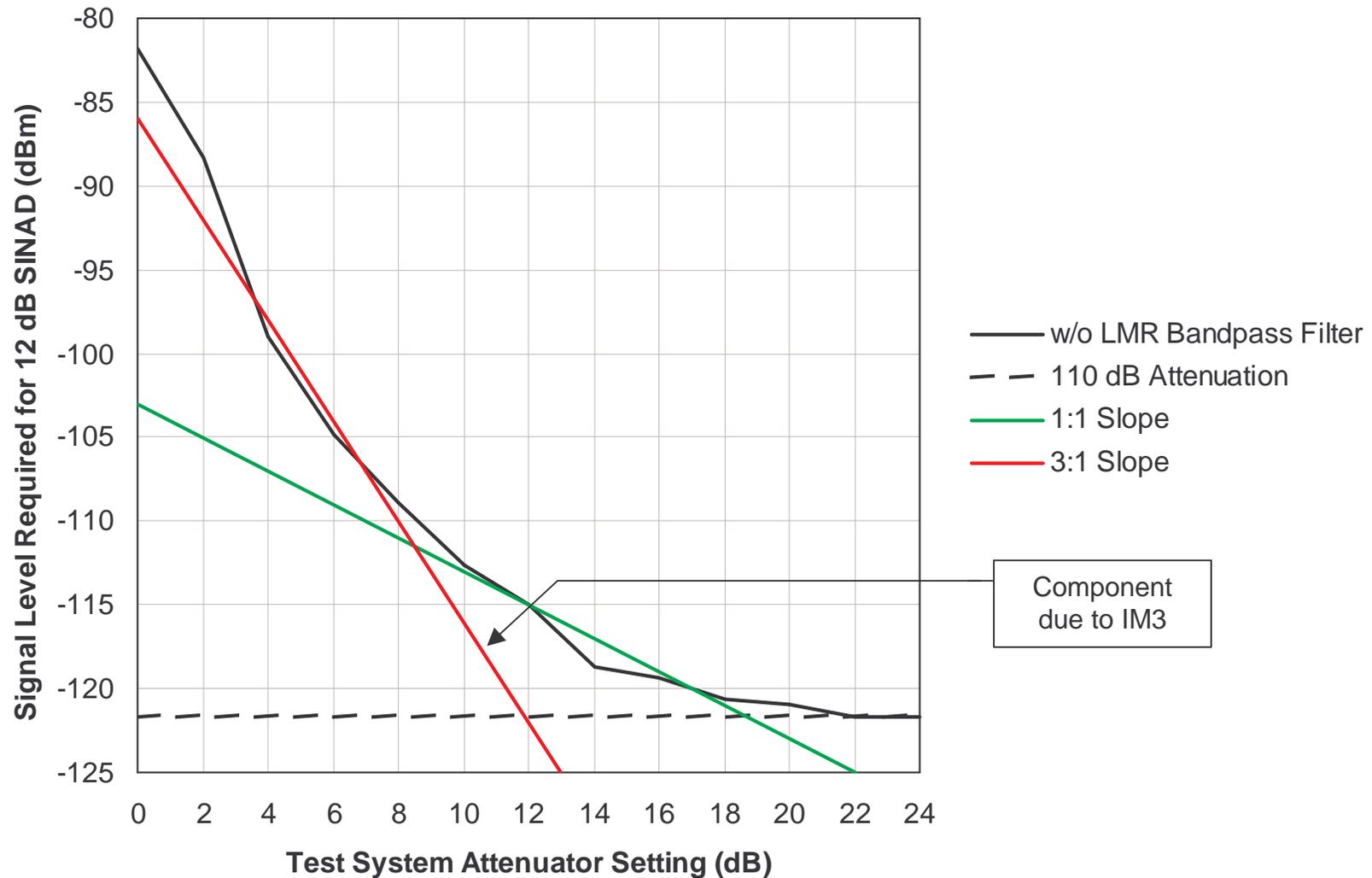
# Adding the Other Attenuator Levels



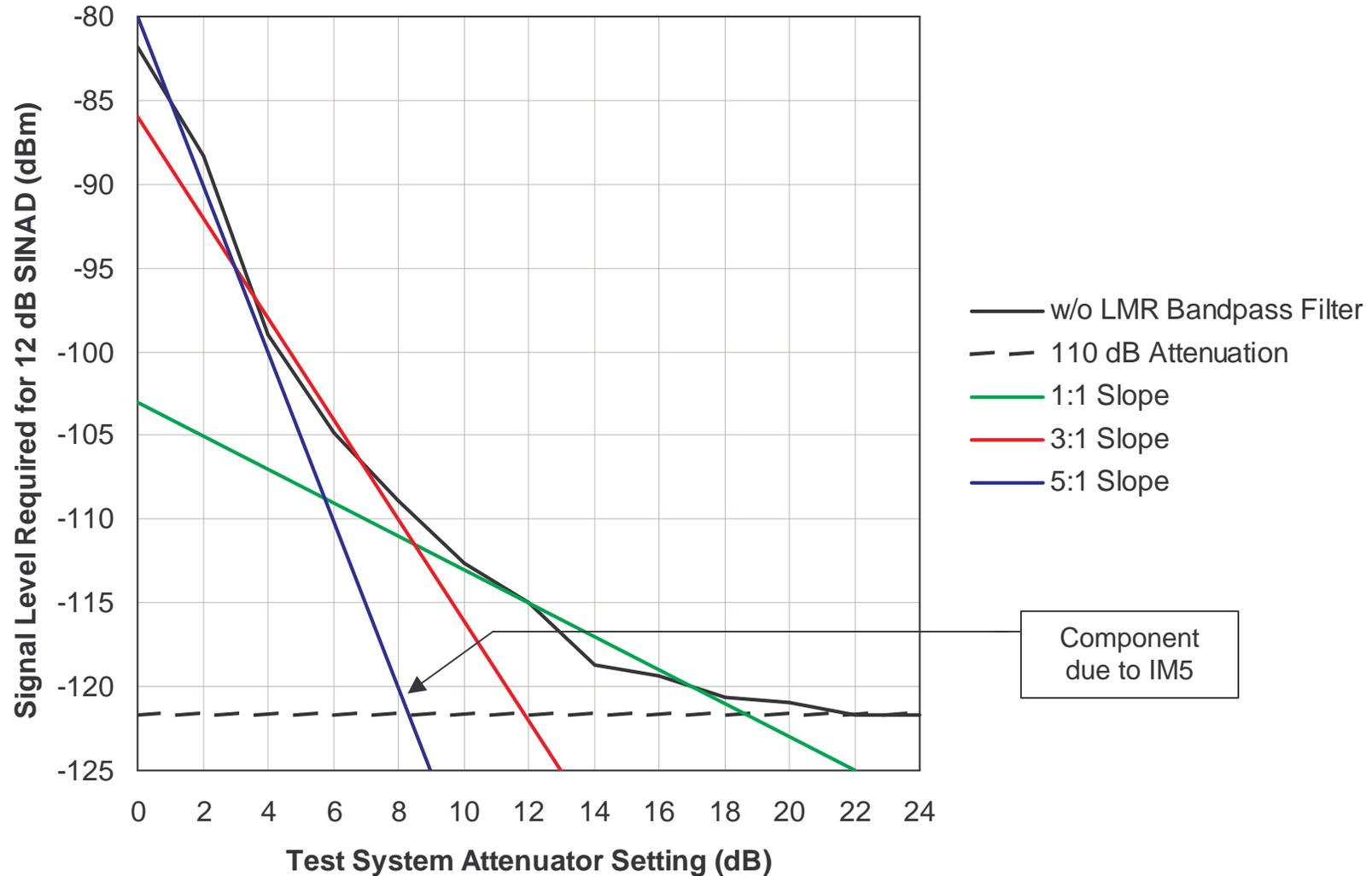
# Identifying the Interference Mechanism



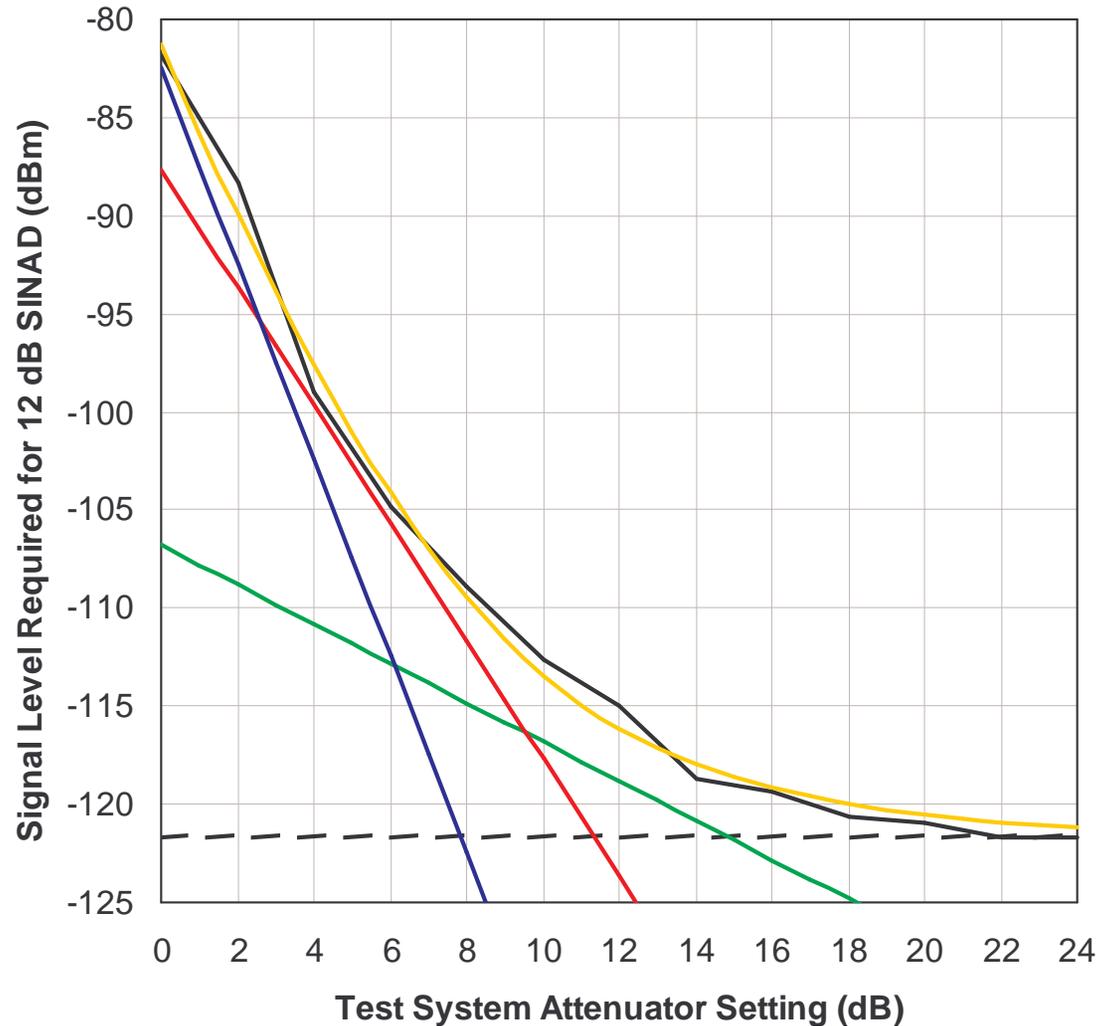
# Identifying the Interference Mechanism



# Identifying the Interference Mechanism



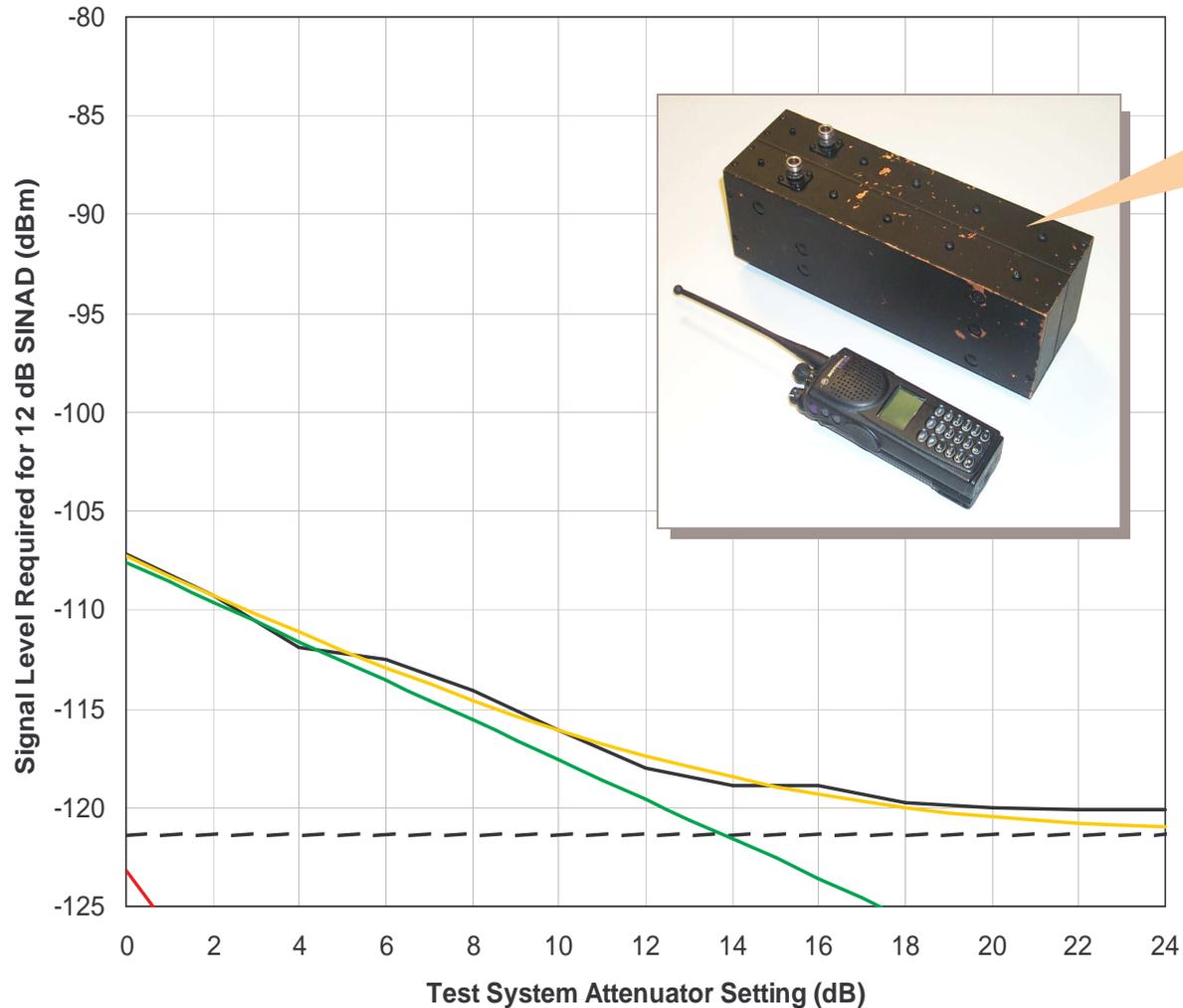
# Finding the Interference Power Models



The powers of the IM models (the green, red & blue lines) and the receiver sensitivity are added to give the gold line. The y-intercepts of the IM models are adjusted to minimize the square-error of the gold line with the measured data

- w/o LMR Bandpass Filter
- - 110 dB Attenuation
- 1:1 Slope
- 3:1 Slope
- 5:1 Slope
- Least Squares Model

# Testing for Cellular A & B Using a Filter



Using This Filter on the Antenna Port

- w/ LMR Bandpass Filter
- - - 110 dB Attenuation
- 1:1 Slope
- 3:1 Slope
- 5:1 Slope
- Least Squares Model

Filtering shows that the IM is not due to LMR alone

# Receiver Overload

- What is the definition of receiver overload?
  - **“Overload” is a loosely defined term, the meaning of which varies by situation.**
  - **There is no TIA, ETSI or IEEE definition of receiver overload.**
- Informal definition of receiver overload
  - **A term often used to describe a scenario where a receiver is functioning other than expected, presumably due to excessive signal power at the receiver RF input port**

# TIA Receiver Tests for “Overload” Behaviors\*

- Blocking
  - 1 interferer at large frequency offset
- Adjacent Channel Rejection
  - 1 interferer at adjacent channel
- Intermodulation Rejection
  - 2 interferers at specific offsets

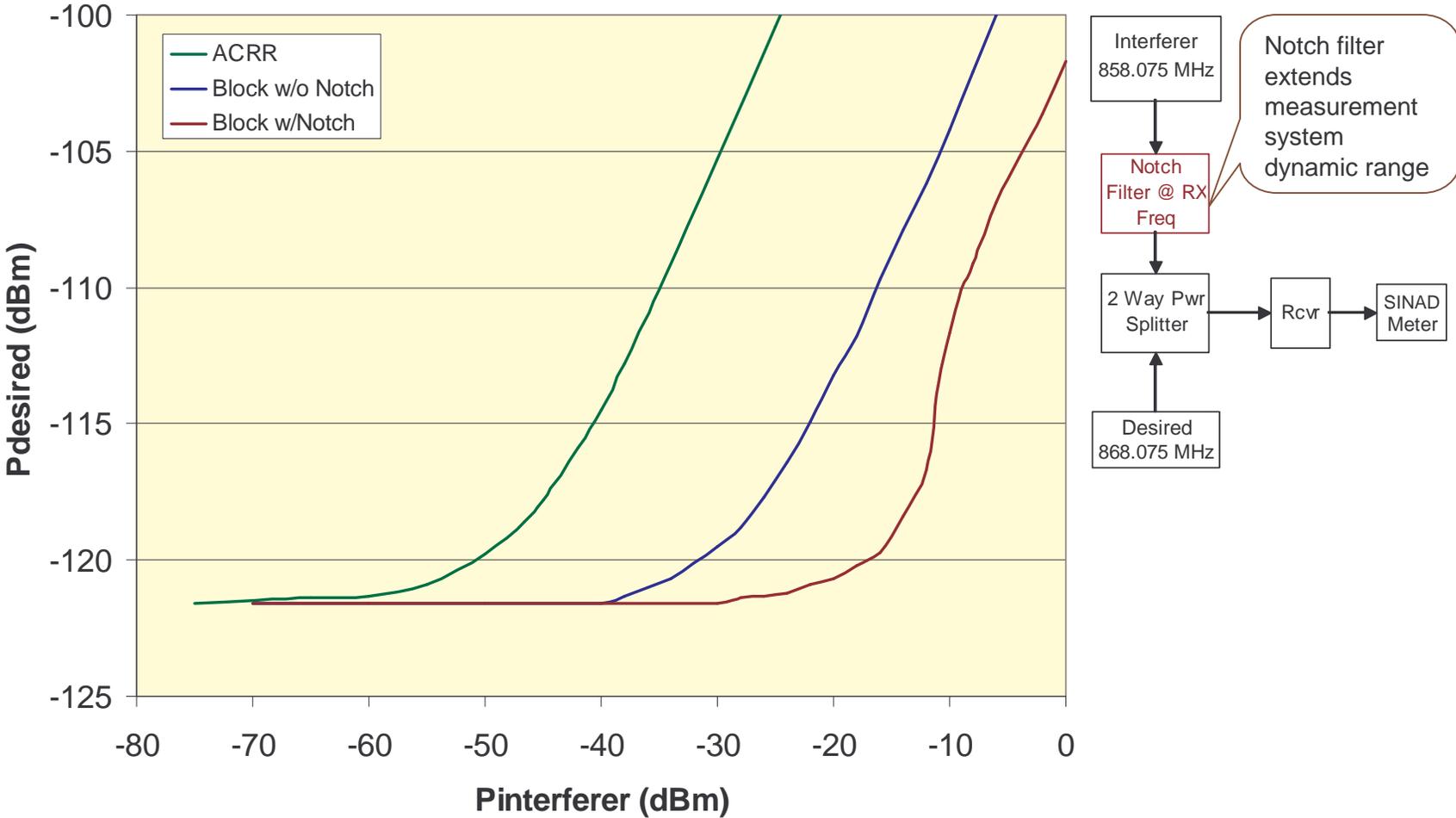
\*per TIA-603



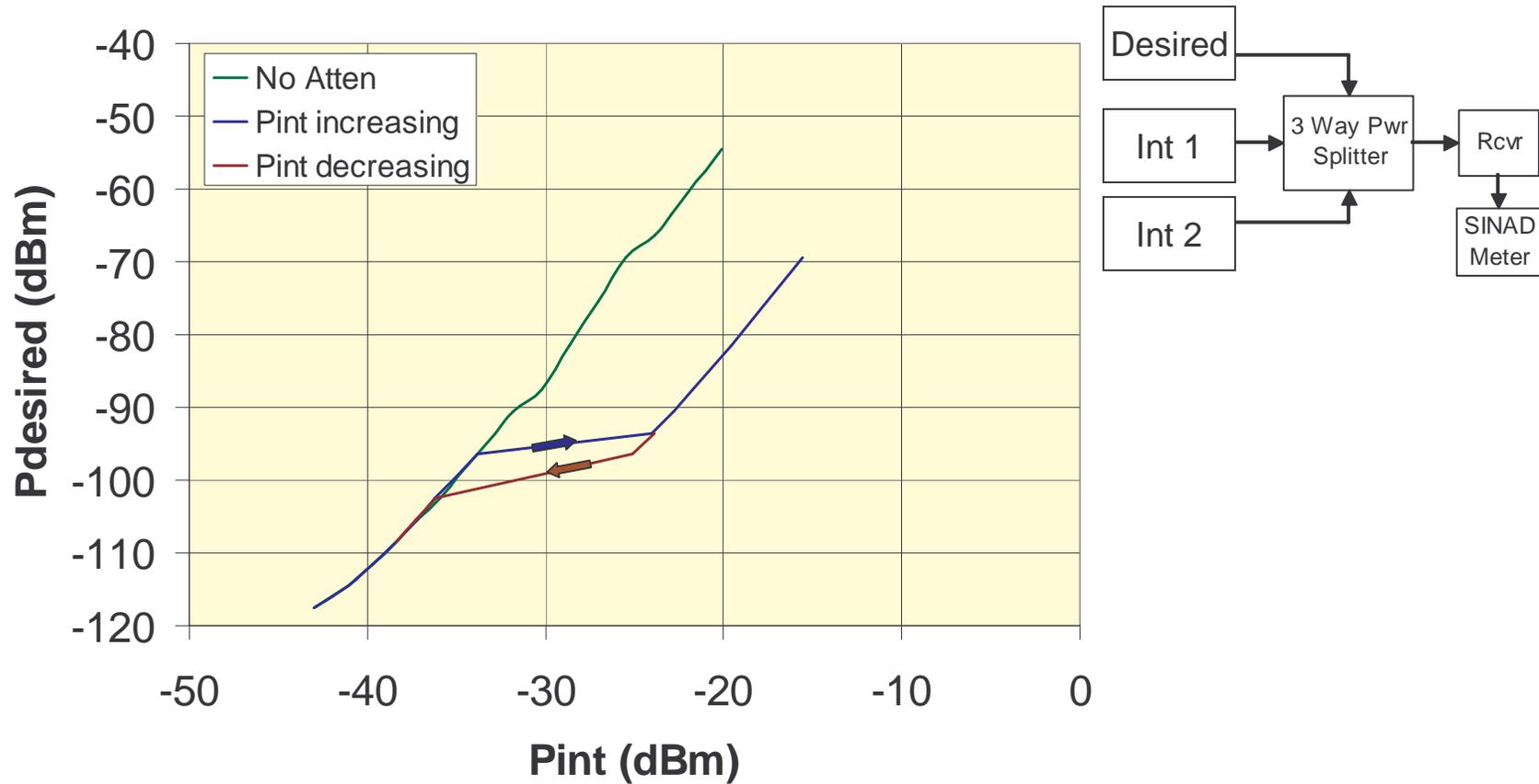
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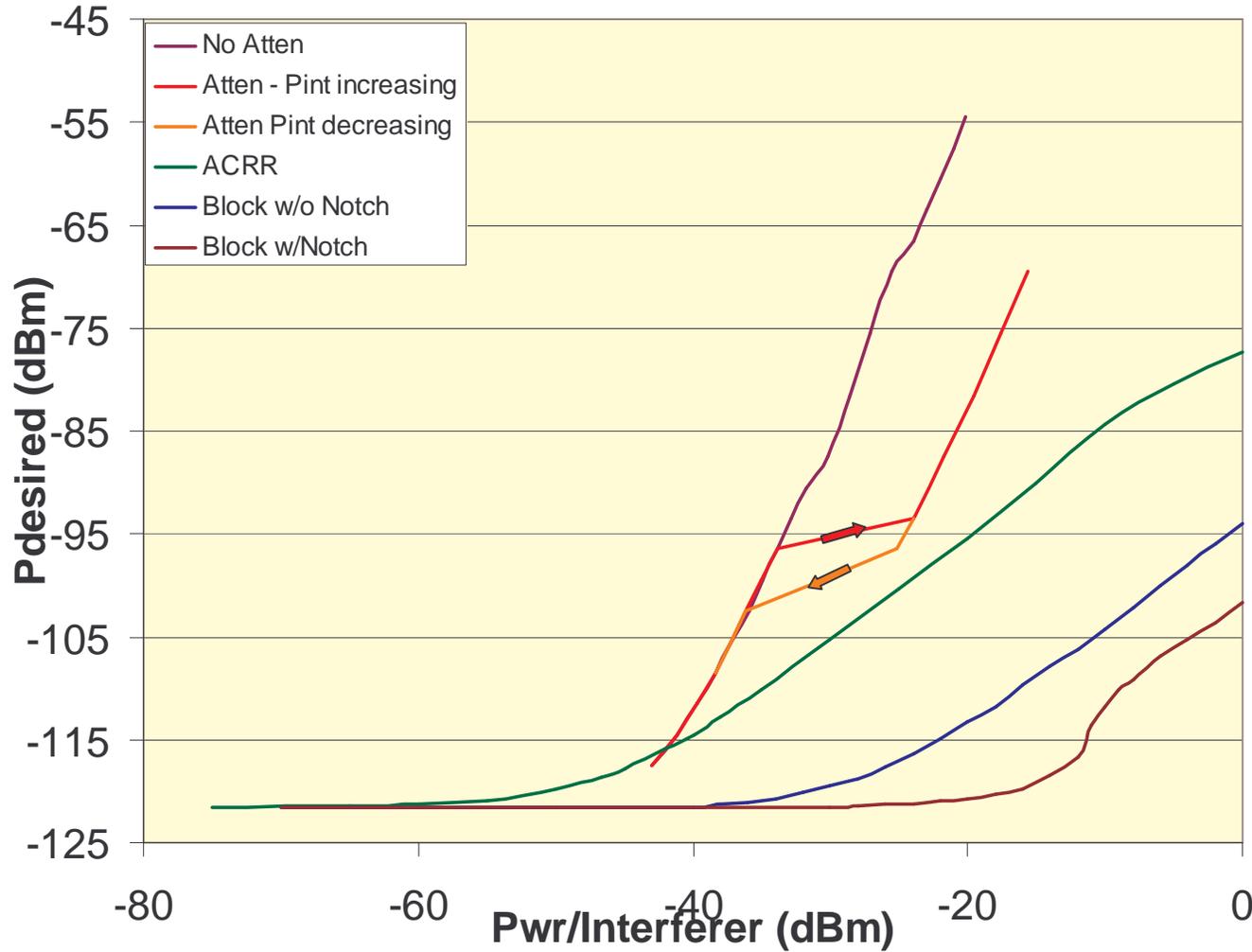
# XTS5000 Receiver Blocking & Adjacent Channel Rejection Ratio



# XTS5000 Intermodulation Rejection

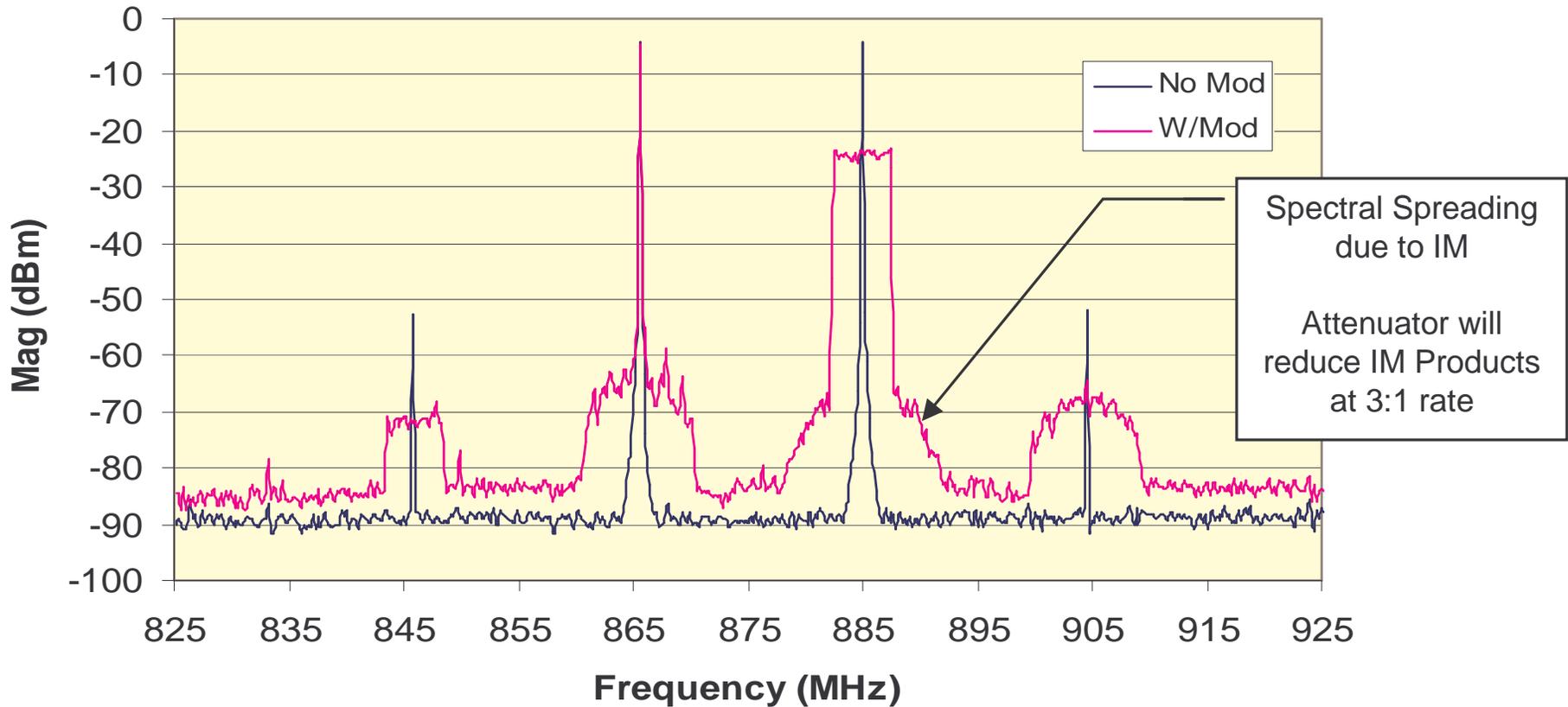
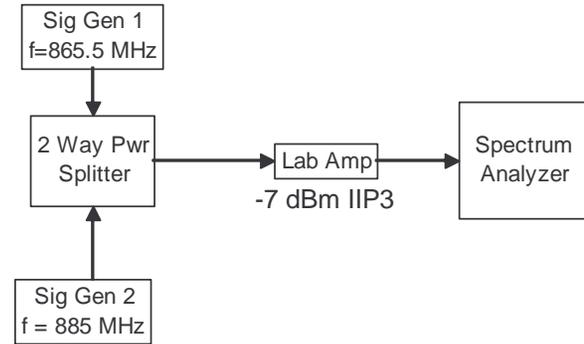


# Receiver IM and Blocking Comparison

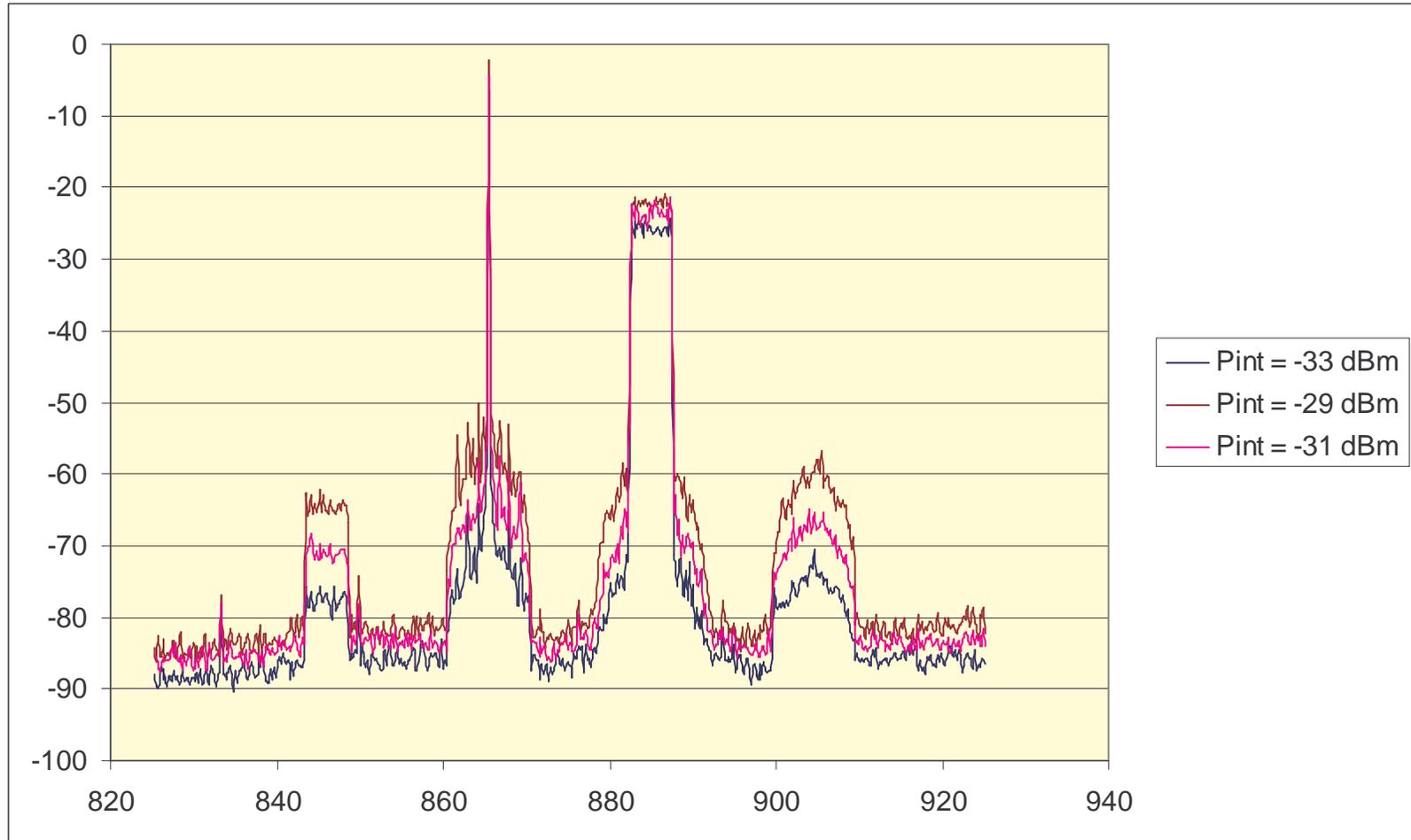


# IM Spectrum

**Output Spectrum of Lab Amp**  
**Input: FM & 4 Carrier CDMA**  
**P = -31 dBm**



# IM vs. Attenuator Level



# Summary/Conclusion

- Test method allows identification of interference types
- Test method can identify IM contributions LMR versus cellular
  - Cellular A & B or LMR band or combination
- Testing based on well established measurement practices augmented with data analysis