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Generic Pre-distortion of a Class-J Power Amplifier

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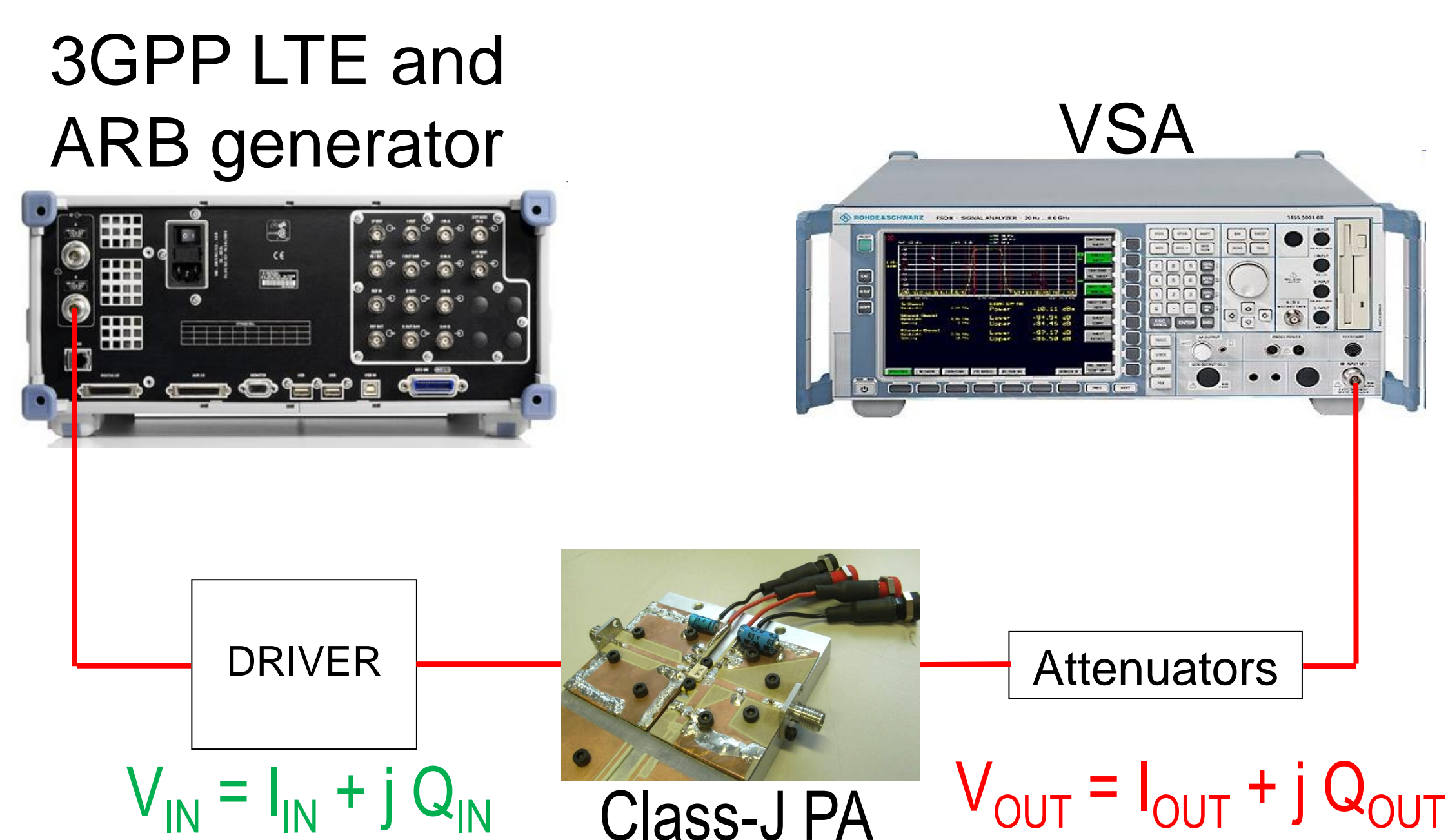2- Cardiff School of Engineering, Cardiff University Queen's Buildings, The Parade CARDIFF CF24 3AA Wales, UK
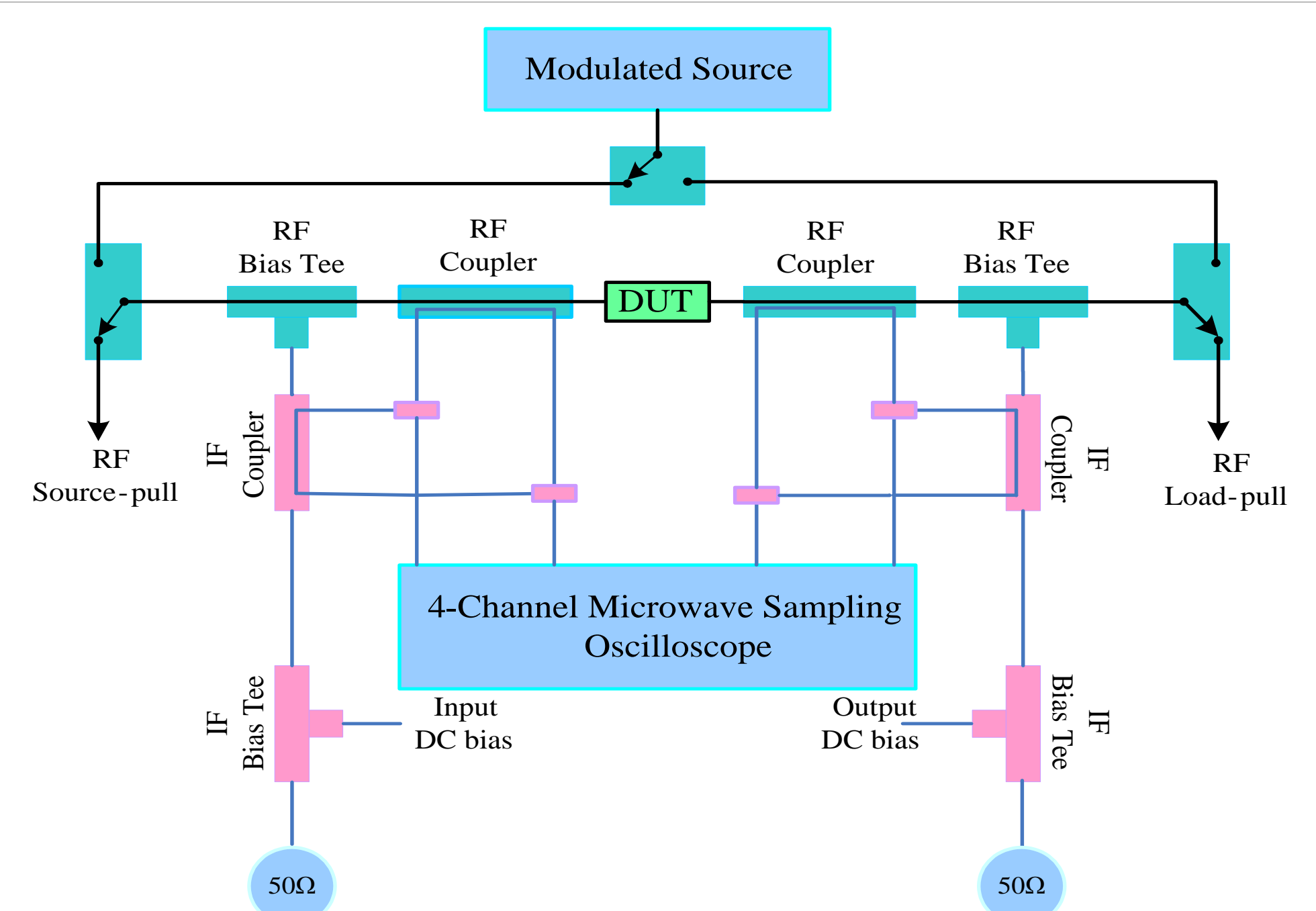Contact: s.bensmida@bristol.ac.uk

ABSTRACT

An improved "generic" pre-distortion method is tested and successfully demonstrated on the recently introduced Class-J power amplifier (PA) architecture. This linearization method is based on AM-AM and AM-PM measurements in the presence of a narrowband multi-tone signal in order to extract the PA's static nonlinearities. A 10W GaN HEMT Class-J structure designed to operate across 1.35-2.25GHz is tested to demonstrate the proof of concept.

GENERIC PRE-DISTORTION ASSUMPTION VERIFICATION

3GPP LTE and ARB generator

VSA

DRIVER

Class-J PA

$V_{IN} = I_{IN} + j\,Q_{IN}$

Attenuators

$V_{OUT} = I_{OUT} + j\,Q_{OUT}$

Two independent measurement systems have been used to verify the assumption on which the generic linearization method relies

Modulated Source

RF Bias Tee — RF Coupler — DUT — RF Coupler — RF Bias Tee

RF Source-pull

IF Coupler

RF Load-pull

IF Coupler

4-Channel Microwave Sampling Oscilloscope

IF Bias Tee

Input DC bias

Output DC bias

IF Bias Tee

50Ω   50Ω

VSA-based measurement setup for AM-AM and AM-PM extraction
-PA testing under 3GPP LTE and multi-tone (generic) signals
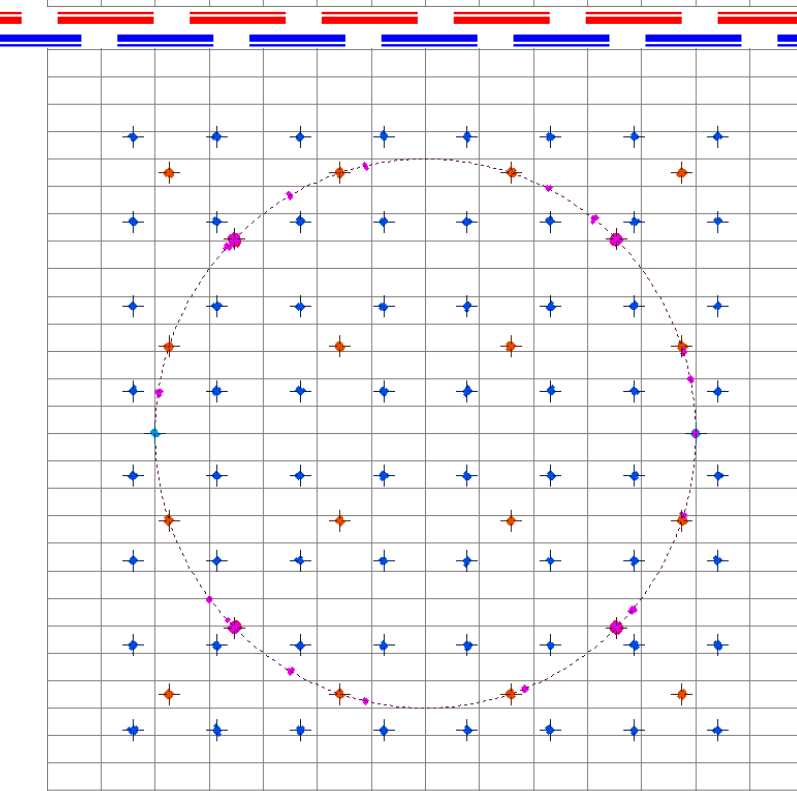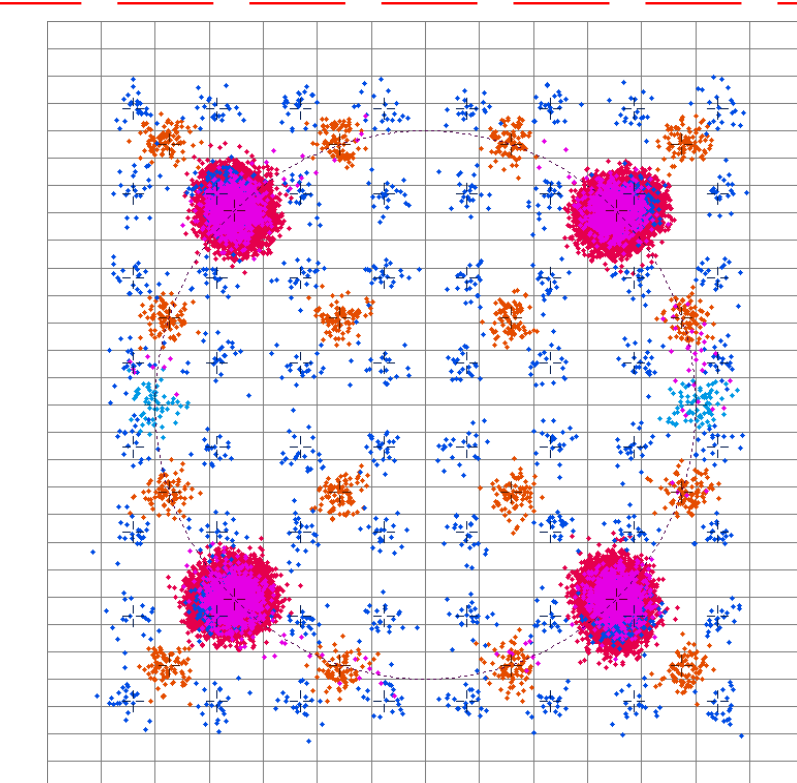-Pre-distortion and linearity assessment

Scope-based measurement setup for AM-AM and AM-PM extraction
-PA and device testing under multi-tone (generic) signals
-Linearity investigation

Envelope of the generic probing signal

AM-AM PA response

AM-PM PA response
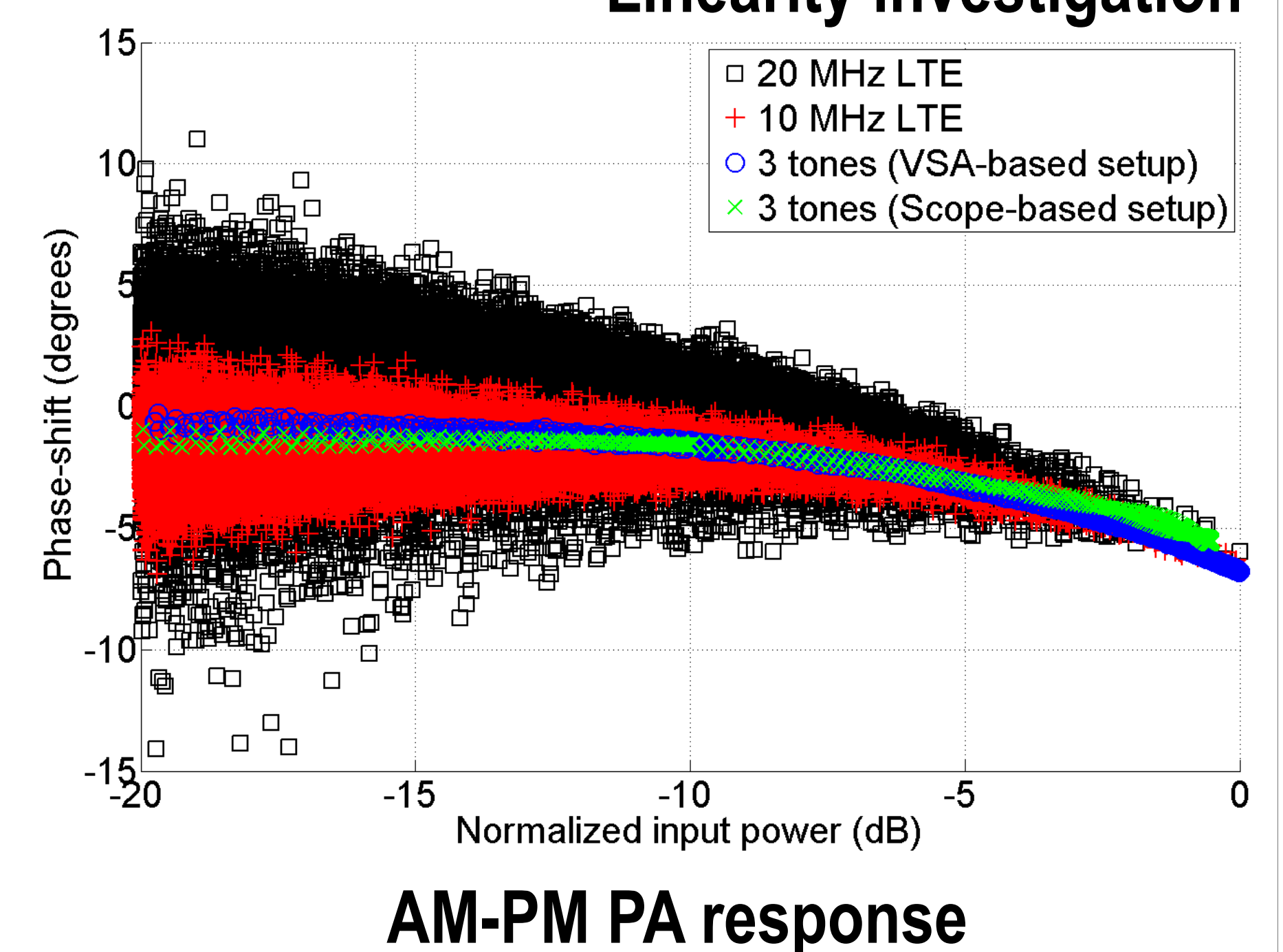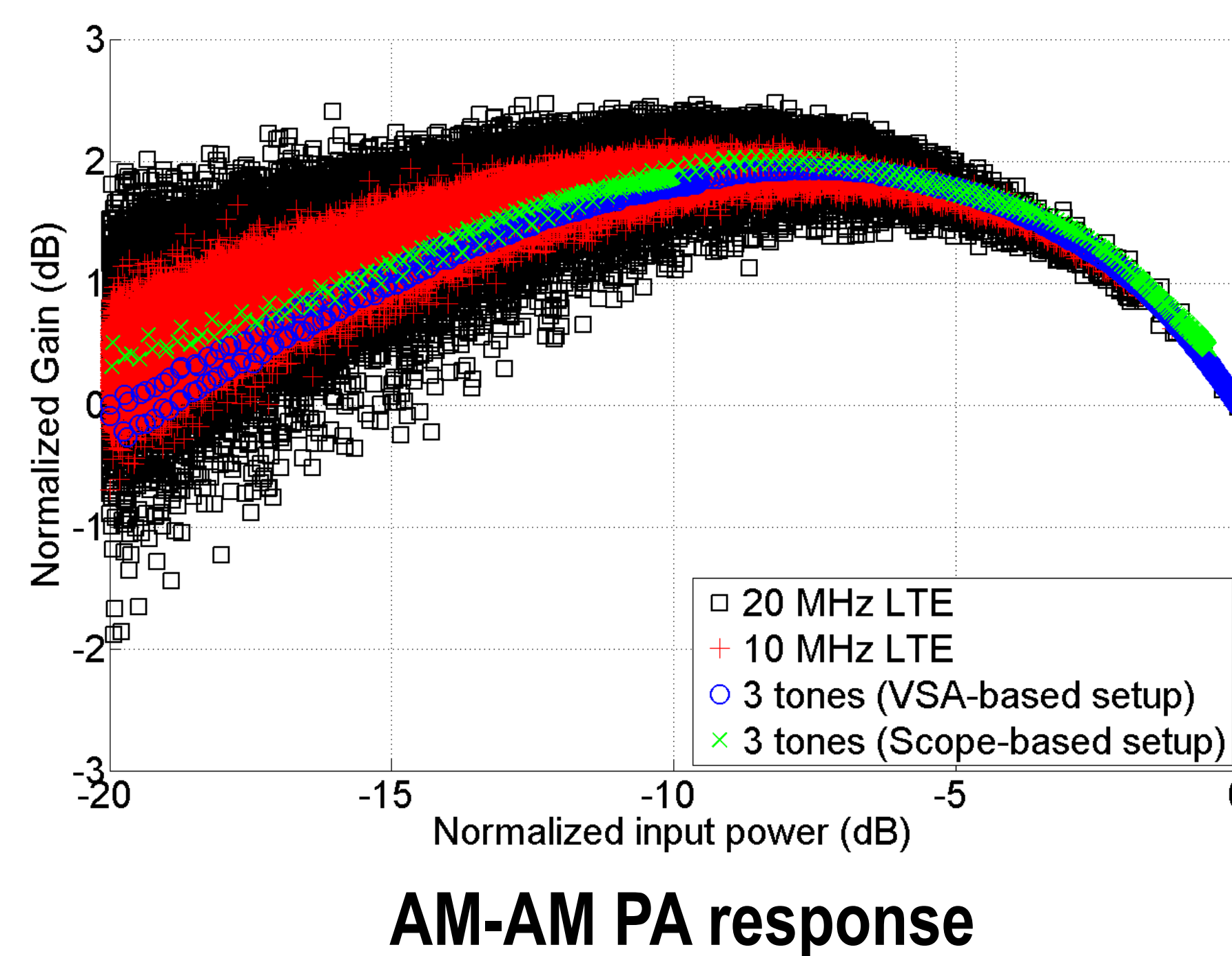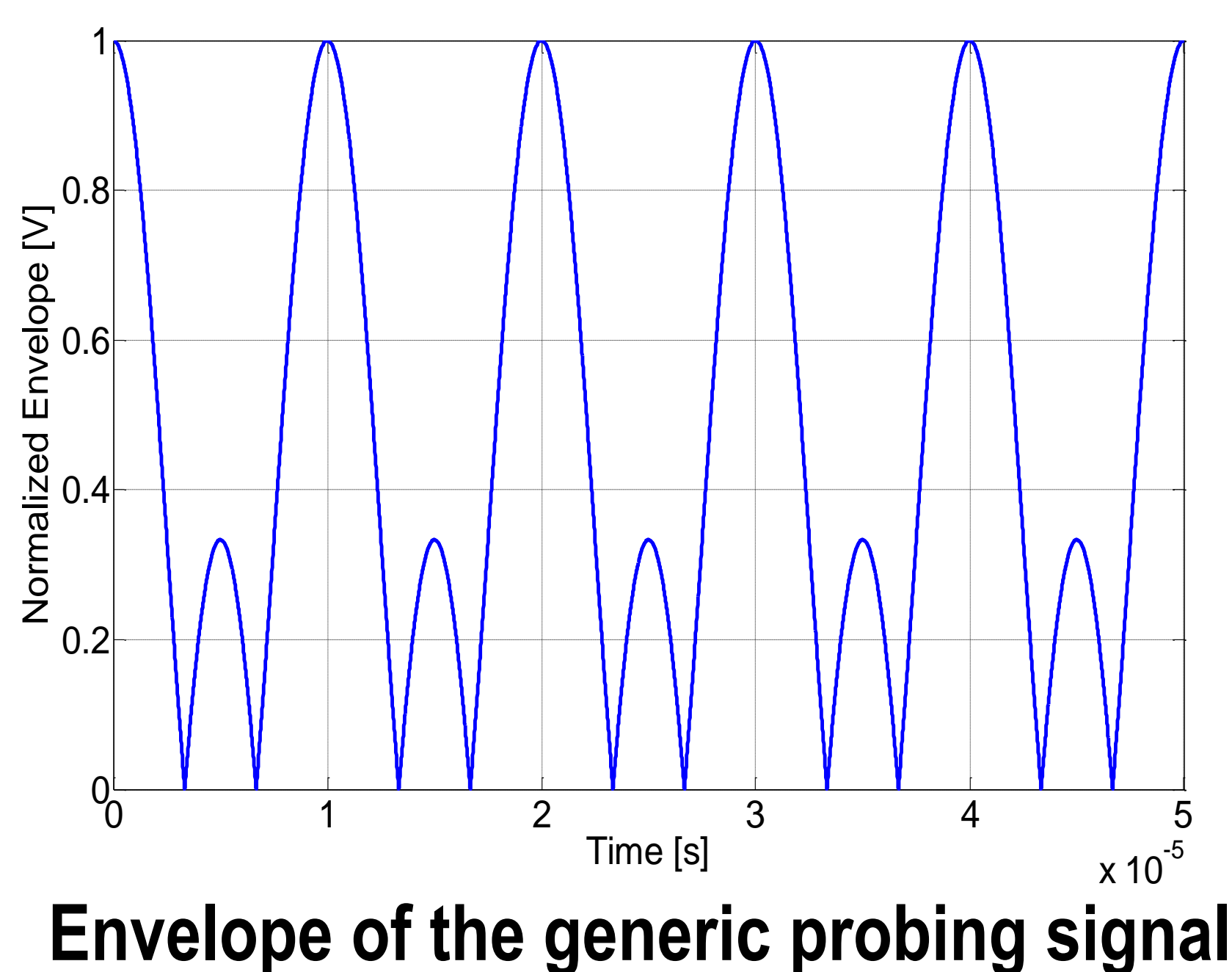
GENERIC PRE-DISTORTION RESULTS
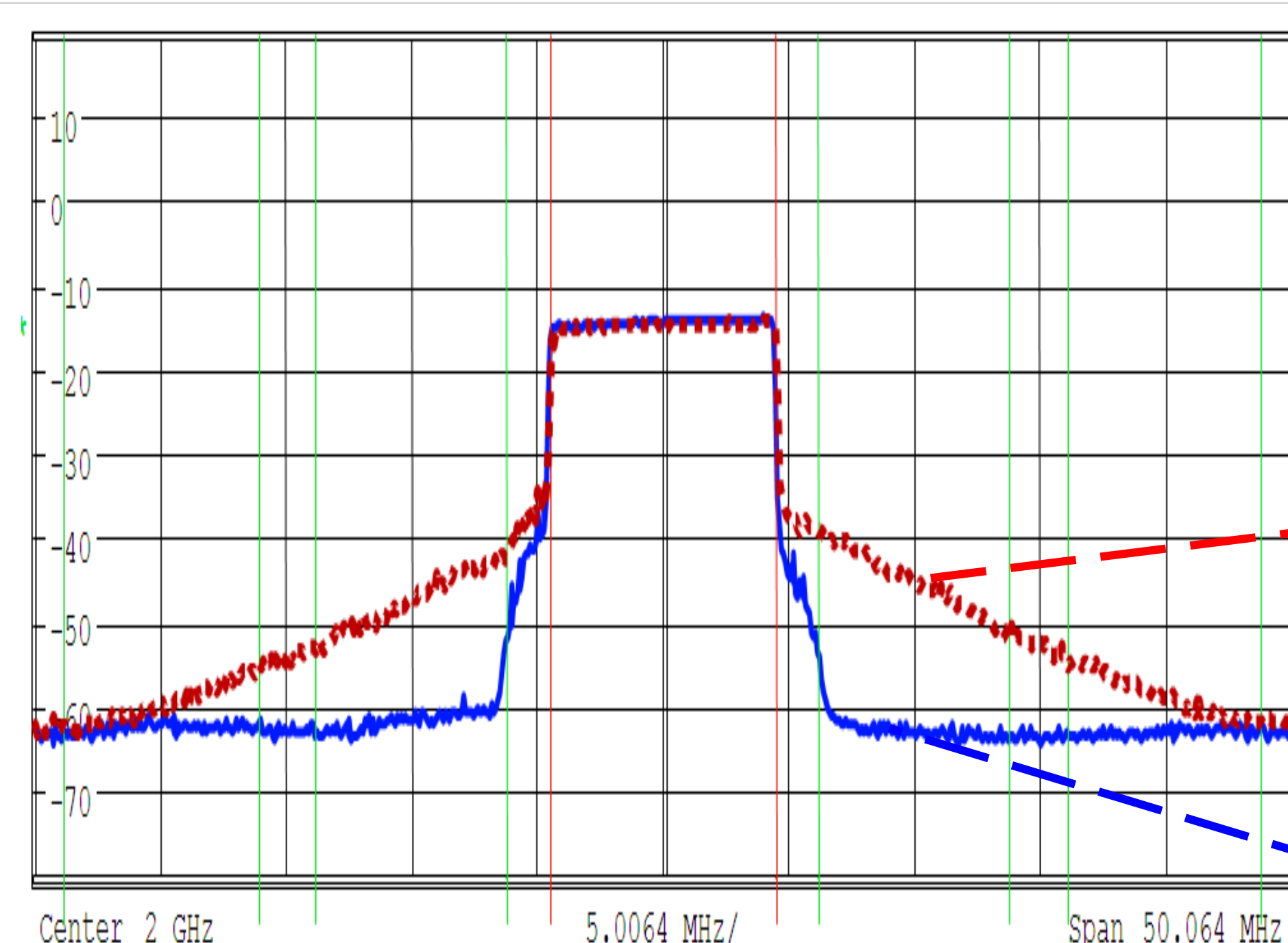
Tx Channel		E-UTRA/LTE Square/RRC	
Bandwidth	9.015 MHz	Power	4.23 dBm
Adjacent Channel			
Bandwidth	7.68 MHz	*Lower	-31.70 dB
Spacing	10 MHz	*Upper	-29.55 dB
Alternate Channel			
Bandwidth	7.68 MHz	*Lower	-44.69 dB
Spacing	20 MHz	*Upper	-43.75 dB

Before Pre-distortion EVM ≅ 7%

Tx Channel		E-UTRA/LTE Square/RRC	
Bandwidth	9.015 MHz	Power	4.51 dBm
Adjacent Channel			
Bandwidth	7.68 MHz	Lower	-45.38 dB
Spacing	10 MHz	Upper	-47.01 dB
Alternate Channel			
Bandwidth	7.68 MHz	Lower	-48.69 dB
Spacing	20 MHz	Upper	-49.18 dB

After Pre-distortion EVM ≅ 1%

Center 2 GHz   5.0064 MHz/   Span 50.064 MHz

PA Generic Pre-distortion in the presence of 10MHz LTE signal

CONCLUSION

The use of a narrowband 3-tone signal improves the linearity of a 10W GaN class-J PA in the presence of an LTE signal. The assumption on which the generic pre-distortion method relies has been verified by measuring the power amplifier response with two independent measurement systems.

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