

AN-60-041

## LTE Base Station MMIC Amplifier

Mini-Circuits PHA-1+ Ultra High Dynamic Range MMIC Amplifier is designed specifically for applications which require extremely linear performance, particularly wideband, advanced digital communications systems such as LTE which require excellent ACLR suppression and low EVM.

The E-PHEMT based PHA-1+ provides typically +42 dB OIP3 which translates to extremely linear performance in multi-carrier and complex signal environments such as LTE supporting ACLR<sub>1</sub> Measurements of better than -60 dBc at +10 dBm output and -26 dbc at 100mW (near the 1 dB compression point).

The PHA-1+ is characterized using a high peak-to-average ratio OFDM signal used for next generation LTE within the AWS-1 Downlink Band.



Figure 1 (PHA-1+ Test Board)

### DUT Configuration:

**Device:** PHA-1+ Test board

**Supply Voltage:** 5.0V, 150 mA

**Temperature:** 25°C

**Note:** All data is referenced to the PCB connectors

### Test Signal:

AWS\_1 Downlink

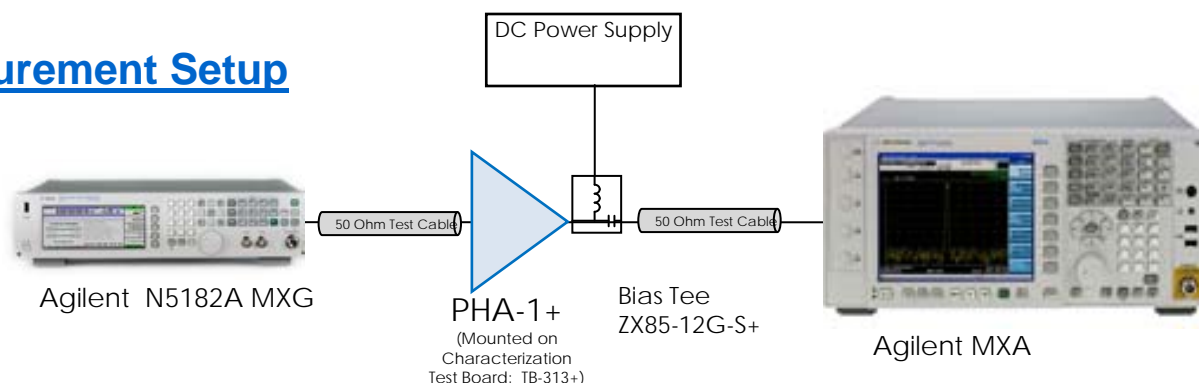
F<sub>c</sub> = 2130 MHz

OFDM, 10 MHz Channel width

### CCDF

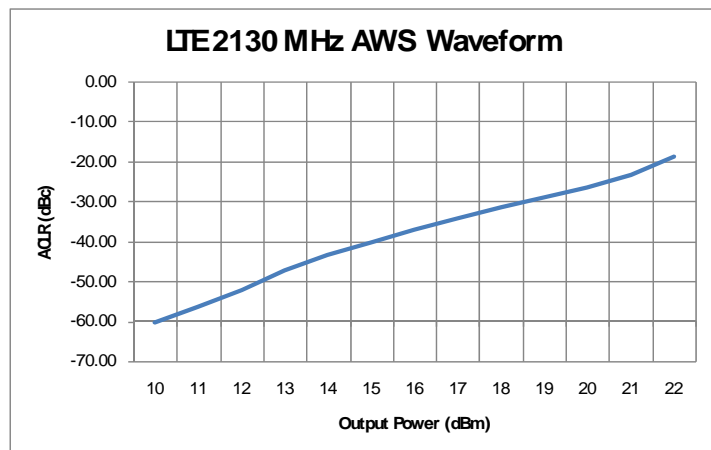
10%	4.05 dB
1.0%	7.27 dB
0.1%	9.12 dB
0.01%	10.32 dB
0.001%	11.40 dB
0.0001%	11.98 dB

## Measurement Setup

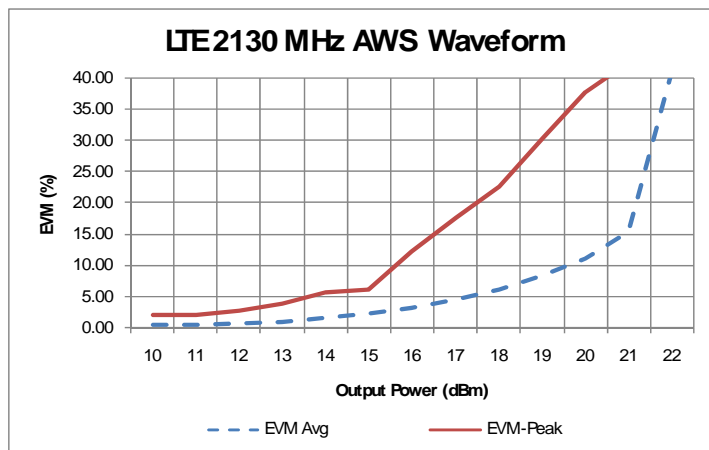


## Summary Data

### ACLR 1 vs. Output Power



### EVM vs. Output Power



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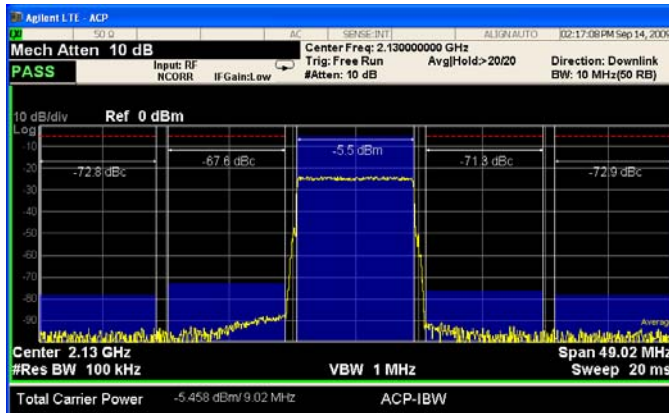
RF/IF MICROWAVE COMPONENTS

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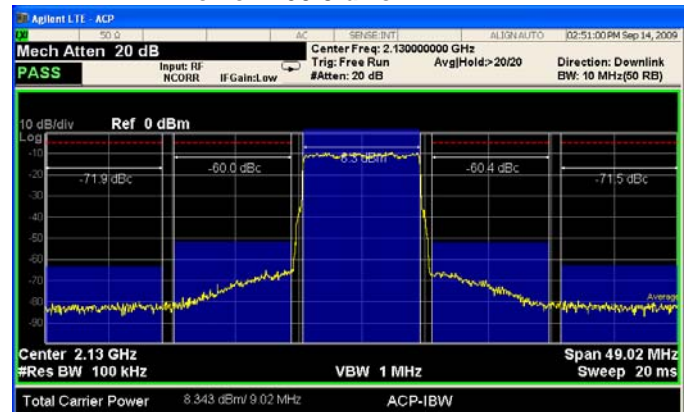
## ACLR\_1 Plots vs. Output power

System Reference

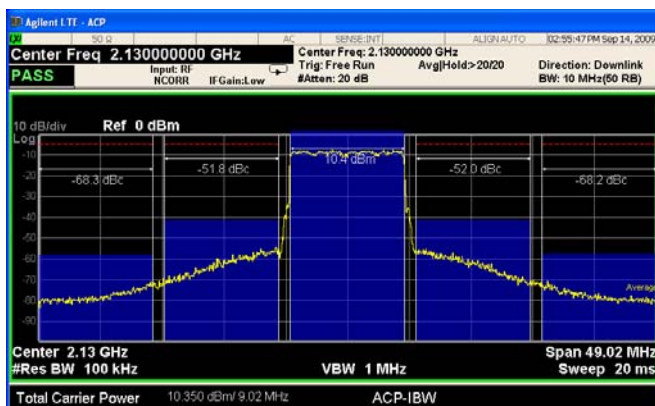
Upper: -67.6 dBc  
Lower: -71.28 dBc



+ 10 dBm Upper: -60.1 dBc  
Lower: -60.3 dBc



+ 12 dBm Upper: -51.8 dBc  
Lower: -52.0 dBc



+ 15 dBm Upper: -39.9 dBc  
Lower: -40.0 dBc



+ 18 dBm Upper: -31.0 dBc  
Lower: -31.2 dBc

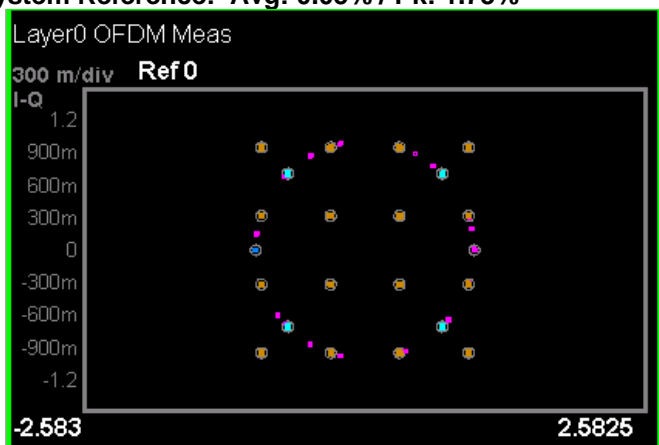


+ 20 dBm Upper: -26.1 dBc  
Lower: -26.3 dBc

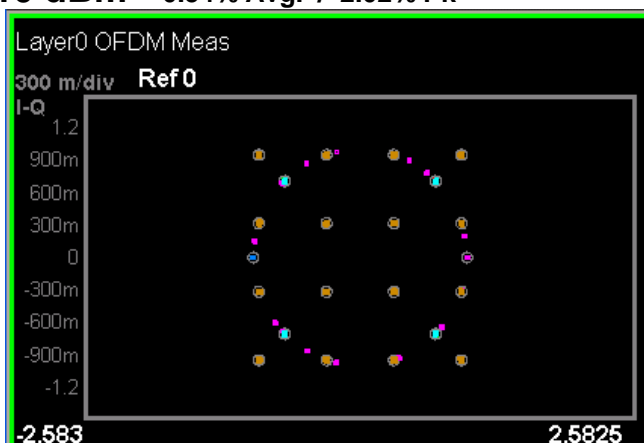


## EVM Constellation Plots vs. Output power

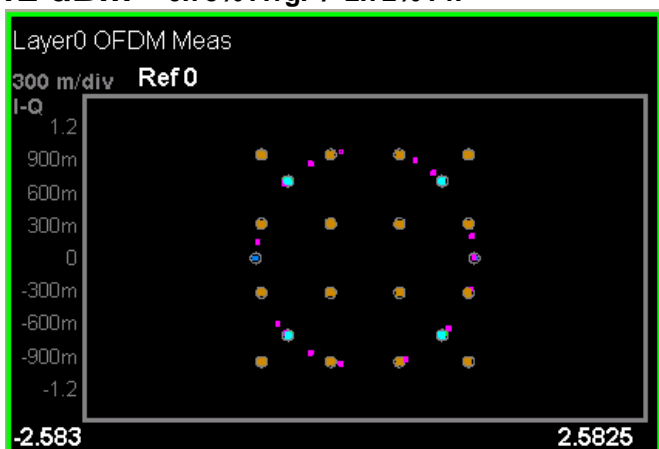
System Reference: Avg: 0.05% / Pk: 1.73%



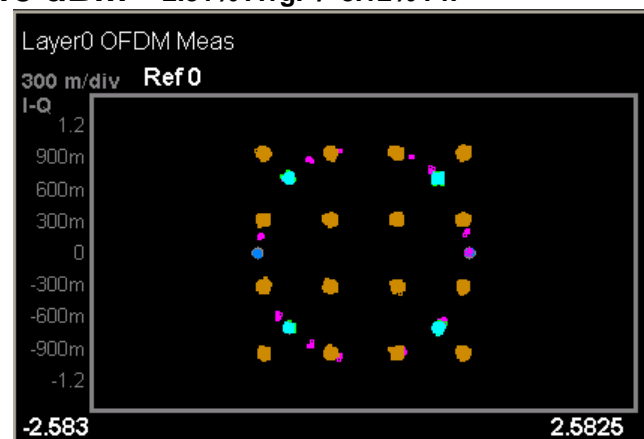
+10 dBm 0.54% Avg. / 2.02% Pk



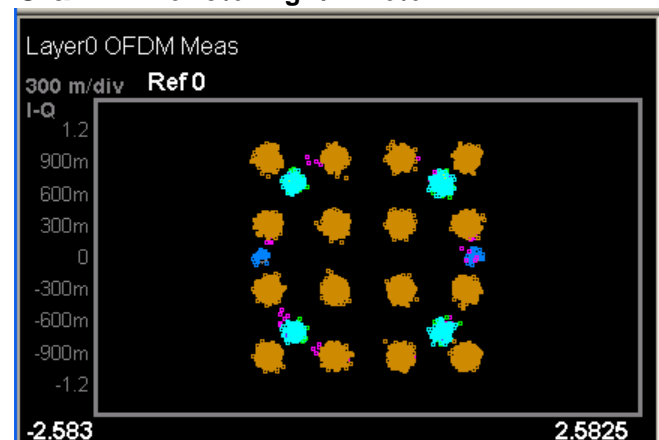
+12 dBm 0.75% Avg. / 2.72% Pk



+15 dBm 2.31% Avg. / 8.12% Pk



+18 dBm 6.19% Avg. / 22.6% Pk



+20 dBm 11.2% Avg. / 37.7% Pk

