# Achieving Compliance to TVWS Spectrum Emissions Mask

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## Authors:


| Name | Company | Address | Phone | email |
|---|---|---|---|---|
| Roger Merel | Scintera | 1517 Maple Knoll Ct, Naperville, IL 60563 | +1(630) 355-5751 | roger@scintera.com |
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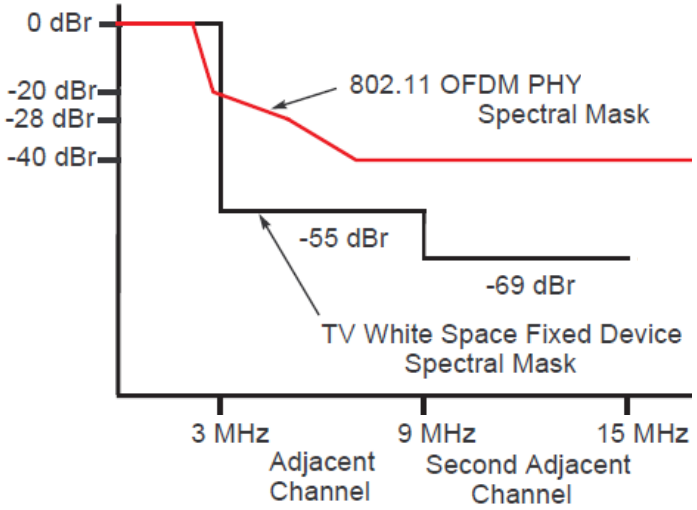
# Abstract

**One of the most challenging requirements imposed on TV White Space spectrum is not even addressed within the scope of the IEEE 802 standards efforts. Meeting the Spectrum Emissions Mask is extremely difficult even for <=100mW TV Band Devices, but is more difficult for system supporting <=1W into the Antenna (4W EIRP). This presentation provides initial results for an RF PA Linearizer which is easily inserted between the RF Modulator and Power Amplifier to achieve full compliance to the Emissions Mask with margin.**

# TVWS Emission Mask

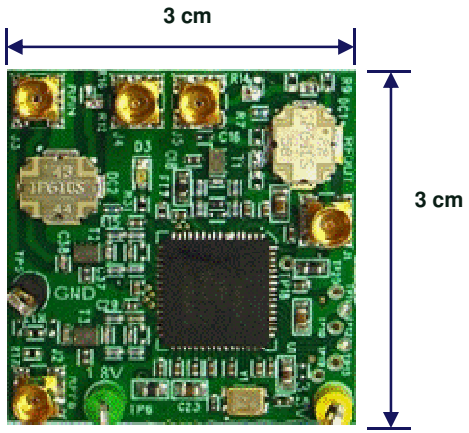



**Extracted from:** *Technical Challenges for Cognitive Radio in the TV White Space Spectrum*; Stephen J. Shellhammer, Ahmed K. Sadek and Wenyi Zhang; Qualcomm Inc.

- **This requirement relates to Fixed TVBDs for 1W at the antenna, 4W EIRP; however, in the final FCC R&O there were slight changes which limit the power for a 5MHz waveform in a 6MHz channel to 5/6 of a Watt which reduces the -69dBr requirement to -68.2dBr.**

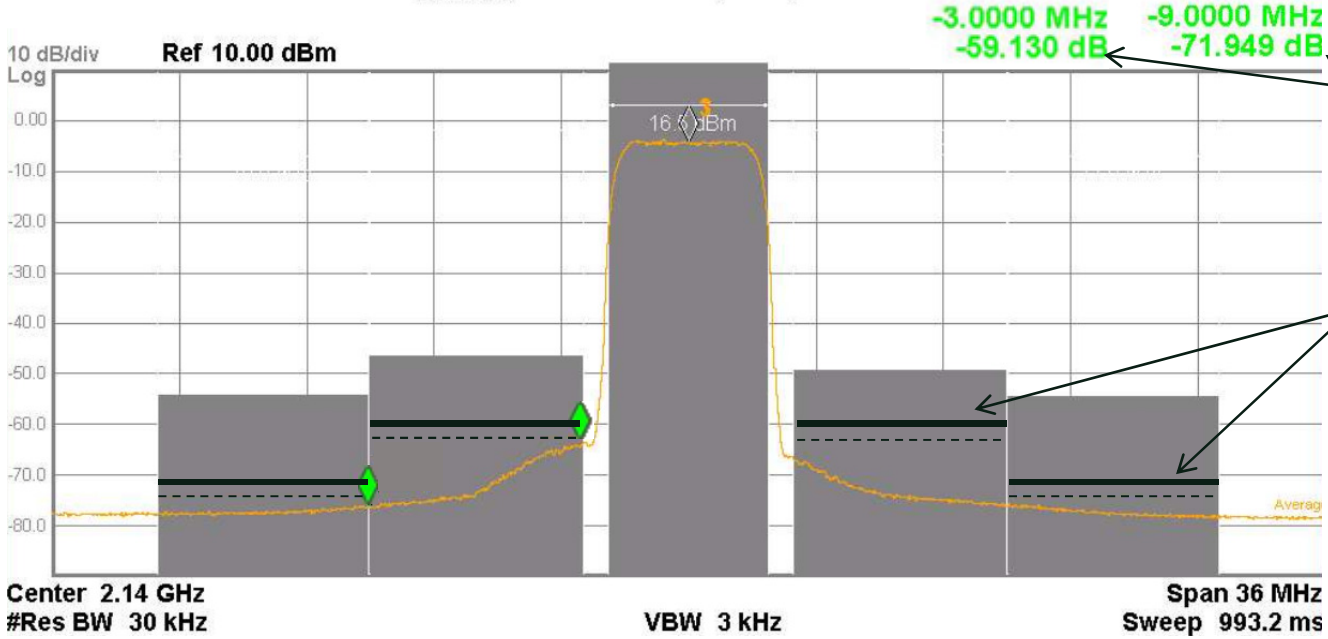
# RF Power Amplifier Linearizer (RFPAL)

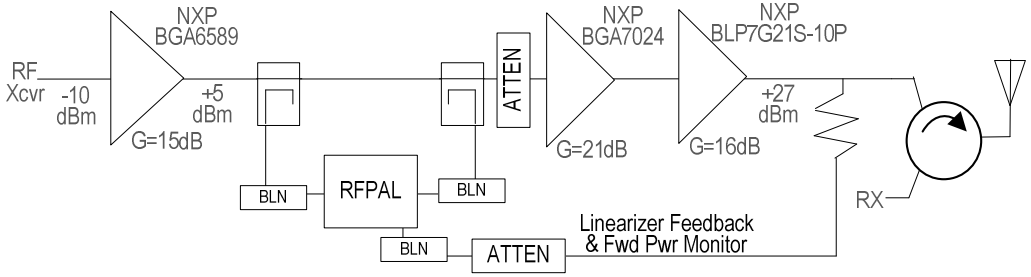
- **Operates over 470-862MHz & beyond.**
- **Supports various SigBW to >20MHz.**
- **Easy to use. Simply insert in Tx RF path. No software, algorithms, DSP, FPGA, or digital baseband processing. Nothing to configure. Automatically detects center frequency, signal bandwdith, etc.**
- **Low-power consumption:**
  - <1.1W during initial adaptation Convergence mode.
  - <0.5W in low-power steady-state Tracking mode.
- **Low-cost, compact solution.**
- **Est. 20W saving in supply & dissipation.**
- **Significant BOM cost savings.**
- **Measures output power level. Can collect and report the output spectrum.**



# Preliminary Results with RFPAL for up to 1W Fixed TVBD Applications

- **Reduces "back-off" required by >10dB, & meets mask with 3dB of margin.**



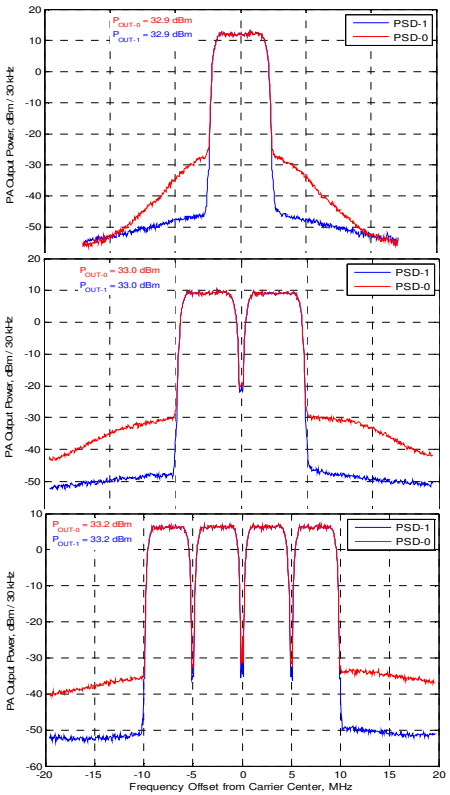

**White Space Performance Targets are met!**

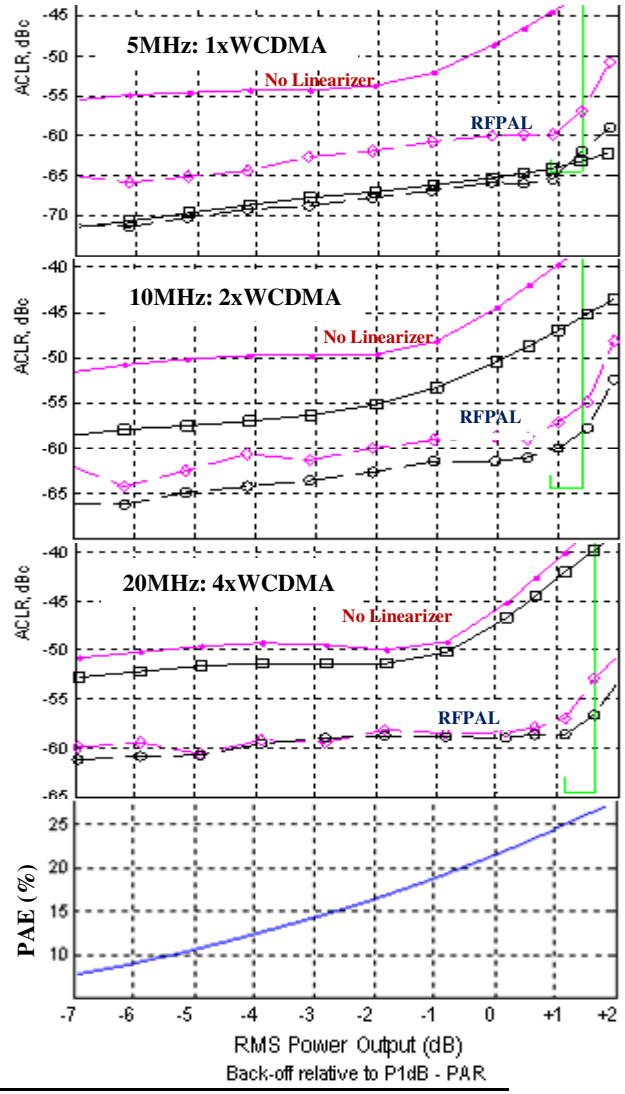
**-55.0dBr – 3dB margin = -58.0dBr @ 3MHz offset**

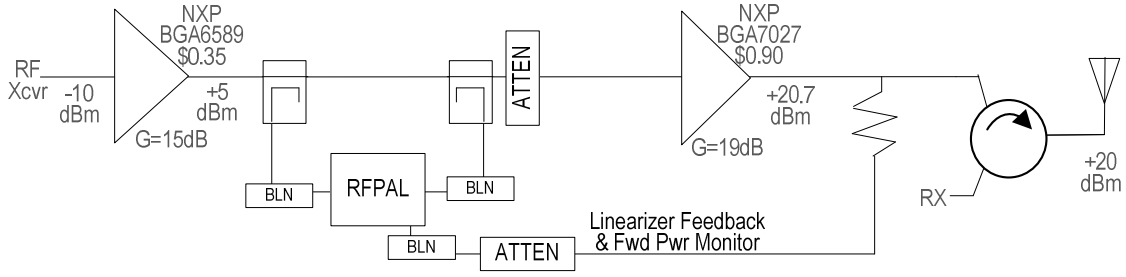
**-68.2dBr – 3dB margin = -71.2dBr @ 9MHz offset**

# Results with RFPAL for <=100mW TVBD

- PA can operate at >P1dB-PAR
- Can use low-cost "Handset" PAs
- Supports up 20MHz waveforms



# References


- *Technical Challenges for Cognitive Radio in the TV White Space Spectrum*; Stephen J. Shellhammer, Ahmed K. Sadek and Wenyi Zhang; Qualcomm Inc.