



# **U-NII Device Testing**

**Part 15, Subpart E:  
Updated Procedures**

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**See KDB Pub # 789033 for details**

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# Continuous Transmission

- All U-NII emission limits (both in-band and unwanted) are based on continuous transmission, i.e., 100% duty cycle
  - Measure during continuous Tx and do not adjust downward for operational duty cycle
  - If continuous Tx is not possible, configure for highest possible duty cycle and correct upward for duty cycle

*[This differs from DTS under 15.247, where we continue to permit restricted band average measurements during continuous transmission to be adjusted downward for operational duty cycle.]*



# Three Types of Averages

- Power (RMS)
  - Required for in-band measurements
  - Preferred for restricted band measurements
  - Available on modern analyzers (e.g., set detector = RMS and set averaging type = power or RMS)
- Voltage (linear)
  - Permitted for restricted band emissions measurements
  - Requires linear display mode on some analyzers
- dB (log)
  - Never permitted

*All can be implemented by trace averaging, slow sweep, or low VBW*



# Emission Bandwidth Measurement

## ● Manual measurement

- Peak detect/max hold (peak detect + view no longer recommended)
- RBW  $\approx$  1% of EBW
- VBW  $>$  RBW
- Width measured at 26-dB down

## ● Automatic measurement

- Permitted if implements same functionality as manual measurement



# Maximum Conducted Output Power: Measurement procedure depends on EUT duty cycle

- EUT configured for 100% duty cycle (at least during each sweep): Measure average power during Tx
  - *Method SA-1*: Trace averaging (RMS)
  - *Method SA-1 Alternative*: RMS detection + specified slow sweep
  - *Method PM*: Average power meter
- EUT configured for high, consistent duty cycle: Measure average power across Tx on/off cycles, and then **correct upward for duty cycle**
  - *Method SA-2*: Trace averaging (RMS)
  - *Method SA-2 Alternative*: RMS detection + specified slow sweep
  - *Method PM*: Average power meter
- EUT w/irregular duty cycle: Use limited averaging+max hold
  - *Method SA-3*: RMS detection + max hold (see KDB)
  - *Method SA-3 Alternative*: Reduced VBW + max hold (see KDB)

***The SA Methods are also used for PPSD and Peak Excursion***





# Peak Power Spectral Density (PPSD) Measurement

- Methods SA-1, SA-2, SA-3, or alternatives to each
  - Find spectral peak
  - If SA-2 or SA-2 Alternative, adjust result *upward* for duty cycle



# Peak Excursion Measurement

- Ratio of maximum of the peak-detect, max-hold spectrum to PPSD (i.e., maximum of the average spectrum)
  - Ratio of the peak of one spectrum to the peak of another (adjusted for duty cycle, if appropriate).  
*Point-by-point computation across EBW is no longer required.*



# Unwanted Emissions Measurement Detector Types

## ● Restricted Bands

- $F \leq 1000$  MHz:
  - Quasi peak field strength  $<$  limit
- $F > 1000$  MHz:
  - Average field strength  $<$  limit
  - Peak field strength  $<$  limit + 20 dB

## ● Non-Restricted Bands

- $F \leq 1000$  MHz:
  - Quasi peak EIRP  $<$  limit
- $F > 1000$  MHz: 15.407(b) specifies “peak emissions”
  - **Peak EIRP  $<$  limit** (*Yes, we know that -27 dBm is below the restricted-band peak limit*)





# Unwanted Emissions Measurements (Restricted & non-restricted bands) Duty Cycle

- Operate EUT at 100% duty cycle
- If 100% duty cycle is not possible due to hardware limitations of EUT,
  - Configure for maximum achievable duty cycle
  - Measure duty cycle
  - Adjust measured average emissions upward based on duty cycle
  - Additional test reporting requirements:
    - The reason for the duty cycle limitation.
    - The duty cycle achieved for testing and the associated transmit duration and interval between transmissions.
    - The sweep time and the amount of time used for trace stabilization during max-hold measurements for peak emission measurements.



# Unwanted Emissions Measurements (Restricted & non-restricted bands) Conducted Alternative

- Limits are for radiated measurements
- Alternative: Cabinet radiated emissions + antenna-port conducted measurements
  - Cabinet radiated emissions:
    - Terminate antenna ports
  - Antenna-port conducted emissions
    - Match test equipment to nominal impedance of antenna
    - Add upper bound on out-of-band antenna gain
      - Maximum in-band gain or 2 dBi, whichever is greater (see KDB for devices operating in multiple bands)
      - Add array gain for devices with multiple outputs (see KDB)
    - In restricted bands below 1000 MHz, add upper bound on ground plane reflection
      - For  $f = 30 - 1000$  MHz, add 4.7 dB
      - For  $f < 30$  MHz, add 6 dB

*If EUT fails alternative test, consider performing radiated test*



# Closing Comment

Please refer to KDB Pub # 789033 for the actual procedures and how to apply them.