Multiple-Output Devices (e.g., MIMO) with Cross-Polarized Antennas

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See KDB Publication # 662911 D02 for details

(Formerly KDB Draft Publication 689094)

TCB Workshop October 2011

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KDB Publications for Multiple Output Devices (e.g., MIMO)

Two attachments to KDB Publication 662911.

Both apply to unlicensed and licensed devices.

- # 662911 D01 (Published April 2011)
  - *Conducted* output emission measurements
  - Modified October 2011 to reference new attachment D02
- # 662911 D02 (Published October 2011)
  - *Conducted and radiated* emission measurements for devices driving *cross-polarized antennas*
  - Formerly KDB Draft Publication 689094

The Reason for D02:

Inconsistency between conducted and radiated tests of devices with cross-polarized antennas

- *Conducted* measurement procedure in 662911 D01 requires summing emissions across the outputs.

But,

- Radiated measurement with a linearly polarized antenna might see only one transmitter (Tx) output at a time.

New Interpretation

- Where a rule specifies a conducted limit (power or PSD):
  - Limit applies to total emission. Sum the power or power spectral density (PSD) across outputs or across polarizations
- Where a rule specifies a radiated limit (EIRP, ERP, or field strength):
  - Limit applies to the maximum emission that would be observed by a linearly polarized measurement antenna unless the rule specifies otherwise.

Interpretation depends on how the limit is expressed (radiated or conducted) rather than on how it is measured (radiated or conducted)

Implementation

Conducted limits (e.g., 15.247, 15.407, 90Y)

- Perform conducted emissions tests
  - Sum the power or PSD across the outputs
- Or, perform radiated emissions tests (if necessary due to integral antennas)
  - Measure radiated emissions with vertical and horizontal polarizations
  - Convert each to power or PSD
  - Sum the power or PSD across the polarizations
    - *Note that this was not in the draft KDB . Comments are welcome.*

A rule that reduces the conducted limit as antenna gain is increased creates a cap on EIRP. But the limit is still a conducted limit.

Implementation (continued)

Radiated limits (e.g., EIRP or ERP in Parts 27C or 90Z)

Unless otherwise specified, the limit applies to the maximum emission that would be observed by a linearly polarized measurement antenna.

- Perform radiated emissions tests
  - Horizontally and vertically polarized measurements must individually comply with the limit
- Or, perform conducted emissions tests as follows:
  - Measure conducted output power or PSD for each Tx chain.
  - Compute EIRP or ERP of each Tx chain individually.
  - Apply the limit as follows:
    - Apply the limit to each of the two EIRPs or ERPs individually **if:**
      - (1) Tx output signals are *uncorrelated* per KDB Publication 662911; or,
      - (2) One Tx output is a *90-degree phase-shifted* replica of the other and the antenna phase centers are co-located.
    - Apply the limit to the sum of the two EIRPs or ERPs **if**
      - Tx output signals are *correlated* per KDB Publication 662911 and (2) does not apply.

Examples with two outputs driving cross-polarized linear antennas

- 15.247: 1 watt conducted power limit if antenna gain < 6 dBi
  - Limit is reached if each output is at 0.5 watts
- 90Y: 1 watt/MHz peak EIRP power density limit
  - For outputs that are *uncorrelated* per KDB 662911, limit is reached if peak conducted emission + antenna gain = 1 watt/MHz for each output.
  - For outputs that are *correlated* per KDB 662911, limit is reached if peak conducted emission + antenna gain = 0.5 watt/MHz for each output.