Consumer Signal Booster Compliance Test Procedures

Office of Engineering and Technology

Laboratory Division

Background

- New rules applicable to signal boosters operating under Parts 22, 24, 27, and 90 became effective in May 2013.
  - Codified in §20.21
  - Created two primary classes of signal boosters, Consumer and Industrial, with specific regulatory requirements for each class.
  - Introduced a Network Protection Standard (NPS) applicable to two subcategories of consumer signal boosters, wideband and provider-specific.

Network Protection Standard

- Wideband (WB) signal boosters that operate on the frequencies and in the market areas of multiple licensees
  - i.e., boosters that amplify all frequencies within one or more commercial mobile radio service (CMRS) frequency bands
  - Technical requirements specified in §20.21(e)(8)
- Provider-Specific (PS) signal boosters that operate only on the frequencies and in market areas of specific licensee(s)
  - i.e., boosters that only amplify frequencies within one or more discrete CMRS frequency blocks
  - Technical requirements specified in §20.21(e)(8)

WB Signal Booster Compliance Test Guidance

- C63.26 task group, with FCC participation, began work on wideband (WB) consumer signal booster compliance measurement procedures in May 2013.
- FCC posted draft guidance under KDB 935210 D03 on iterative basis for public consideration and comment and for interim use.
  - 14 June 2013 (DR-03-41439)
  - 7 August 2013 (DR-04-41516)
  - 27 November 2013 (DR-05-41605)

WB Signal Booster Compliance Test Guidance

- Compliance measurement KDB published on 21 January 2014 (KDB 935210 D03 v01).
  - Procedures primarily developed based on theoretical expectations (i.e., NPS-compliant devices not yet available for testing)
- Modified KDB published on 6 March 2014 (KDB 935210 D03 v02).
  - Procedures modified based on actual test experiences with NPS-complaint boosters
- KDB 935210 D03 v02 is now applicable to all WB signal booster compliance tests initiated on or after 6 March 2014.

PS Signal Booster Compliance Test Guidance

- C63.26 TG development of compliance test procedures for provider-specific (PS) consumer signal boosters began in December, 2013.
  - Utilized prior work to address requirements common to WB boosters
  - Developed additional procedures to address technical requirements unique to PS boosters
- Draft FCC guidance (KDB 935210 D04) posted on 6 March 2014 (DR06-41704).
  - Currently open for comment through 18 April 2014.
  - Acceptable for interim use until finalized.

Summary of WB/PS Compliance Measurement KDB Guidance

- Clauses 1-4 and 6 provide introductory and general information.
- Clause 5 provides basic equipment requirements and maximum input levels per signal booster platform/configuration
  - Spectrum analyzer, signal generator(s), step attenuators, RF combiner/couplers and RF filters required for WB and PS booster tests
  - Base station simulator required for testing PS boosters
- Clause 7 provides measurement procedures for use in demonstrating compliance to the various technical requirements specified by the NPS (§20.21(e)).

Key Distinctions/Considerations

- Terminology
  - Consumer signal boosters required to be bi-directional
    - Traditional references to input and output ports can be confusing since each port of a booster is used for both an input and an output.
    - Donor/Server designations used to distinguish between the ports
      - Donor port receives a downlink signal (input) and transmits an amplified uplink signal (output)
      - Server port receives an uplink signal (input) and transmits an amplified downlink signal (output)

Key Distinctions/Considerations

- Test Signals
  - Simulated LTE (5-MHz OBW) and single-time-slot GSM are the specified CMRS signal types for use as input boundary test stimuli.
  - Band-limited (4.1-MHz OBW) AWGN and/or pulsed CW (570 µsec PW and 12.5% dc) acceptable as alternatives to 5-MHz LTE and single time-slot GSM, respectively.

Key Distinctions/Considerations

- Out-of-Band Emissions (OOBE) Tests
  - WB signal booster rules require that OOBE be 6 dB lower than OOBE specification in relevant rule part (e.g., 22, 24, 27) for mobile/portables (*i.e.*, -19 dBm).
  - Compliance must be demonstrated from the band/block edge to ± 300 kHz (f_o < 1 GHz) or 3 MHz (f_o ≥ 1 GHz) for both WB and PS boosters.

Key Distinctions/Considerations

- Anti-Oscillation Tests
  - Inadequate donor/server antenna isolation can lead to oscillation in bi-directional signal boosters
    - Oscillation condition can generate significant noise power spikes.
    - Recommend a pad (20 dB) be used at the spectrum analyzer input to prevent front-end overload from oscillation power spikes.
  - NPS requires boosters to detect oscillation conditions and mitigate within a specified time period.

Key Distinctions/Considerations

- Anti-Oscillation Tests (continued)
  - Measurement procedure currently provides a methodology for demonstrating compliance to the mitigation timing requirements
  - Also want to know the maximum oscillation power level and frequency in addition to timing data
    - When the power level can't be determined from the spectrum analyzer plot (*e.g.*, exceeds the screen reference level), then record the maximum level in test report.

Industrial Booster Compliance Test Procedures

- C63.26 Task Group currently developing industrial signal booster test procedures
  - Separate procedures under development for wideband (CMRS) and narrowband (Part 90) signal booster applications.
- With further maturation, a draft KDB will be posted for comment.
- Once comments have been considered and incorporated, final guidance will be provided in KDB 935210 D05.
- In the interim, test procedures currently provided in KDB 935210 D02 are acceptable.