



# **C63.26 STM1-RF Power Output Update**

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# Background

- C63.26 attempting to document standard procedures for performing compliance measurements on transmitters intended for operation in the U.S. licensed radio services and which require FCC certification.
- Standard Test Methods task group 1 (STM 1) is assigned the task of documenting, and where necessary, developing, standard procedures for measuring the RF output power in the fundamental emission of licensed transmitters
  - Specific considerations: average power measurements, signal substitution methods, peak power measurements, peak-to-average ratio measurements.



# Objective

- The objective of STM-1 is to document standard test procedures for measuring the fundamental emission output power of licensed transmitters that will produce accurate and consistent (repeatable) results across a range of currently available instrumentation options.



# Approach

- Research and document the FCC rules for licensed operation related to fundamental emission output power limits.
  - Note how the limits are expressed (e.g., ERP, EIRP, PSD, PAR)
  - Note any associated bandwidth limitations or channel plans
  - Note any measurement guidance provided by the rules
- Research lab policies, industry standards, and applicable literature for established measurement procedures and practices.
- Identify predominate signal/waveform types (modulation formats, emission bandwidths and access schemes) among contemporary and near-term future technologies.



# Approach (continued)

- Initially focus on those rule parts that accommodate devices transmitting digitally-modulated broadband emissions
  - Most questions related to measurement of broadband signals
  - Procedures and policies not well established
  - > 1 MHz assumed as demarcation between narrowband and broadband emissions
  - Relevant rule parts are §22H, §24E, §27, §90 (Y&Z)



# Constraints

- FCC rules require that measurement of RF output power be performed over a period of continuous transmission (over a burst duration or time slot allocation).
  - STM 1 not addressing how to set up DUT for this condition
  - Proper DUT set-up assumed to be responsibility of test lab in coordination with manufacturer/applicant
- FCC rules require that measurements be performed in “worst-case” (highest realized power) operational mode.
  - STM 1 not addressing how to identify worst-case mode
  - Intent is to develop technology-independent procedures
  - Means for identifying worst-case mode to be left up to test labs



# Progress on Specific Tasks

- Average Power Measurements
  - Instrumentation
    - Average Power Meter (assumed as reference instrument)
    - Spectrum/Signal Analyzer
  - Measurement Methodology (BB emissions)
    - Integrated band/channel power
    - Comparing several possible techniques (Power meter, SA Marker BPWR function)
  - Issues
    - Minimum instrumentation specifications
    - Proper analyzer settings (RBW, integration time, etc.)
    - Signal bandwidth definition (EBW vs. OBW)



# Progress on Specific Tasks

- Signal Substitution Methods
  - FCC rules permit conducted measurements for determining the output power in the fundamental emission of licensed devices (§2.1046).
  - Practical considerations (e.g., devices with integral antenna) often require that radiated measurements be performed.
  - No rules requirement for use of a calibrated test site.
    - To compensate, FCC lab policy has been to require use of signal substitution methodology.
    - FCC refers to TIA 603 standard.



# Progress on Specific Tasks

- Signal substitution (continued)
  - Questions/Issues
    - Many test facilities use calibrated test sites (required for Part 15 measurements) to perform radiated measurements on licensed devices.
    - Some have complained that requiring signal substitution introduces unnecessary redundancy.
    - Substitute signal is often CW
      - Questions arise as to whether a CW signal is fairly representative of a digitally-modulated broadband signal.
      - Measurements and white papers under review within STM 1 to examine this issue.
    - TIA standard procedures vague with respect to applicability to broadband emissions.



# Progress on Specific Tasks

- Peak Power Measurements
  - Some FCC rule parts specify output power limits in terms of “peak” power.
  - Not clear that the intent is to measure the instantaneous peak power of a digitally-modulated signal.
    - Arranging meetings with other FCC bureaus to resolve this question.
  - For digitally-modulated broadband emissions, measurement of instantaneous peak power can be challenging
    - Statistical time-domain parameter
    - Requires instrumentation with resolution/measurement bandwidths  $\geq$  signal emission bandwidth
  - This topic has not yet been considered in detail



# Progress on Specific Tasks

- Peak-to-Average Ratio (PAR) Measurements
  - Recent rules modifications require the measurement of PAR when average output power is measured.
    - E.g., Part 24(E) and 27.50(d)
  - A method for performing this measurement is the use of Complimentary Cumulative Distribution Function (CCDF) curves.
    - Statistical power measurement
    - Capability included in many modern test instruments.
    - Suggested technique in recent FCC Public Notice (DA 10-592).
  - This topic has not yet been considered in detail.



# Future Work

- Continue to refine average integrated band power measurement procedures for broadband waveforms.
- Develop/document procedures for measuring the average fundamental output power of narrowband digitally-modulated waveforms.
- Develop/document procedures for measuring the peak fundamental output power for both narrowband and broadband digitally-modulated waveforms.
- Define those rule parts where each procedure is applicable.
- Describe procedures for performing compliance measurements on both a conducted and radiated basis
  - Signal maximization
  - Signal substitution



# Recent KDB-Published Measurement Procedures

- Medical Device Radiocommunication (MedRadio) Service
  - New radio service established by 2009 rulemaking (FCC-09-23)
  - Regulations codified in new Subpart I of Part 95 rules
  - Incorporates existing Medical Implant Communications (MICS) “core” frequency band of 402-405 MHz and establishes two newly designated “wing” bands (401-402 MHz and 405-406 MHz)
  - Original MICS rules permitted use of an average power procedure for measuring the output power of the fundamental emission.
    - Referenced a procedure that was defined in ANSI C63.17-1998 permitting the use of video averaging techniques.
    - ANSI C63.17-1998 replaced by ANSI C63.17-2006
    - Newer standard no longer contains the average power procedure.
  - FCC recently published a power measurement procedure (KDB publication 771134) to replace the average power procedure previously contained in C63.17-1998
  - FCC also recently published guidelines on the use of a human torso simulator when performing compliance measurements of MedRadio Service devices (KDB publication 617965)



# Recent KDB-Published Measurement Procedures

- 3650-3700 MHz Wireless Broadband Services
  - 2005 rulemaking (FCC-05-56) established rules to provide for licensed terrestrial wireless broadband service utilizing contention-based protocol
  - Regulations codified in Subpart Z of the Part 90 rules
  - Establishes limits on total power over 25 MHz bandwidth and on maximum power spectral density in 1 MHz.
  - FCC recently published procedures for measuring both the total power and the power spectral density (KDB publication 965270)
  - Procedures tested by FCC lab and Motorola and found to produce output power results consistent with power levels measured with an average power meter.
  - Rules also accommodate use of MIMO antenna technologies
  - Guidance with respect to compliance measurements for MIMO antennae currently under development



# Questions and Answers

**Thanks!**