Part 95M Radar Certification Updates

Office of Engineering and Technology
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Recent Part 95M Policy Issues

- Recently fielding questions/inquiries regarding the ability to use in-cabin vehicular radar applications in the 76-81GHz frequency band under the auspices of Part 95M
  - Footnote #3 of KDB Publication 653005 states that "*Radar devices intended solely for automotive in-cabin usage cannot be accommodated under these rules*."
  - Reflective of current FCC policy that Part 95M rules are specific to vehicle-mounted radars used to detect objects outside of the cabin but within proximity of the vehicle, or for those in-cabin sensors integral to such externally-dedicated sensors.

Part 95M Radar Compliance Measurement Guidance

- Compliance measurement procedures for Part 95 M radar applications were recently finalized in C63.26 Task Group
- FCC KDB guidance based on these procedures is in preparation
- Should be published before the end of this calendar year
- Will be posted to our KDB page for a comment period before final publication

Test Procedure Overview

- Although FMCW radar technologies are initially anticipated, compliance test procedures applicable to traditional RF pulsed radar are also included in C63.26 guidance
- Provides detailed guidance for measuring relevant EMC parameters (OBW, output power levels, unwanted emissions power levels) while operating under normal conditions
  - no requirements under 95M to stop the frequency sweep or to limit duty cycle consideration to within a 100 ms period as is required under Part 15 rules (§15.31(c) and §15.35(c), respectively)

Instrument Desensitization Considerations

- Pulse desensitization (*i.e.*, decreased sensitivity and resolution = amplitude reduction) is a well known phenomena associated with the measurement of pulsed RF signals
  - effected by the resolution bandwidth (RBW) of the measurement receiver relative to the pulse repetition frequency (PRF) of the pulsed signal under measurement.
- A similar instrumentation desensitization can also be encountered when using a swept frequency spectrum analyzer or receiver to perform **peak** power measurement of an FMCW signal
  - Effected by the resolution bandwidth of the measurement instrument and the chirp characteristics (chirp time and bandwidth) of the signal
    - Analyzer sweep time assumed to be negligible (*i.e.*, sweep time >> T_{Chirp})

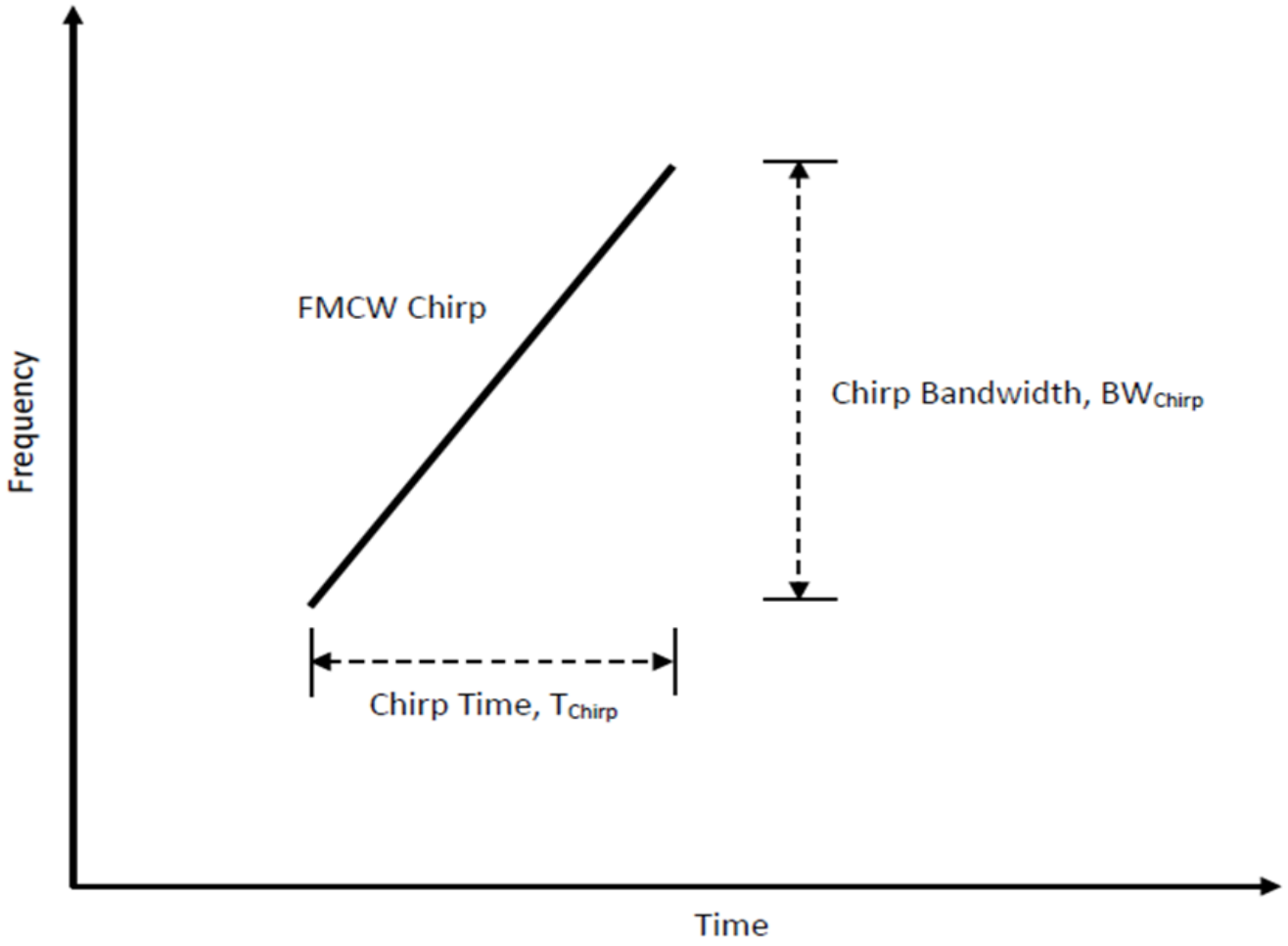
Instrument Desensitization Considerations (continued)

- Appendix B of Keysight Technologies Application Note 5952-1039 provides formulas for predicting and correcting for desensitization to peak power amplitude measurements.
- This information has been reproduced in the C63.26 Vehicular Radar TG measurement procedure and is summarized in the following slides.
  - Note that the resolution bandwidth of the measurement instrument is presumed to be fixed at 1 MHz as per Part 95M specification.

FMCW Signal Parameters Related to Desensitization

- The derivation of desensitization is primarily a function of two basic parameters associated with a linearly-swept FMCW signal (particularly when instrumentation RBW is established by rule)
  - The sweep width (in frequency) is designated as the Chirp Bandwidth (BW_{chirp})
  - The time required to complete the frequency sweep is designated as the Chirp Time (T_{chirp})
  - These two parameters are depicted graphically in the figure below

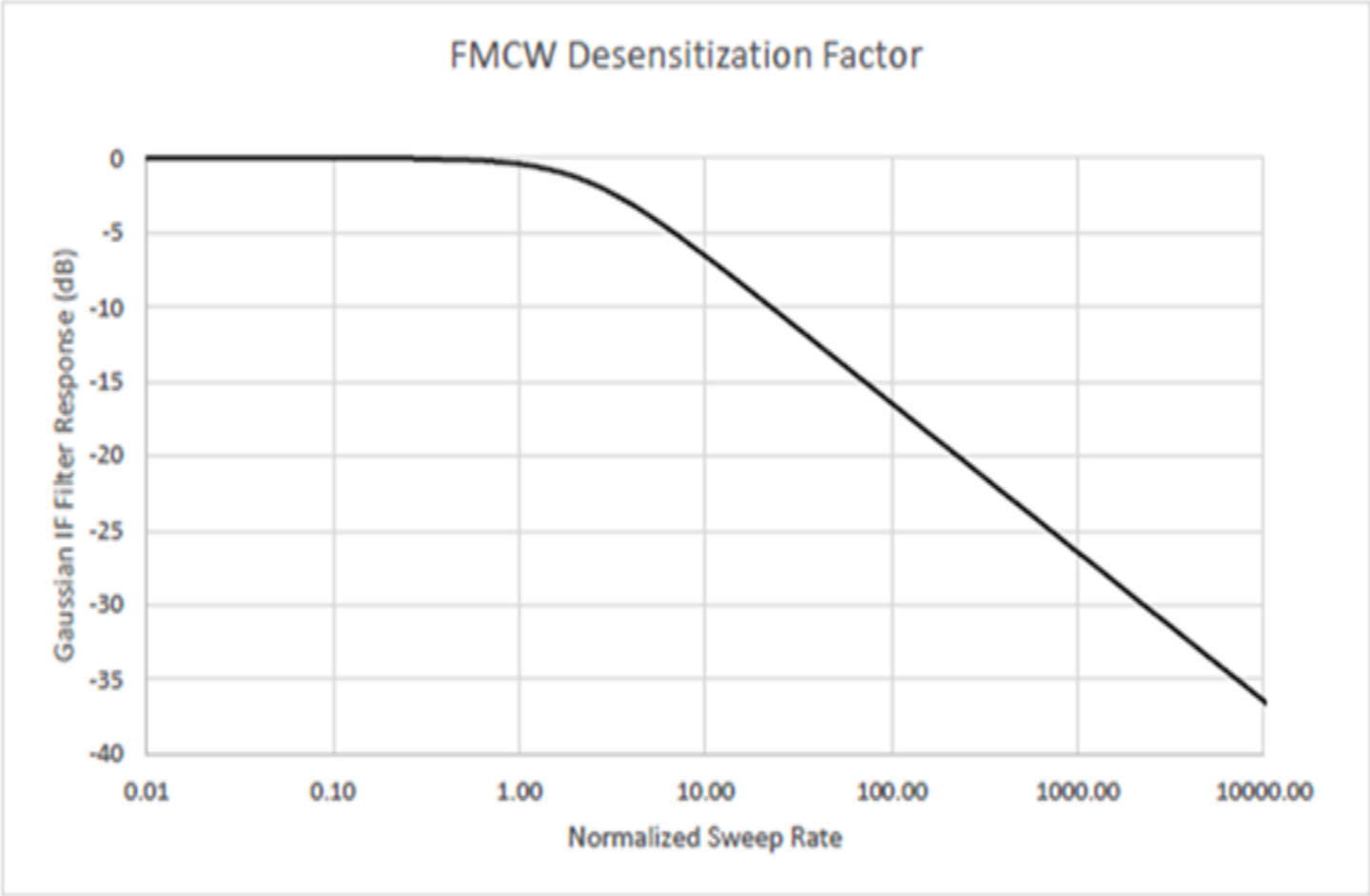
Frequency-time characteristics of an FMCW chirp with a linear sweep



FMCW desensitization as a function of normalized sweep rate

- The following figure depicts the Gaussian IF filter (*i.e.*, RBW) response as a function of the Normalized Sweep Rate of a linear-swept FMCW signal
  - The normalized sweep rate is defined as BW_{Chirp} / (T_{Chirp} x B^2)
  - B represents the 3 dB IF bandwidth = RBW in Hz, which is established by rule as 1 MHz
  - The figure shows that measured amplitude is reduced as the normalized sweep rate increases
  - Information is provided in C63.26 procedures, and will be included in the forthcoming KDB guidance, to correct for this amplitude reduction due to FMCW signal desensitization

FMCW desensitization as a function of normalized sweep rate (continued)



Other FMCW Measurement Considerations

- Although FMCW desensitization is not a concern when performing average (median) power measurements, it may still be necessary to perform average measurements using a very slow instrument sweep time when measuring over the FMCW frequency range (fundamental and harmonically-related)
- FMCW harmonic frequency ranges will vary as a function of the harmonic relationship., *e.g.*, subharmonic frequency ranges are "N" times smaller and harmonic frequency ranges are "N" times larger than for the fundamental, where "N" represents the numerical harmonic relationship to the fundamental emission (i.e., 2, 3, …)

Initial Pre-Scan Measurements Recommended

- The FMCW signal should be observed prior to formal compliance measurements (pre-scanned) in both peak and mean measurement modes to confirm the accuracy of the signal description provided and to initially establish where in the frequency domain that maximum values are observed
- A time domain pre-scan should also be performed to confirm the sweep characteristics of the FMCW signal (or pulse signal characteristics, as applicable).

Specific Test Procedures

- Radiated Testing Likely to be Only Feasible Option
  - Testing to be performed in far field region of DUT and measurement antenna
- Test Procedures Provided for measuring:
  - Occupied Bandwidth (OBW)
  - Peak EIRP spectral density
  - Maximum (average) EIRP
  - Mean EIRP spectral density
  - Power Duty Cycle
- Methods provided for use of:
  - Spectrum or signal analyzer
  - Power Meter (peak and/or average)
  - Oscilloscope (time domain)
- Detailed guidance also provided for performing frequency stability testing over extreme temperature and voltage conditions

QUESTIONS?