CenTex IEEE Meeting
2-25-09

New CISPR Detectors

Ave + Meter or CISPR-Ave

RMS-Ave or CISPR RMS

75 Years of Driving Innovation

ROHDE&SCHWARZ

Quasi-Peak Detector

- Quasipeak

  - QP is an attempt to quantify annoyance factor
  - Think of it as radio receiver + person receiver
  - Weighting Factors: amplitude, freq, pulse repetition

- Quasipeak History

  - AM radio installed in 1922
  - Complaints about disturbances, but no measurements tools until 1933
  - 1933 CISPR formed to unify measurement and weighting of disturbances

Quasi-Peak Detector

- Quasipeak; Compliance vs Pre-compliance
  - QP should always be less or equal to peak detector
  - Peak is worst case, QP may relax peak values
- Quasipeak on Spectrum Analyzers
  - Dwell time (per measurement point) at least 1 second
    - zero span each measurement point
    - calculate sweep time necessary since “coupled”
  - Pulsed signals indicate as if CW signal
    - QP results ~ 30 dB lower for pulse rates 100 Hz – 1 Hz
  - SA need ~40 dB RF attenuation for QP & pulsed signals
    - mixer dynamic range / VSWR requirements of CISPR-16-1

Other EMI Detectors

- RMS and Peak Detectors
  - RMS for ultra wide band, dwell time critical for integration
  - Peak is “safest detector”: fast enough to see most signals even if instrument settings are not “optimum”

CISPR Average & RMS-Average Detector

- C-Ave responds to “intermittent, unsteady & drifting narrow Band disturbances” equivalent to a peak power meter
- C-RMS responds to signals that interfere with digital communication systems like WCDMA, Tetra, DECT, DVB

CISPR Ave Detector

CISPR Ave Detector

- CISPR Ave detector created to capture “intermittent, unsteady & drifting narrowband disturbances”

  - Implements a “meter simulating network”
  - Allows variable charge / discharge timing to be set
  - 160 mS time constant in CISPR bands A & B (9 kHz – 30 MHz)
  - 100 mS time constant in CISPR bands C & D (30 MHz – 1 GHz)

- End Goal was compromise between averaging of “spikes” and full peak weighting

- Couldn’t change the QP due to history / legacy systems

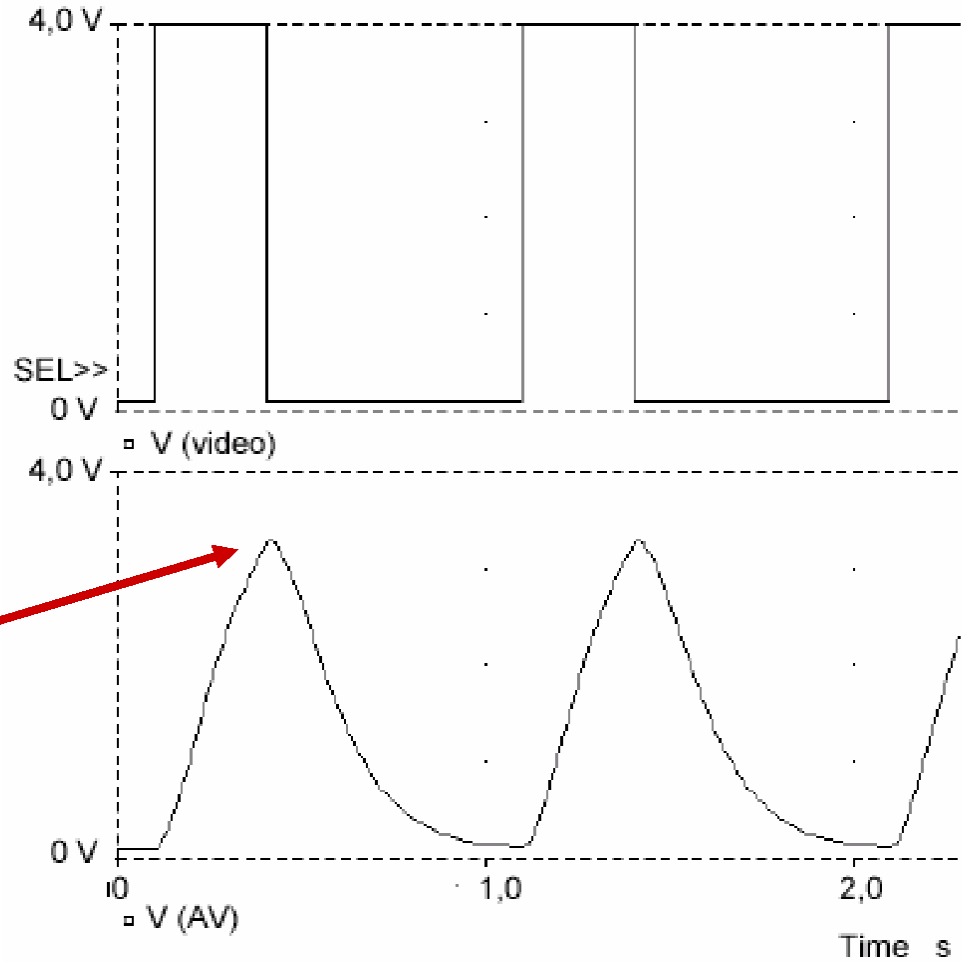
CISPR Ave Behavior

- CISPR Ave weighting for pulsed signals

  Amendment A1:2002 to CISPR 16-1:1999

For pulse-modulated signals with a PRF lower than the meter time constant, e.g. fp < 6 Hz for Band A/B, the measurement result is not the average!

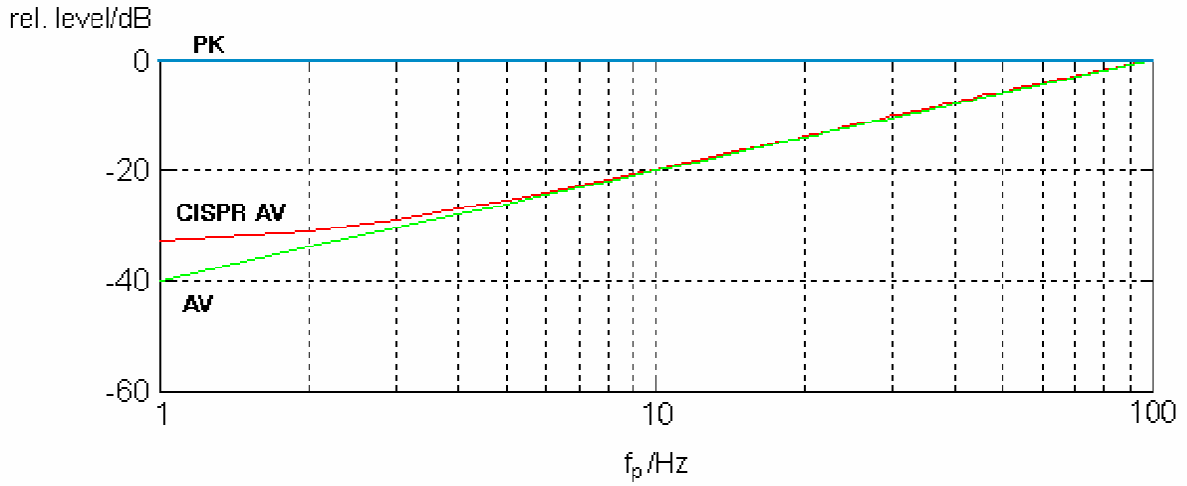
but the maximum of the output of the meter simulating network



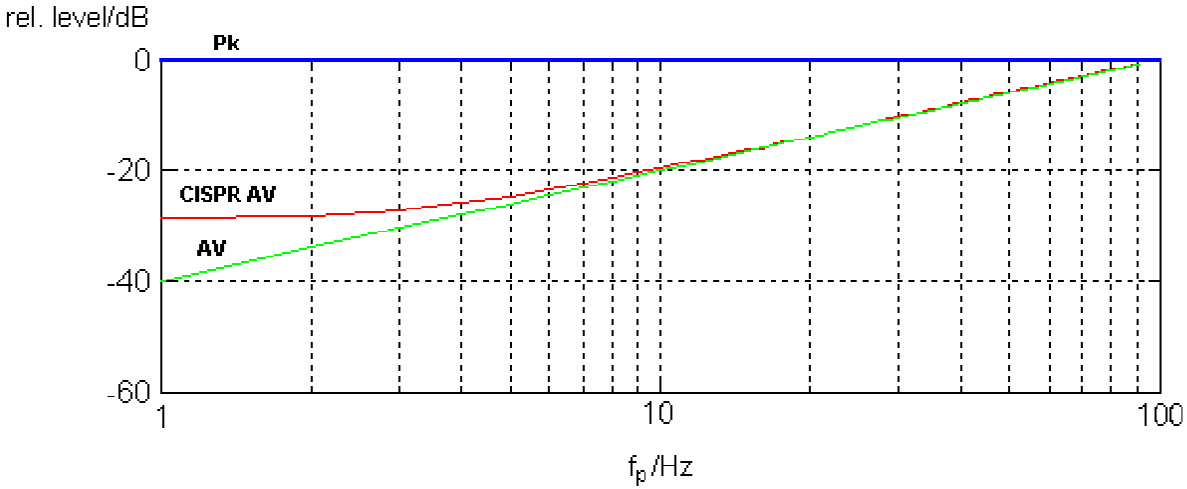
CISPR Ave Behavior

- Example for pulse width = 10 ms, measurement time Tmeas > 10 / fp

Band A/B:
Tmeter = 160 ms



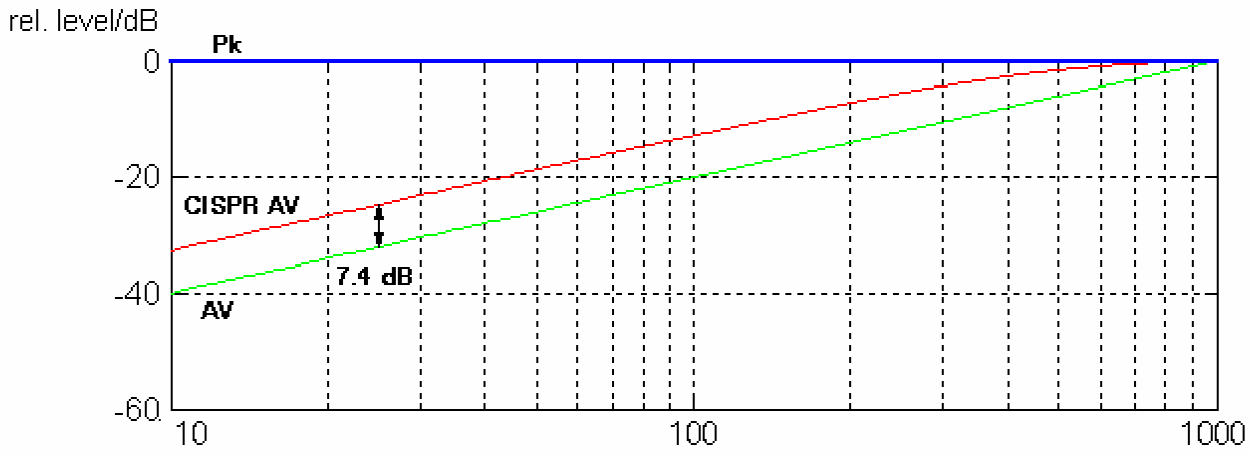
Band C/D:
Tmeter = 100 ms



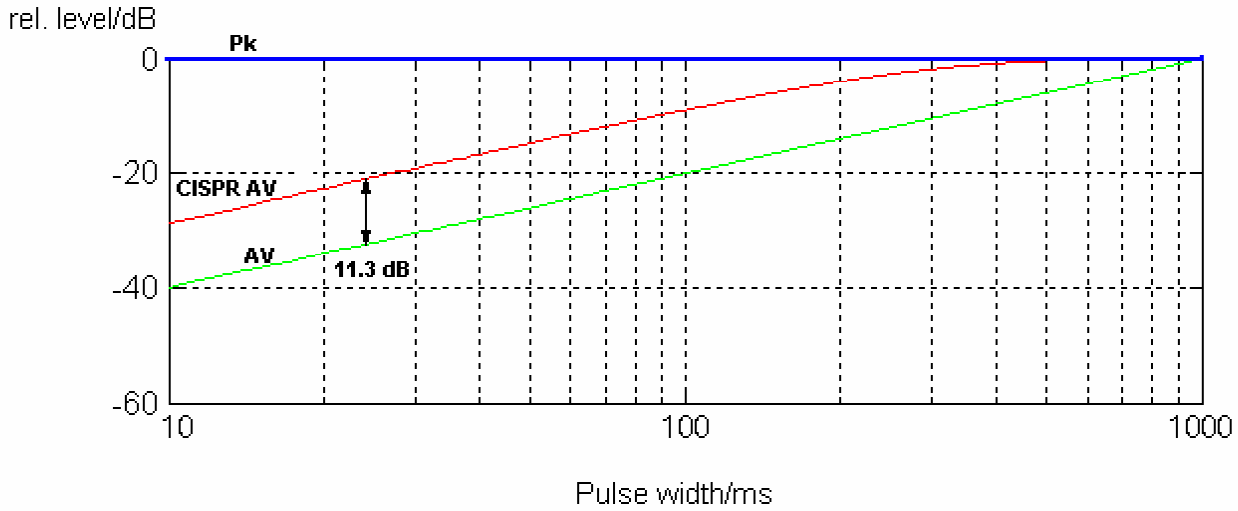
CISPR Ave Behavior

- Example for fp = 1 Hz, measurement time Tmeas > 10/fp

Band A/B:
Tmeter = 160 ms

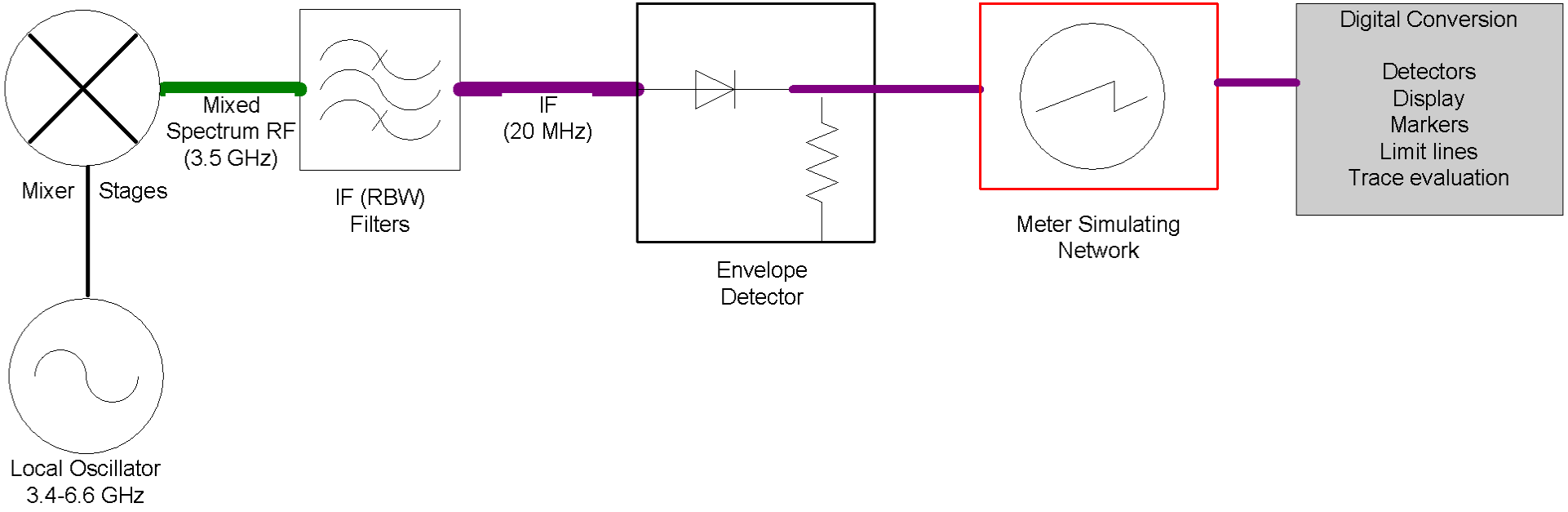


Band C/D:
Tmeter = 100 ms



Detector Implementation

Intermittent, unsteady & drifting narrowband disturbances



CISPR16-1-1:2006 (2nd Ed)

- CISPR16 says here is new detector for use
- Product committees decide if detector is applicable to specific products
- Extension of frequency range up to 18 GHz
- New Band E = 1 to 18 GHz
- For Band E, 2 average detector modes defined
  - linear average detector / logarithmic average detector
- Meter time constant is 160 mS (band A&B) and 100 mS (band C,D,E)
- For logarithmic average detector no meter time constant is yet defined

C-Ave Product Applications

CISPR 11:200x EN55011:200x	Applicable with publication of 5th edition expected in 2009
EN55012:2007	Applicable since 2007 (6th edition May 2007)
EN55013:2001	Mandatory since 2002
EN55014-1:2006	Applicable since 2005, mandatory since 1-9-2007 (*)
EN55015:2006	Applicable since 2005, mandatory since 1-9-2007 (*)
EN55022:2006	Applicable since 2005, mandatory since 1-9-2007 (*)
EN55025:2008	Applicable since March 2008 3rd edition
EN55022:2008	6th edition makes C-Ave Mandatory above 1 GHz

* Based on date of withdrawal for CISPR 16:1999 and its amendments, from this date on CISPR 16-1-1:2003 (in Europe published as EN 55016-1-1:2004) have to be applied.

CISPR Ave Conclusion

- CISPR Ave available for use (CISPR-16), mandatory for some product standards, applicable for others
- Are you seeing limit lines for C-Ave?
- Covers a fairly small range of signals
- Dwell time requirements lower than QP (i.e. faster)
- Seems most are still using QP below 1 GHz and Peak/Average above 1 GHz
- More to come on Log-Av definition for above 1 GHz use

RMS-Average or CISPR-RMS Detector

RMS-Ave / CISPR RMS Detector

- History

  - QP in 1939 well before any “digital modulations”, no longer the best evaluation

  - Digital modulations have I/Q modulators

  - Examples GMSK, QPSK, QAM, CDMA

- Quality of demodulation measured via

  - Bit error rate (BER) or Block error rate (BLER)

  - Since digital, only bits and packets matter, no voice data until after demod and processing, if at all

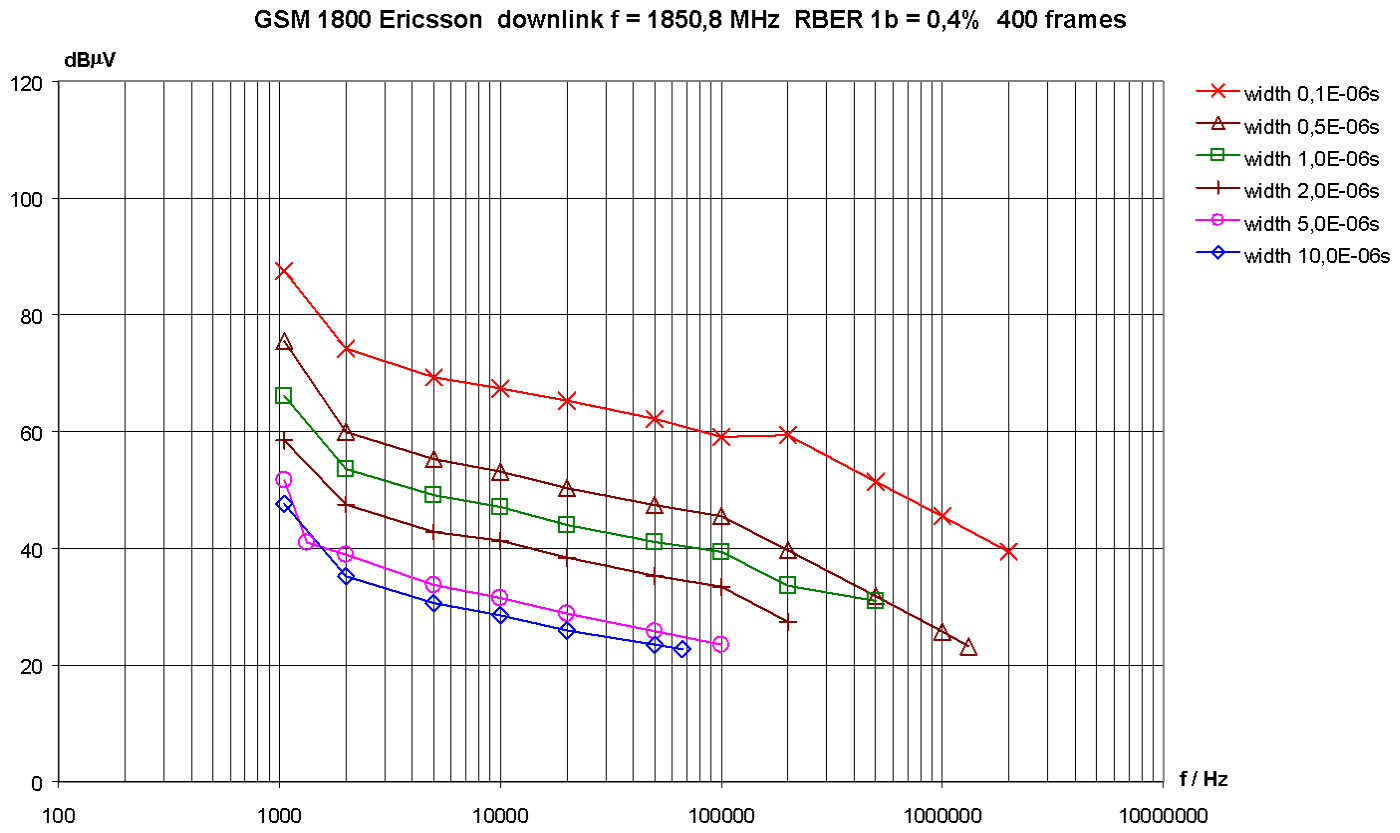
Background for RMS-Ave

Driver for RMS-Ave

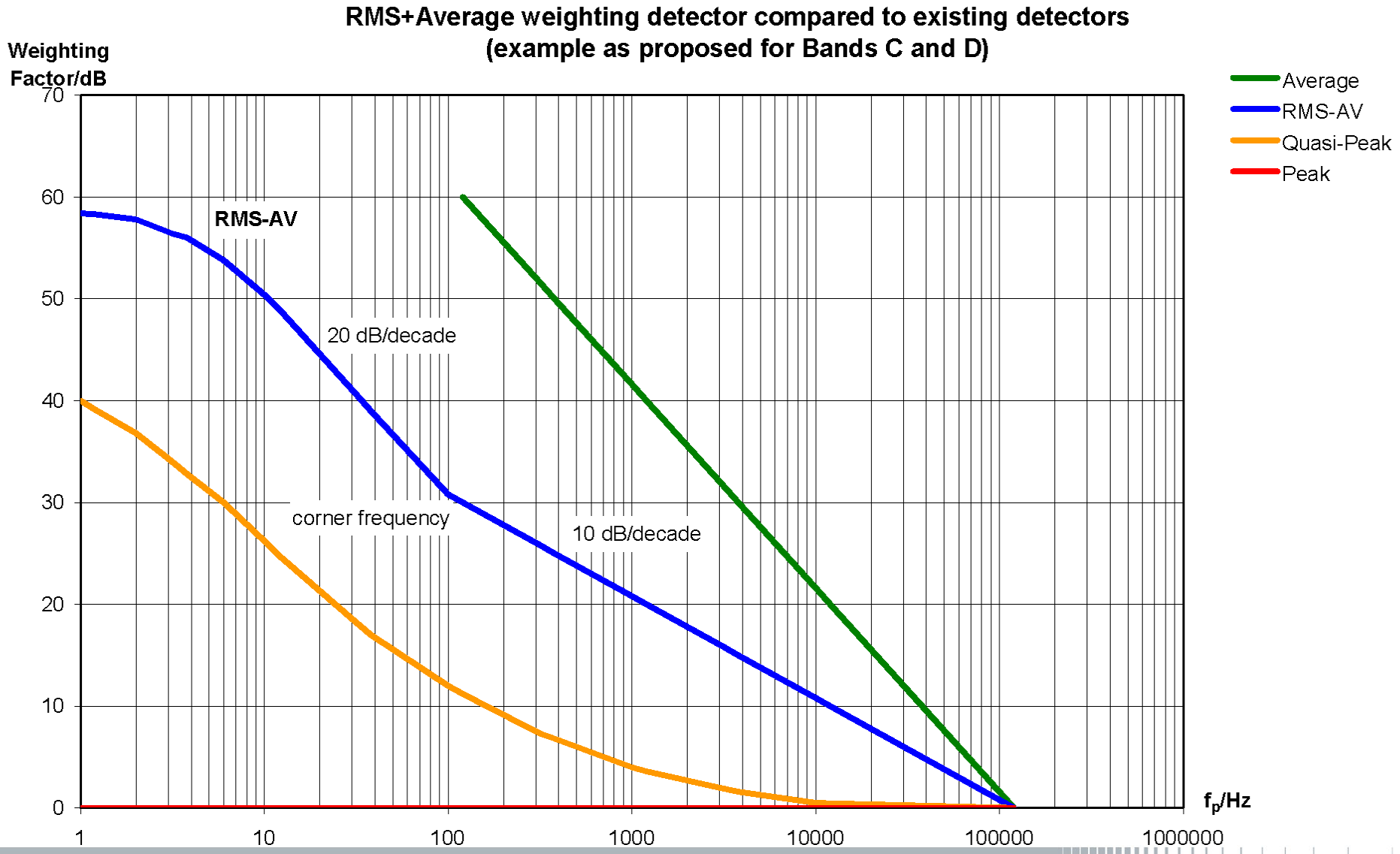
- QP shown to overweight signal's impact on digital demodulators (error correction, processing gains…)
- Linear Average shown to underweight impact
- CISPR evaluated GSM, DECT, CDMA, DVB type radio systems, plotted BER against PRF
- Weighting = PRF dependent conversion (mostly reduction) of a peak-detected impulse voltage level to an indication which corresponds to the interference effect on radio reception

RMS-Ave Weighting

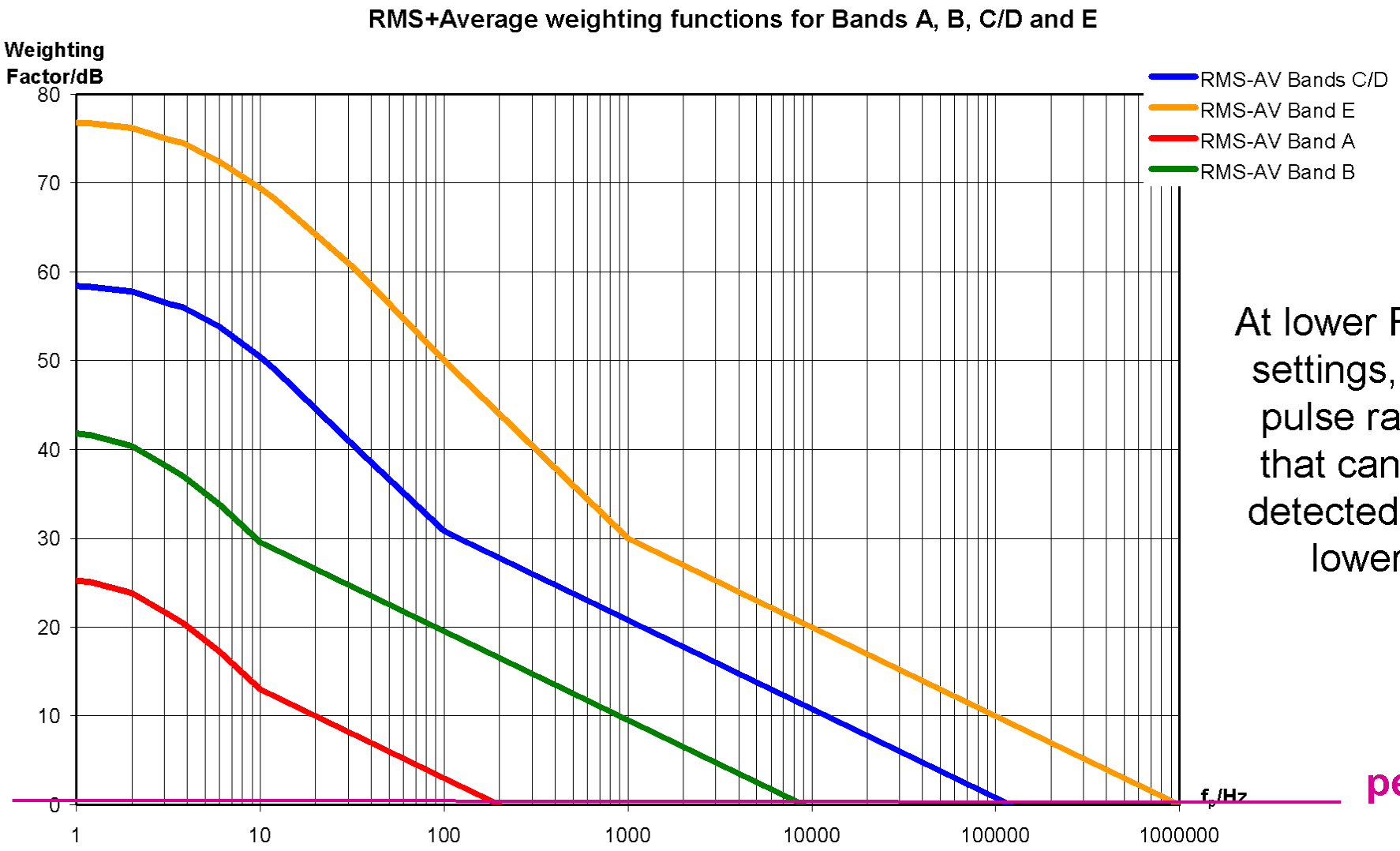
- Effect of impulsive disturbance on GSM radio communication system:
- Weighting characteristic = peak voltage level as a function of PRF and pulse width for a constant effect on a specific radio communication system.



RMS-Ave Comparison



RMS-Ave Compared to Band



At lower RBW settings, the pulse rates that can be detected are lower

RMS-Ave Detector Compare

- RMS-Ave behavior (applicable to continuous disturbances)

  - Unmodulated sinewave signals (CW)

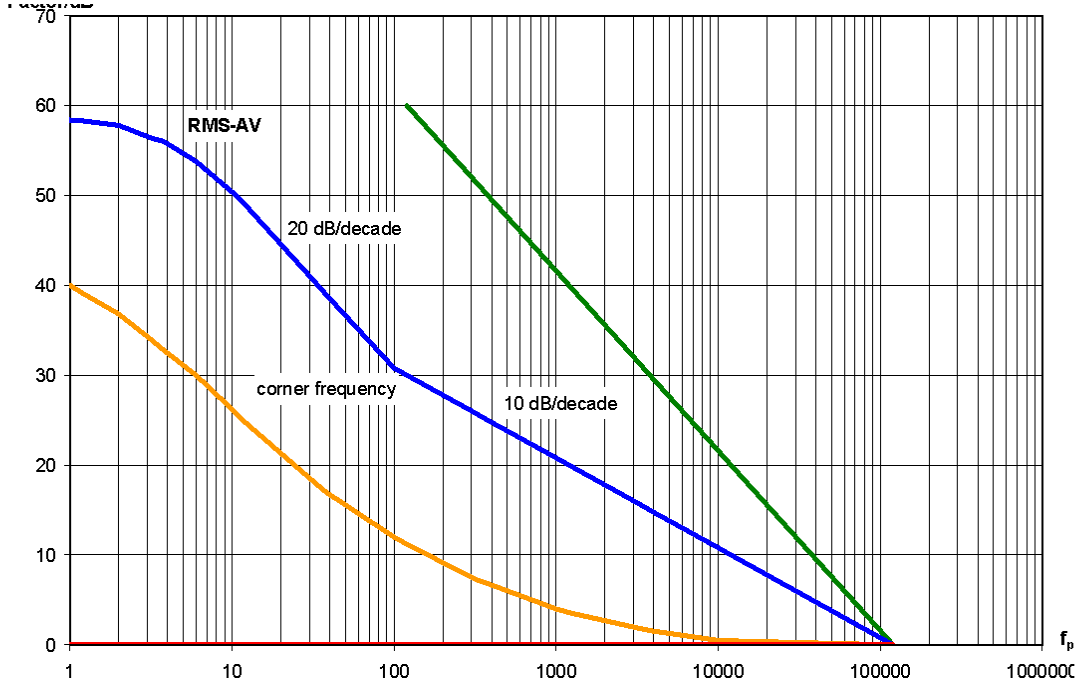
    ⇒ All detectors yield same values

  - Gaussian Noise

    ⇒ ~1dB higher than ave
    ⇒ ~ 6 dB lower than QP
    ⇒ ~10 dB lower than PK

  - Impulsive Noise

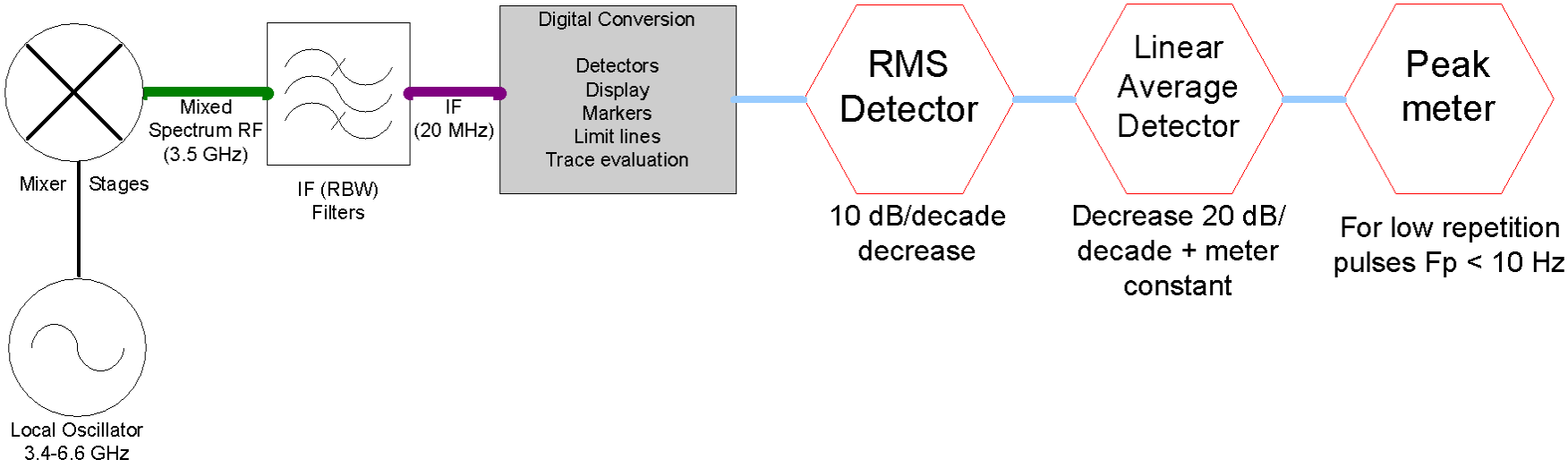
    ⇒ higher than linear Ave
    ⇒ lower than QP and PK



RMS-Ave Construction

- RMS Detector with measurement time equal to the reciprocal of the corner frequency *fc* (e.g. 10 ms for Band C/D)
- Followed by a linear Average Detector with Meter Time Constant (e.g. 100 ms for Band C/D) and Peak Detector

  → for pulse-modulated signals with a PRF lower than the meter time constant the measurement result is not the average!



Standardization Update

Amendment 2:2007 to CISPR 16-1-1:2006 2nd edition

- Provided background material on the definition of the RMS-average weighting detector for measuring receivers
- Existing RMS detector is replaced by new RMS-average detector
- Frequency range 9 kHz to 18 GHz
- Specific definition for overload factor and response to pulses

CISPR/I/261/CDV – New Amd. to CISPR 13 4th Ed.

- Round Robin Tests for several communication systems conducted to prove weighting values
- Introduction of the RMS-average detector as an alternative to quasi-peak and average detector for conducted and radiated emission measurements
- Limit lines for CE proposed at + 4 dB Ave, - 6 compared to QP
- Limit line for RE proposed at same values as current QP line up to 18 GHz for both broadband and narrowband emissions

Conclusion for RMS-Ave

- The RMS-average detector corresponds to the weighting characteristic of digital radio communication systems
- The proposed weighting function for the RMS-average detector was confirmed by the round robin tests
- There is no need to change the detector for measurements above 1 GHz
- Trend is to issue one limit line rather then QP and Ave
- Faster measurements are possible when the RMS-average detector is used instead of the Quasi-peak detector for final measurements

The RMS-average detector will likely become the new standard