
802.3CG EMISSION LIMITS AND PSD MASK

Rosemont, March 5-6th 2018

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802.CG



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Problem Definition

- Emission Limits for entire frequency range of interest not 100% clear
- Analytical method to check proposed transmission waveforms against emission limits is needed
 - To double-check measurements
 - To evaluate tweaks to the transmit waveform faster
- Needed for the draft/standard
 - Definition of transmit PSD (and transmit amplitude) in conjunction with
 - Mode conversion limit curve which
 - Satisfies emission limits with a non-zero margin

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Emission Limits

■ Definitions by OEM

- Deviate only in details from each other

■ For example BMW Group Standard GS95002-02 (2013)

■ Stripline test

■ Stripline Transfer Function

- Only flat between 30MHz and 200MHz (for CM-Termination 25Ω, plateau is -8dB)

- -20dB/dec outside plateau

GS95002-02 2013-07 (Table 8, page 17) - Stripline Limits

Broadcasting						Limit Class AV (rms) in dBμV			
Band	Wavelength		MHz		MHz	3	4	5	RBW/kHz
1	LW		0,15	bis/to	0,28	44	34	24	10
2	MW		0,52	bis/to	1,73	37	29	21	10
3	KW	75m	3,85	bis/to	4	33	27	21	10
4	KW	49m	5,8	bis/to	6,3	33	27	21	10
5	KW	41m	7,1	bis/to	7,6	33	27	21	10
6	KW	31m	9,3	bis/to	10	33	27	21	10
7	KW	25m	11,5	bis/to	12,1	33	27	21	10
8	KW	22m	13,5	bis/to	13,9	33	27	21	10
9	KW	19m	15	bis/to	15,8	33	27	21	10
10	KW	16m	17,4	bis/to	17,9	33	27	21	10
11	KW	15m	18,9	bis/to	19,1	33	27	21	10
12	KW	13m	21,4	bis/to	21,9	33	27	21	10
13	KW	11m	25,6	bis/to	26,1	33	27	21	10
14	UKW		76	bis/to	108	18	12	6	120

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Emission Limits

■ Definitions by OEM

- Deviate only in details from each other

■ For example BMW Group Standard GS95002-02 (2013)

■ Capacitive Coupler test

- GS defines to mathematically remove all attenuation in measurement setup from measured values
→ Transfer Function is 0dB

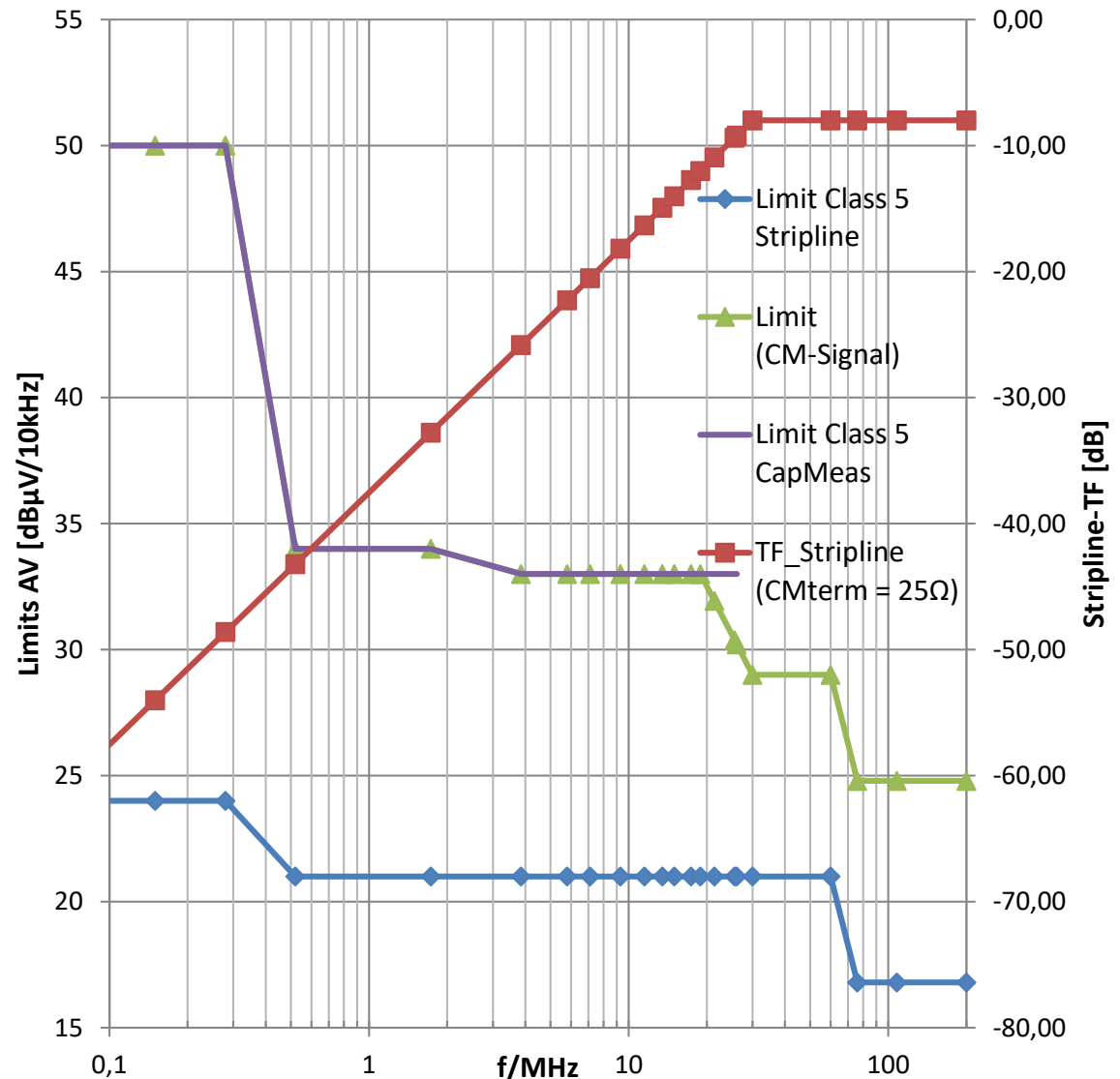
GS95002-02 2013-07 (Table 6, page 15) - Capacitive Voltage Measurement

Broadcasting		Limit Class AV (rms) in dBμV							
Band	Wavelength	MHz	MHz	3	4	5	RBW/kHz		
1	LW	0,15	bis/to 0,28	70	60	50	10		
2	MW	0,52	bis/to 1,73	50	42	34	10		
3	KW	75m	3,85	bis/to 4	45	39	33	10	
4	KW	49m	5,8	bis/to 6,3	45	39	33	10	
5	KW	41m	7,1	bis/to 7,6	45	39	33	10	
6	KW	31m	9,3	bis/to 10	45	39	33	10	
7	KW	25m	11,5	bis/to 12,1	45	39	33	10	
8	KW	22m	13,5	bis/to 13,9	45	39	33	10	
9	KW	19m	15	bis/to 15,8	45	39	33	10	
10	KW	16m	17,4	bis/to 17,9	45	39	33	10	
11	KW	15m	18,9	bis/to 19,1	45	39	33	10	
12	KW	13m	21,4	bis/to 21,9	45	39	33	10	
13	KW	11m	25,6	bis/to 26,1	45	39	33	10	

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Emission Limits

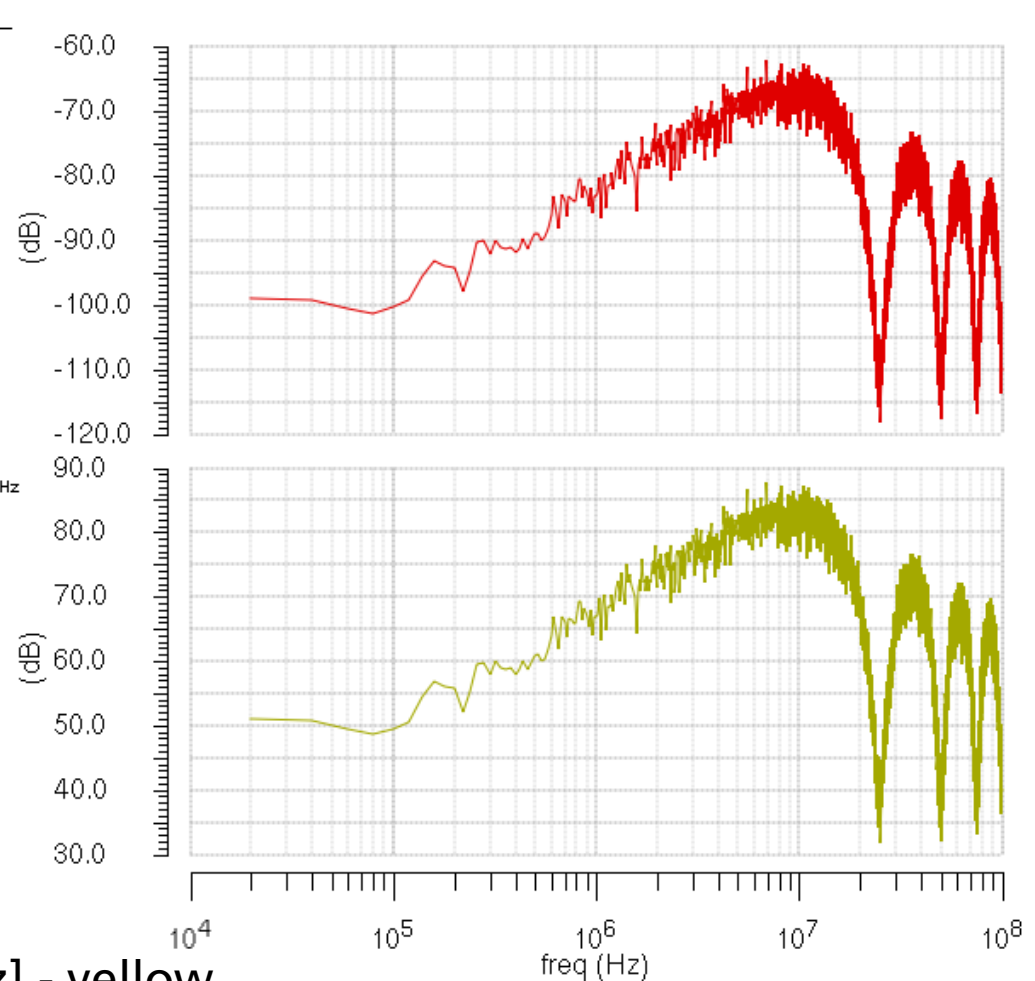
- Both tests apply
 - Capacitive Coupler limits directly as limits on CM
 - Stripline limits converted to CM via transfer function
- Resulting limit is minimum of both curves (green line)
 - Below 20MHz -> capacitive coupler
 - Above 20MHz -> stripline
- Stripline Band 14
 - RBW: 120kHz → 10kHz
 - Limit 10.79dB higher



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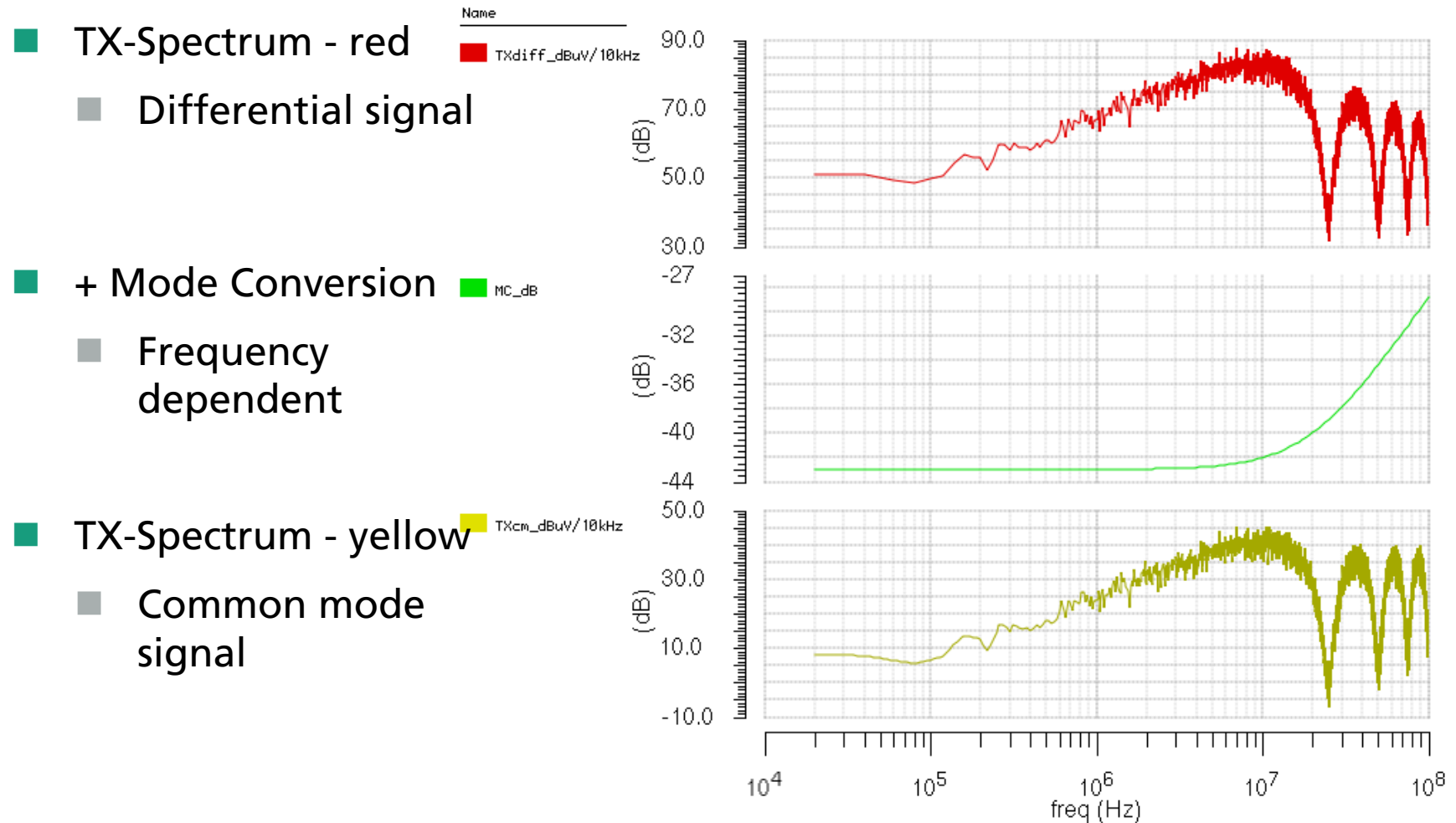
Transient TX Waveform to Emission Spectrum

- PSD [dBm/Hz] - red
 - Transient signal: PRBS11, 4b5b, scrambler, DME
 - $200\mu\text{s} - 2500 \cdot T_{\text{sym}}$
 - 2^{14} point DFT
 - 20kHz step
- dBm \rightarrow dB μ V: +110dB
 - $\text{dB}\mu\text{V} = \text{dBm} + 10\log(Z) + 90$
 - $Z = 100\Omega$
- ../Hz \rightarrow ../10kHz: +40dB
 - $+ 10 \cdot \log_{10}(10\text{k})$
 - TX- Spetrum [dB μ V/10kHz] - yellow



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Transient TX Waveform to Emission Spectrum



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TX PSD & Emission Spectrum – 1Vpp - MC: 43dB 20MHz

Transmit PSD

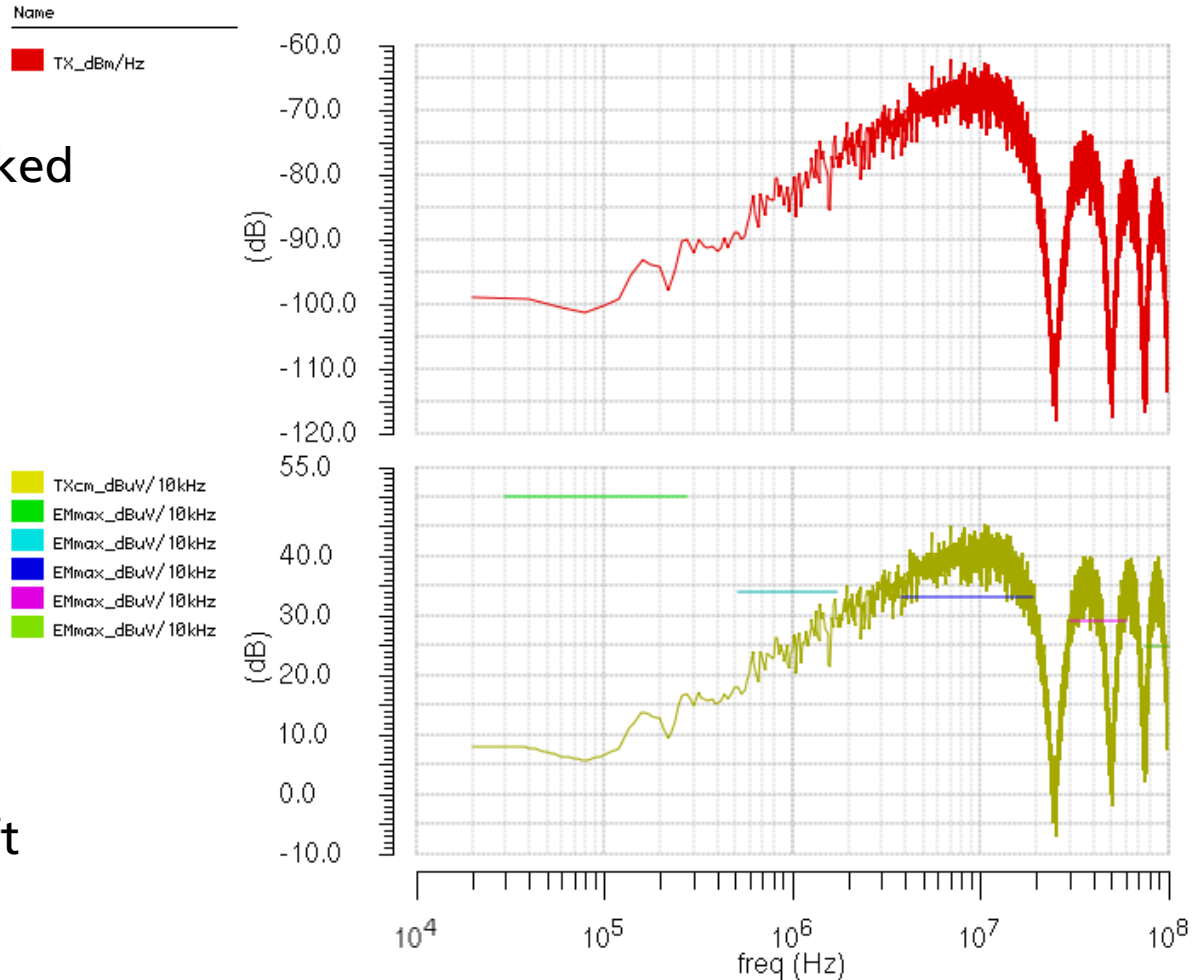
- Freq-domain integration checked vs. Time-domain integration ✓

- Level consistent with other presentations

Emissions

- Strong violations

- → Parameter combination of draft 1.1 is not feasible



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TX PSD & Emission Spectrum – 0.4Vpp - MC: 46dB 25MHz

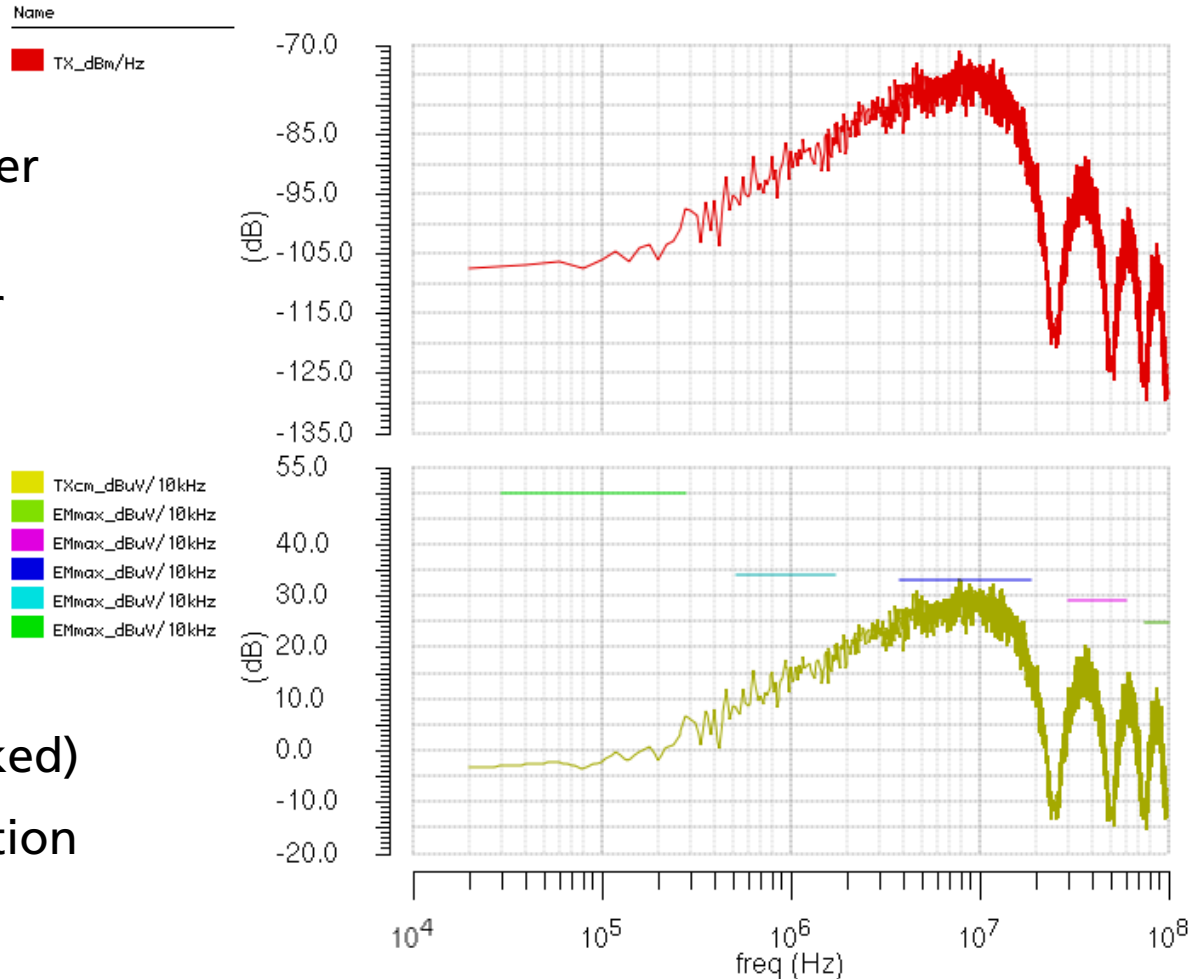
Transmit PSD

- About -8dB because of smaller amplitude
- TX uses 1st order low pass
 $f_{-3dB} = 15\text{MHz}$

Emissions

- Zero margin (tiny violation, other patterns need to be checked)

- Parameter combination much more feasible



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Emission Limits and PSD mask

Conclusions

- 10SPE waveform has signal components in frequency range, where both capacitive coupler and stripline test apply for emissions
 - Transfer function stripline is well understood
 - Transfer function capacitive coupler is based on BMW GS text
- Parameter combination
Emission limits & Mode Conversion & TX PSD mask/amplitude
needs an overhaul