DOE with COM parameters for ~30 dB Channels

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Motivation

- 0.5 dB out of a channel budget is unacceptable to some system and interconnect providers
- 0.5 dB out of a silicon budget is unacceptable to some chip manufactures
- More complex COM computations are considered unacceptable by some folks
- How should a specification address manufacturing and environmental impact?
  - Should margin include the “worst of the worst”

An Approach to Lend Some Light on the Problem

A DOE experiment

- ❑ Define an experiment which spans all COM parameters within reasonable limits
- ❑ Determine relative impact
- ❑ Use data to facilitate margin discussions
- ❑ 2 channel near 3dB COM used (so far)
  - Channel 1: Mellitz PAM4_2conn_MP_v2_85ohm_30dB_LzHzLz_thru
    - http://www.ieee802.org/3/50G/public/channel/mellitz_01_021716_30dB_6_channels.zip
  - Channel 2: Dudek 30dB_HighZ_thru.s4p
    - http://www.ieee802.org/3/cd/public/channel/Cavium_30dB_HghZ_Nom_HighZ.zip
- ❑ More are in the queue

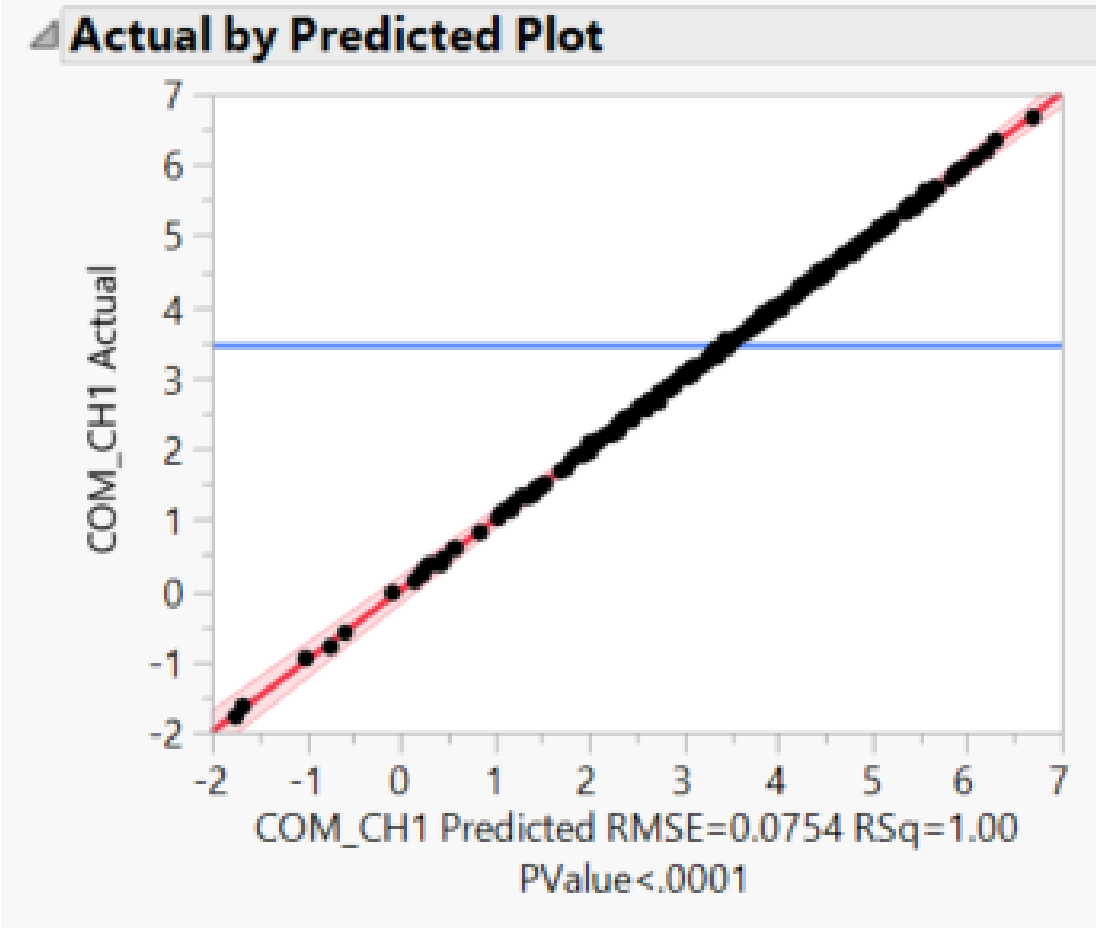
DOE Parameters and Ranges

- A good DOE extends parameters slightly outside the a ranges of consideration
- The idea is to create single equation which relates COM to these parameters
  - The single equation is a 2nd order mean square fit to a collection of COM computations with parameter values designed for good fitting.
    - I.e. the fit variance is small over the parameter ranges
  - X values are COM parameters and Y values are the computed COM

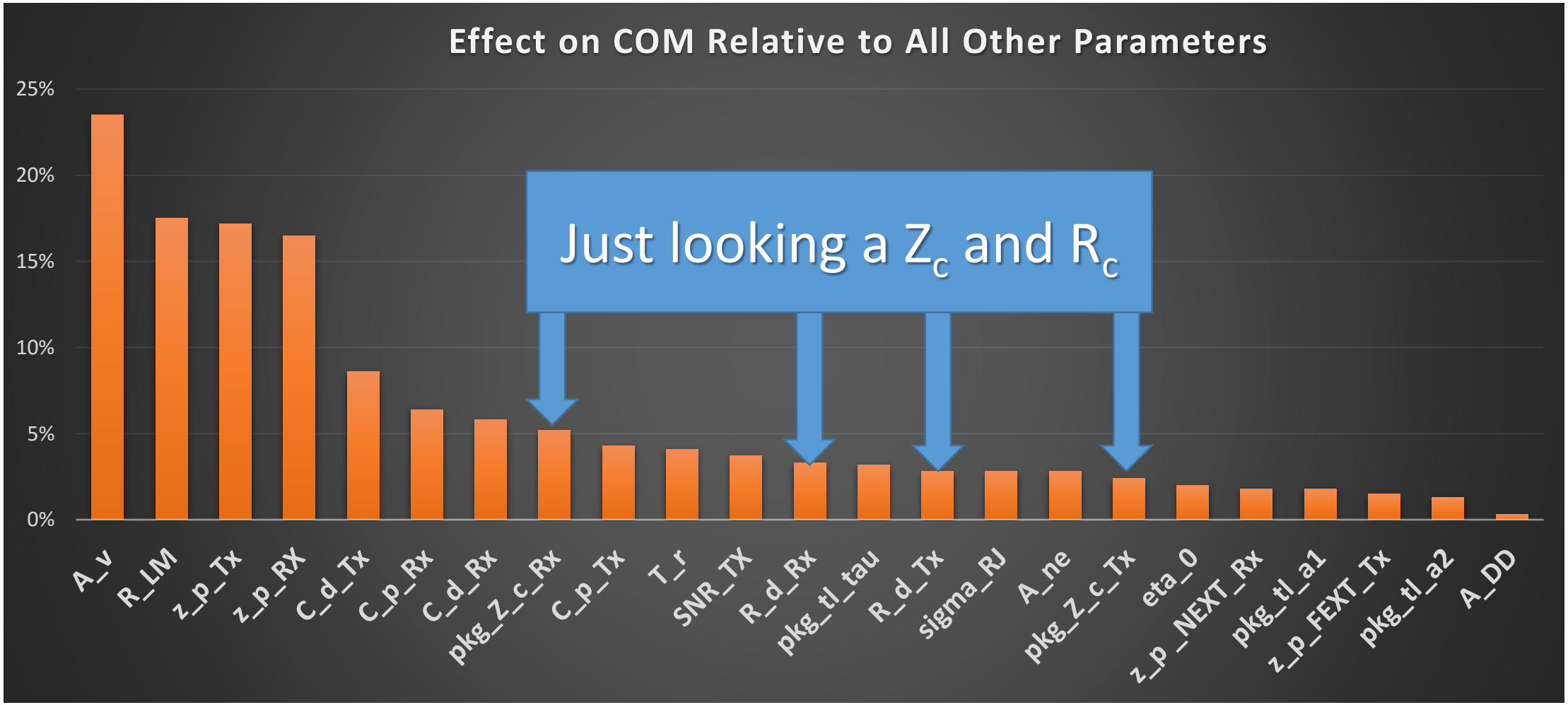
X values are COM parameters which are used to generate 306 carefully chosen runs

Parameter	DOE Min	DOE Max	COM D1.3
z_p_Tx	10	45	30
z_p _NEXT_Rx	10	45	12
z_p_FEXT_Tx	10	45	30
z_p_RX	10	45	30
C_p_Tx	0.08	0.28	0.18
C_p_Rx	0.08	0.28	0.18
C_d_Tx	0.05	0.25	0.11
C_d_Rx	0.05	0.25	0.11
R_d_Tx	42	58	55
R_d_Rx	42	58	55
A_v	0.4	0.65	0.4
A_fe	A_v	A_v	0.4
A_ne	0.4	0.65	0.6
sigma_RJ	0.0085	0.0115	0.01
A_DD	0.017	0.023	0.02
eta_0	1.312E-08	1.968E-08	1.64E-08
SNR_TX	31	34	32.5
R_LM	0.89	0.98	0.95
T_r	0.01	0.014	0.012
package_tl_gamma0_a1_a2			[0 1.734e-3 1.455e-4]
pkg_tl_a1	0.0013872	0.0020808	0.001734
pkg_tl_a2	0.0001164	0.0001746	0.0001455
pkg_tl_tau	0.0049128	0.0073692	0.006141
pkg_Z_c_Tx	80	100	90
pkg_Z_c_Rx	80	100	90

Fit R^2 is good and RMSE in COM dB 0.075 dB

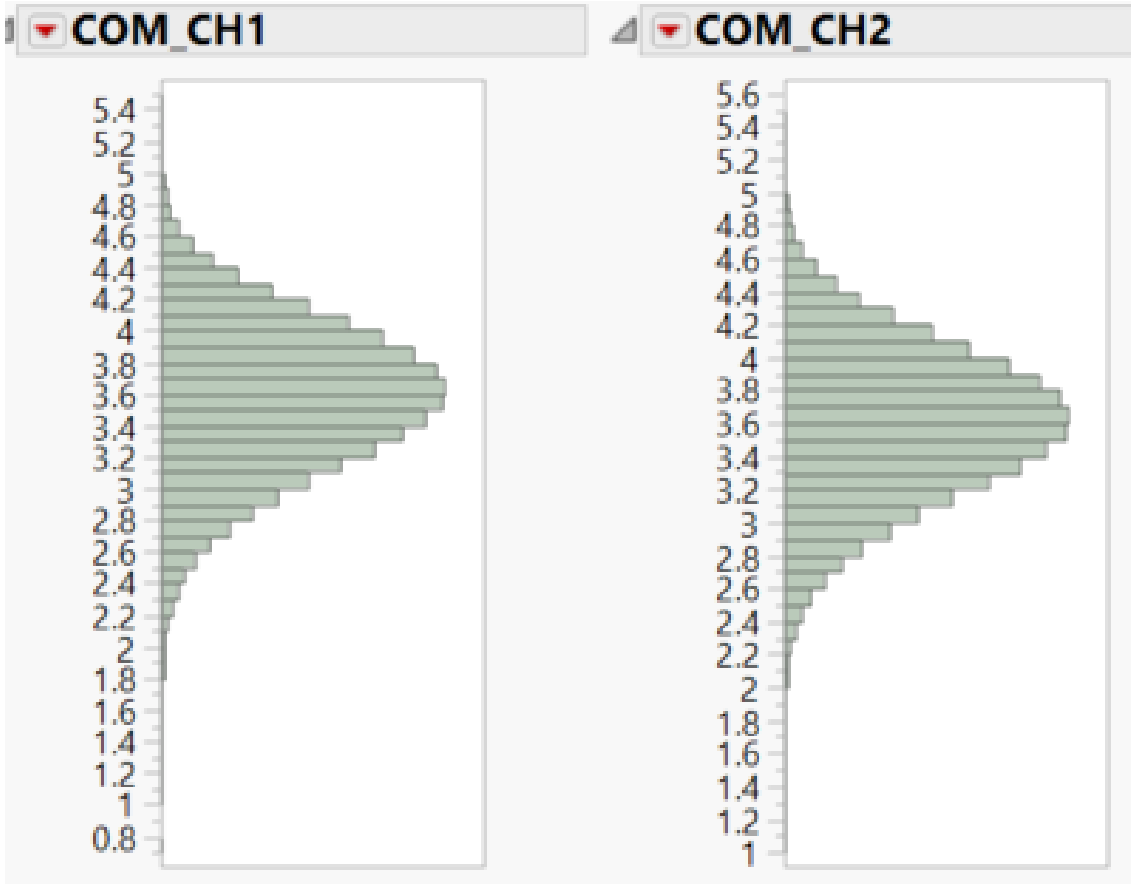


Parameter impact suggest Z_c and R_d are not the largest contributors



Food for thought: One example of variations with over 1 million instances for the 2 channels

COM dB



probability

Discussion

- Is Rd and Zc sufficient for parameter impact assessment?
- Is 0.5 dB is not enough given all the variability?
- Can return loss be adjusted to limit variation? (mellitz_3cd_02_060717_elect_adhoc)
- Any other comments on parametric variation.