CA ERL: COMMENT #103

Bruce Champion, TE

Overview

Table 162–16—Cable assembly characteristics summary

Description	Reference	Value	Unit
Maximum insertion loss at 26.56 GHz	162.11.2	19.75	dB
Minimum insertion loss at 26.56 GHz	162.11.2	11	dB
Minimum cable assembly ERL[a]	162.11.3	TBD	dB
Differential to common-mode return loss	162.11.4	Equation (162–9)	dB
Differential to common-mode conversion loss	162.11.5	Equation (162–10)	dB
Common-mode to common-mode return loss	162.11.6	Equation (162–11)	dB
Minimum COM	162.11.7	3	dB

[a]Cable assemblies with a COM greater than 4 dB are not required to meet minimum ERL.

Cl **162** *SC* **162.11** *P* **163** *L* **18** # 103

Champion, Bruce — TE Connectivity

Comment Type **T** *Comment Status* **X**

Cable Assembly ERL listed as TBD in Table 162-16

SuggestedRemedy

TBD to be changed to 7.4 dB. See champion_3ck_02_1020.pdf

Proposed Response *Response Status* **O**

Cl **162** *SC* **162.11** *P* **163** *L* **18** # 94

Haser, Alex — Molex

Comment Type **TR** *Comment Status* **X**

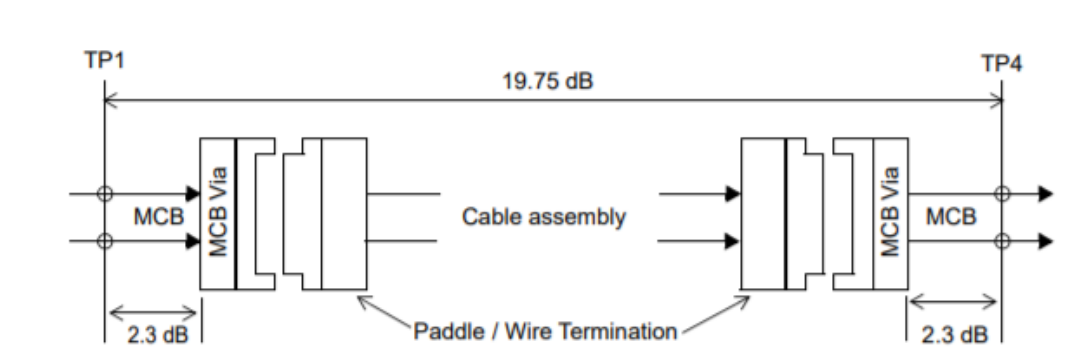
Fill in TBD for CA ERL limit

SuggestedRemedy

Replace TBD with 7.4 dB based on champion_3ck_02_1020.pdf slide 6

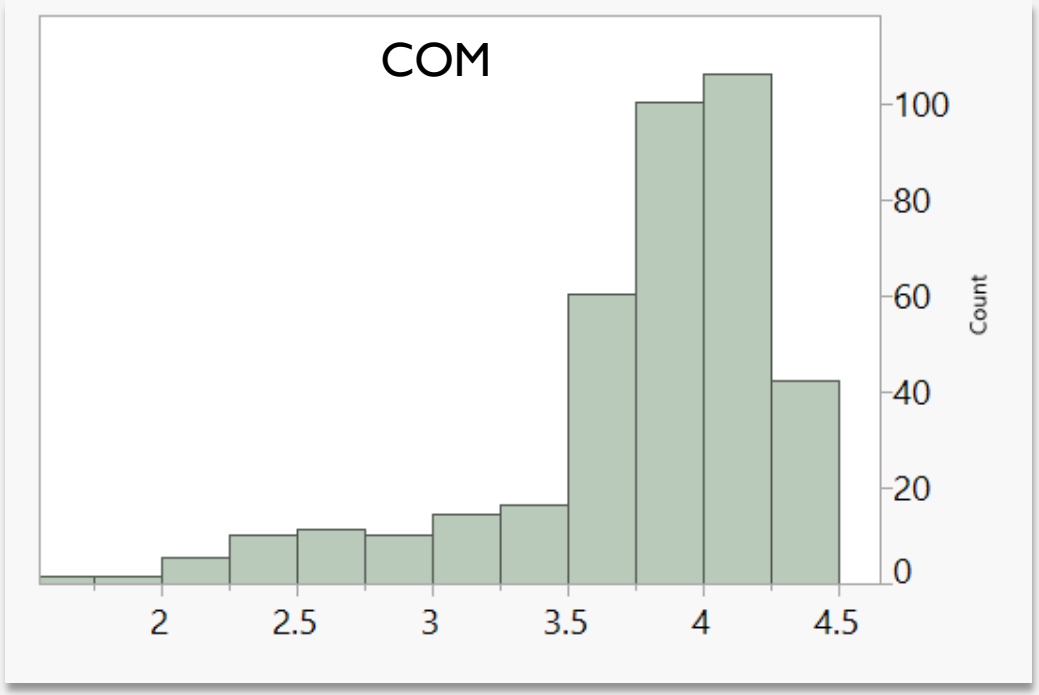
Proposed Response *Response Status* **O**

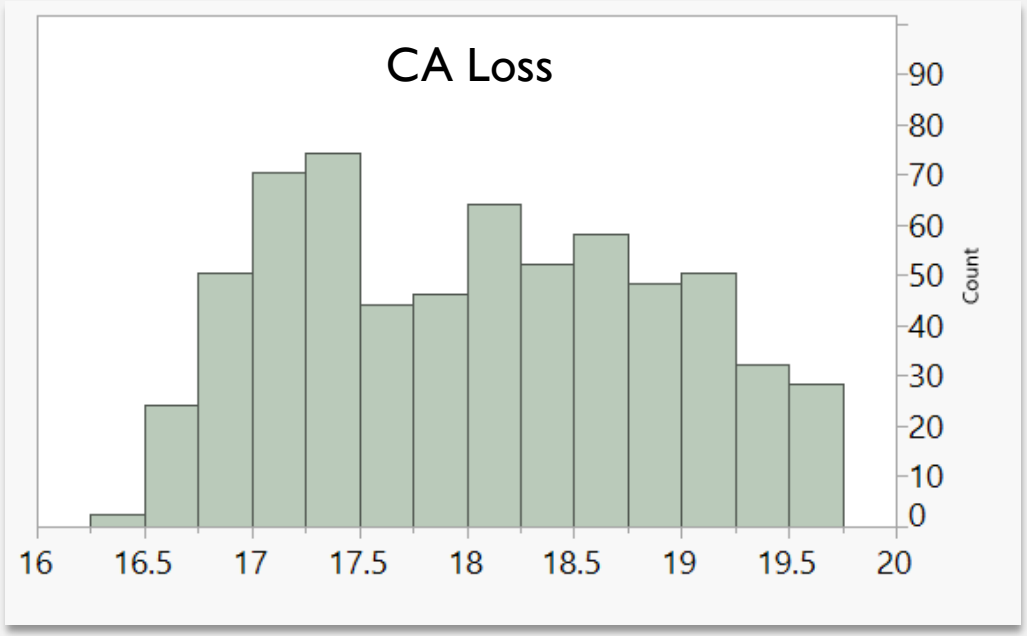
- 376 measured OSFP channels analyzed
  - Data measured to 50 GHz
  - Taken from Tp1-Tp4

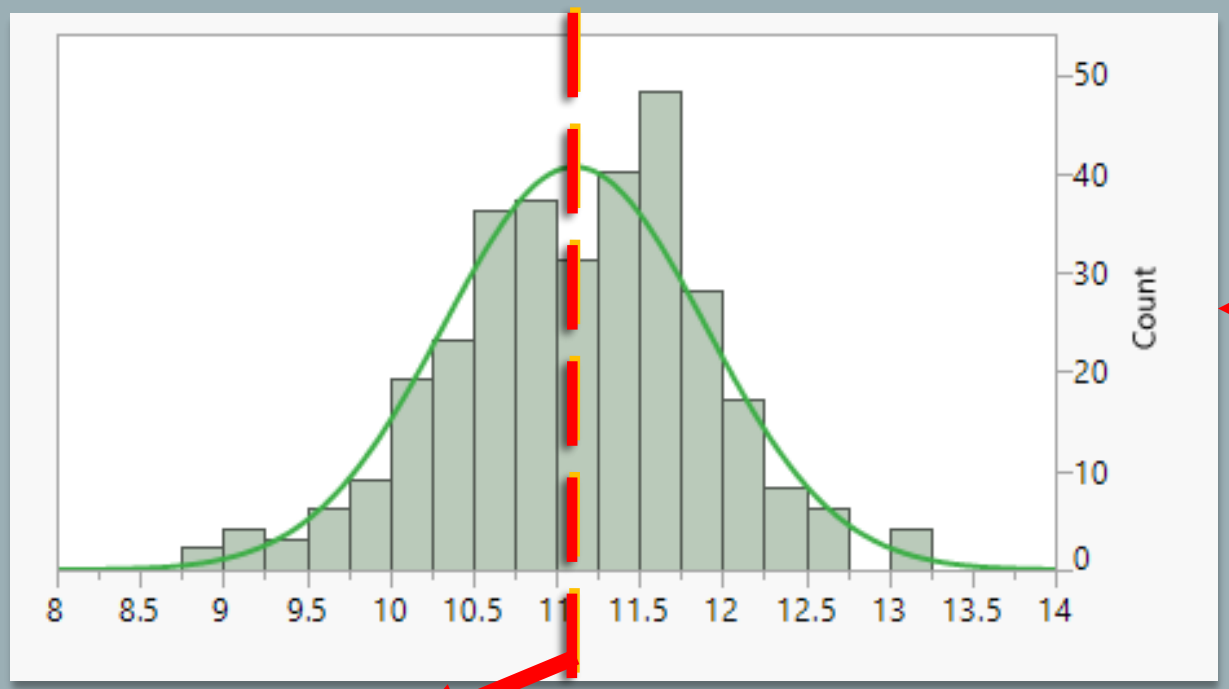


- All channel pass:
  - IL
  - Diff-to-Common RL
  - Diff-to-Common conversion loss
  - Common-to-Common RL

- Some lanes fail COM
  - Reasoning will be shown on later slides



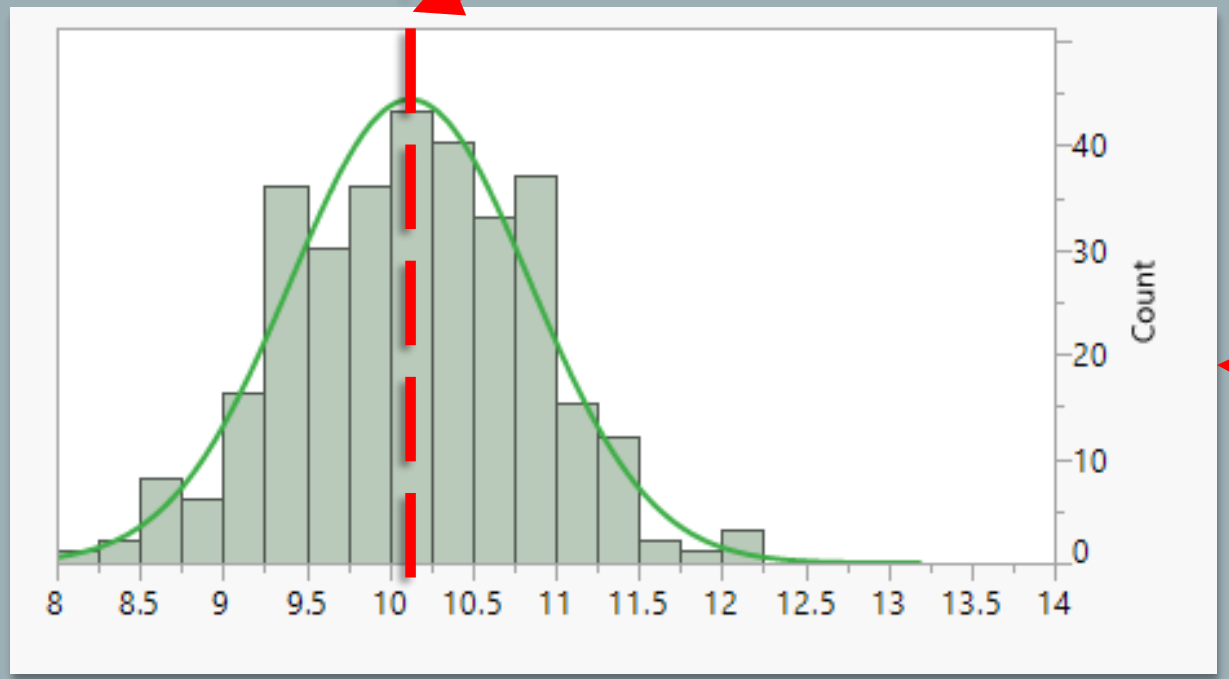




- The way we calculate ERL was modified between COM version 2.93 and 2.95
- This resulted in a reduced ERL value

The way we calculated ERL in version 2.93

The same exact channels ran through 2.95 version



The way we calculate ERL in version 2.95

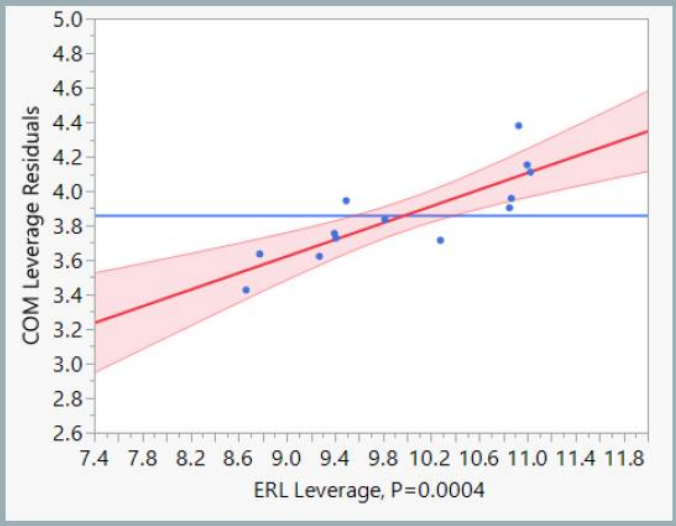
ERL Values are lowered by 1 dB!

- Data presented champion_3ck_02_1020.pdf recommending ERL of 7.4
- Limited data points were included in this presentation
- At the time it was requested that we need more data
- More data was collected and is shown on next slide

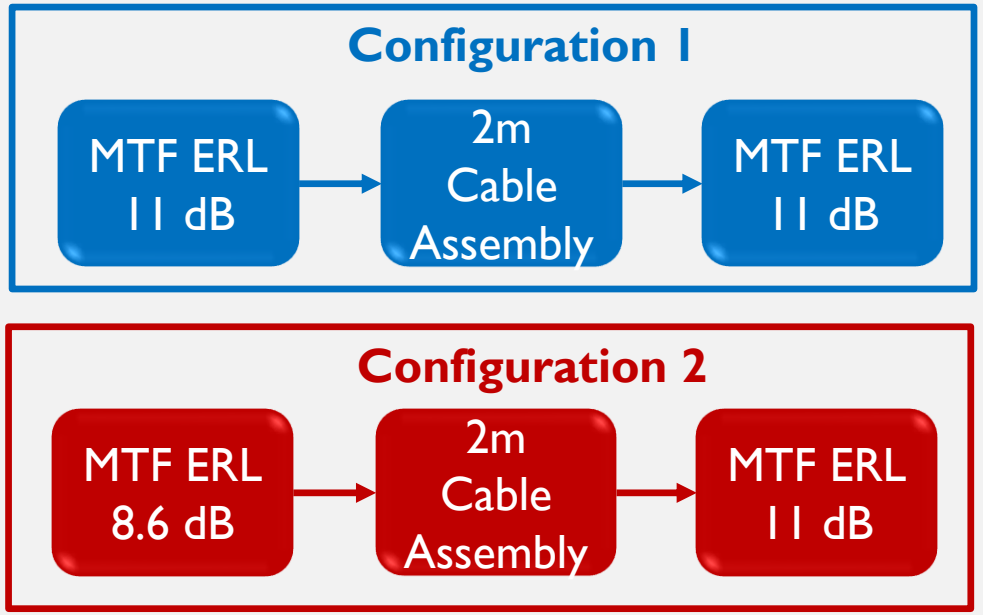
Slide from champion_3ck_02_1020.pdf

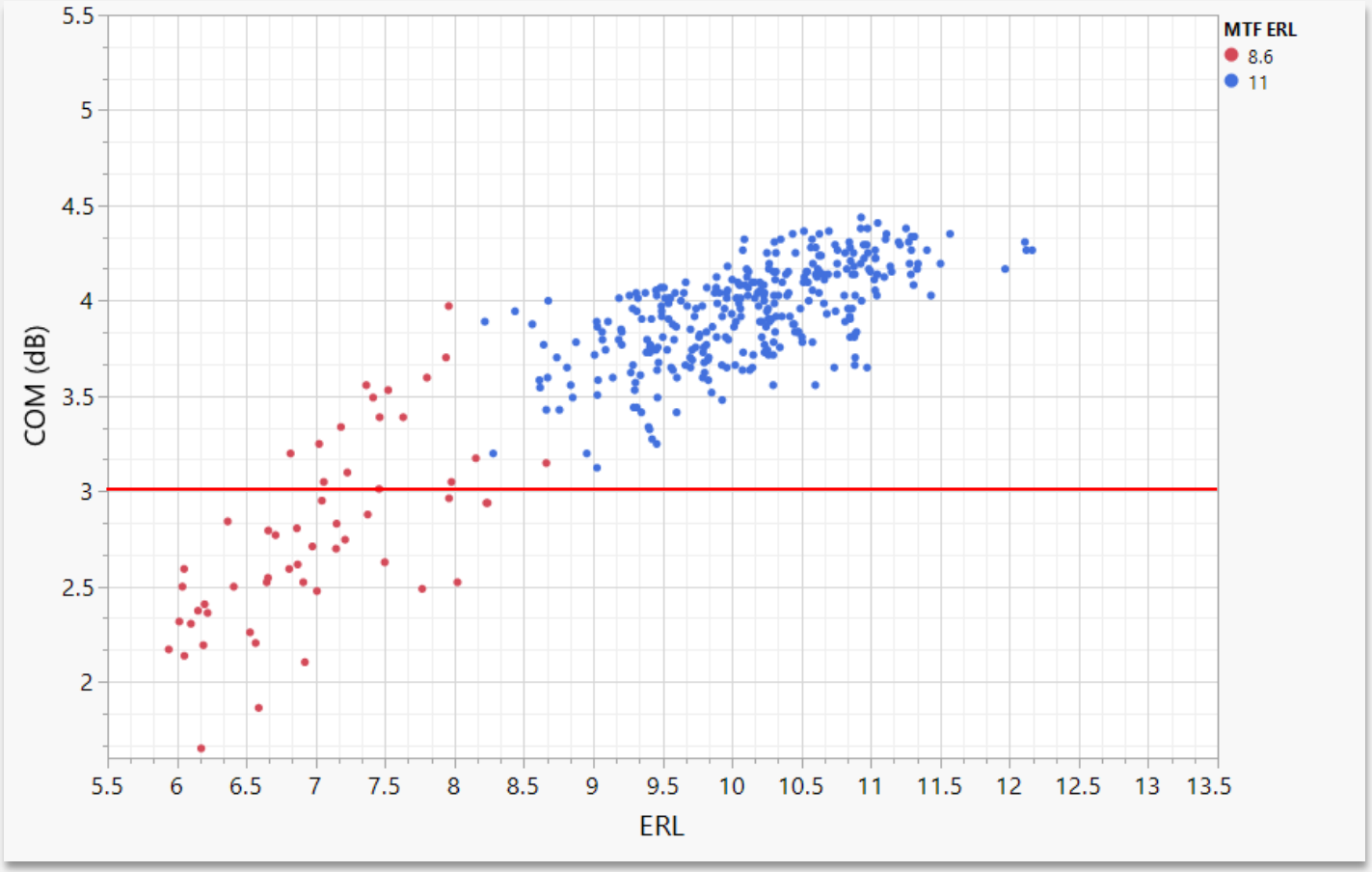
Proposed Limit

- Same13 channels from previous slide used
- Relationship between ERL and COM observed
- The linear fit of data is showing:
  - COM = 3 dB at ERL = 6.4 dB
- Looking at the confidence interval:
  - COM = 3 dB at ERL ≈ 7.4 dB
  - Using this data, a limit of 7.4 dB for ERL is proposed



- To fill in plot two different MCBs were used
- Configurations shown below





- A MTF ERL of 8.6 dB is below most recommendations and will most likely not be in the specification
  - Most recommendations are in the 10 dB range
- If a MTF with ERL of 10dB is used, it is reasonable to assume the results will lie somewhere between the 8.6 dB ERL MTF and 11 dB MTF ERL
- Next slide reviews how we look at this data to determine best balance between ERL and COM
  - We don't want to fail assemblies for ERL that have passing COM (False Negative)
  - We don't want to pass assemblies for ERL that show consistently failing COM values (False Positive)

- We don't know what ERL value breaks a system
- COM is our best indicator to date of whether a channel will work
- We can statistically correlate ERL to COM

To determine where ERL limit should be

- ERL limit is varied from 6.5 to 10 dB in 0.5 dB increments
- Confusion matrix created to count TP, TN, FN, FP instances for various ERL limits

- Precision minimizes False Positives
- Recall minimizes False Negatives
- F1 Score combines Precision and Recall to get the best balance between the two

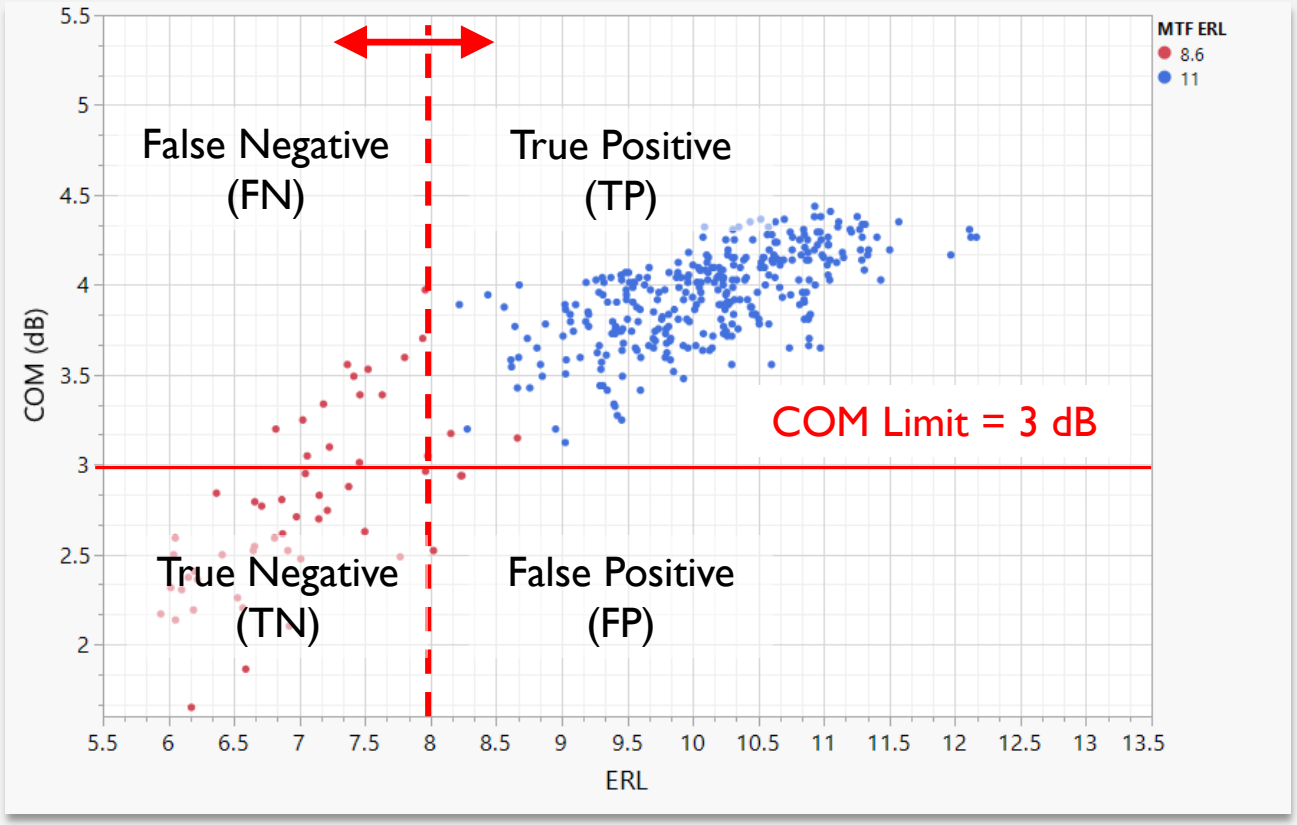
$$Precision = \frac{TP}{TP + FP}$$

$$Recall = \frac{TP}{TP + FN}$$

$$F1 = \frac{2 * Precision * Recall}{Precision + Recall}$$

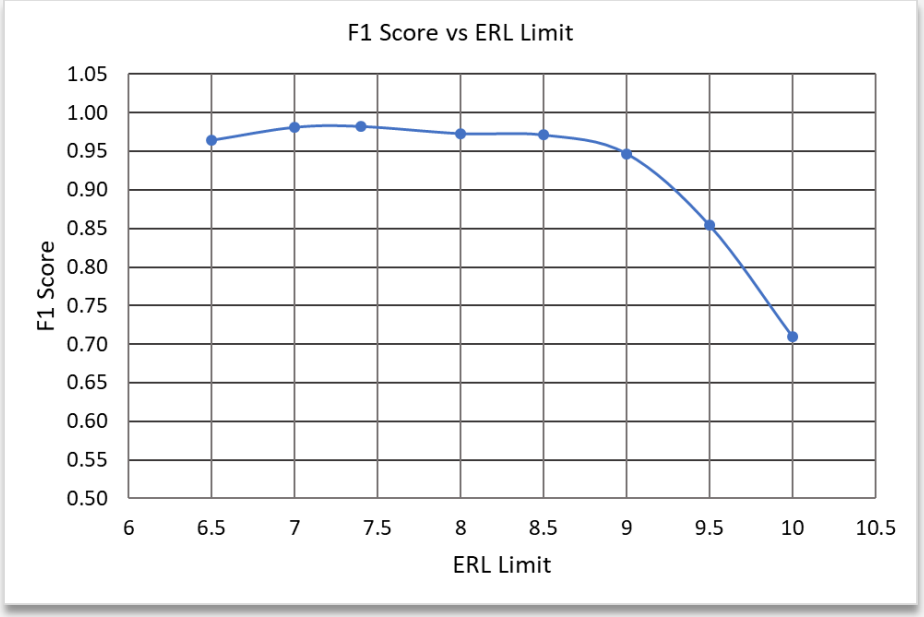
- We don't want to fail assemblies for ERL that have passing COM (False Negative)
- We don't want to pass assemblies for ERL that show consistently failing COM values (False Positive)

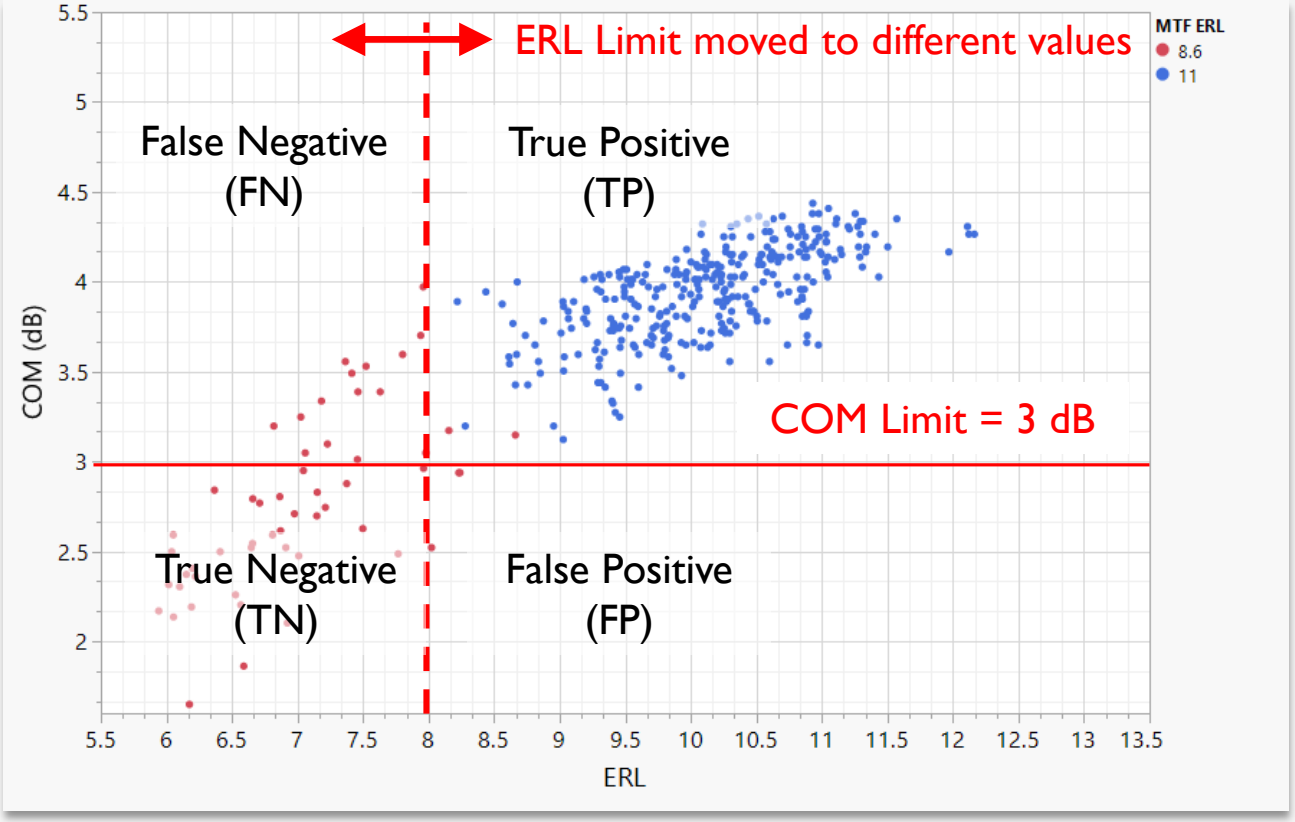
ERL Limit moved to different values



- The data was broken up into a confusion matrix using varying CA ERL Limits
- The higher the F1 score the better balance between recall (False Negatives) and precision (False Positives)

ERL Limit	6.5	7	7.4	8	8.5	9	9.5	10
True Positive	338	337	332	323	319	304	252	186
True Negative	13	26	32	35	38	38	38	38
False Positive	25	12	6	3	0	0	0	0
False Negative	0	1	6	15	19	34	86	152
Precision	0.931	0.966	0.982	0.991	1.000	1.000	1.000	1.000
Recall	1.000	0.997	0.982	0.956	0.944	0.899	0.746	0.550
F1 Score	**0.964**	**0.981**	**0.982**	**0.973**	**0.971**	**0.947**	**0.854**	**0.710**





- All of the data shown here is actual measurement data taken on 2m OSFP Assemblies
- Higher CA ERL limits show a dramatic drop in the F1 score
- Data is showing an optimal CA ERL in the 7.4 dB range
  - Achieves balance between COM and ERL
- Other MDIs such as QSFP-DD have not been taken into consideration for this study

Questions