MTF OSFP 1.6T Connector #1 Full Crosstalk Data and Remeasured Through

Kevin Mammenga
Wilder Technologies

Intent

- The purpose of this presentation is to share the remeasured data of the mated test fixture that uses connector #1 previously shown in mammenga_3dj_adhoc_01_25121. An additional purpose is to share a full set of crosstalk data for this specific mated test fixture.

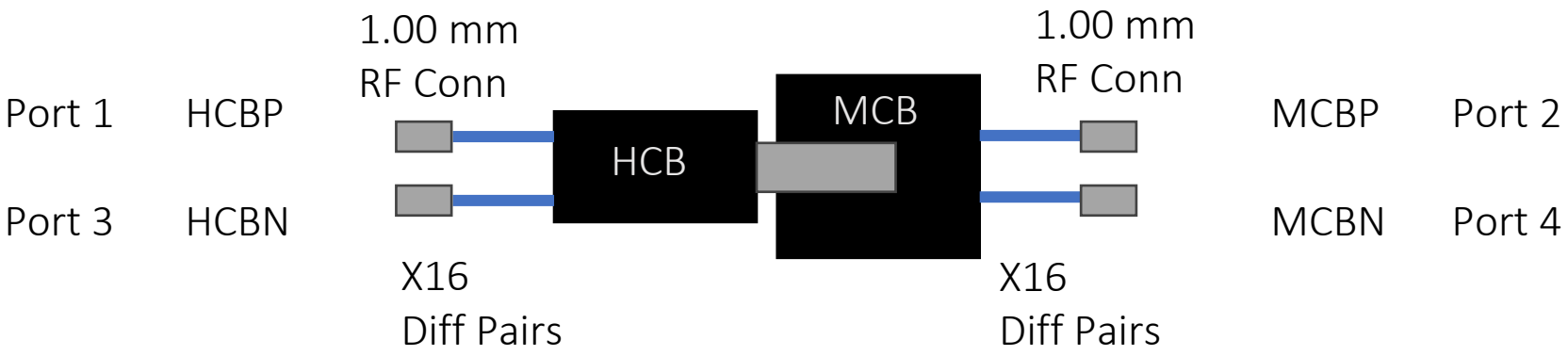
Mated Test Fixture (MTF) Through Setup

Only Wilder Technologies test fixtures are used.

VNA Information:

Keysight 110 GHz VNA using Port Extenders, 1.00 mm cable (300 mm)
IFBW = 1 kHz
Frequency Start: 10 MHz
Frequency Stop: 110 GHz
Frequency Step: 10 MHz

OSFP 1.6T MTF using Connector #1



MTF Files in Data Package

MTF using Connector #1
QTY 16 MTF files measured to 110 GHz
QTY 16 MTF files truncated to 67 GHz

OSFP1p6T_Mated_File_HCB-WT32954_MCB-OCONN1_RX1.s4p

Form Factor | Config | HCB Name | MCB Name | Diff Pair | 4-port touchstone format

File Header

```
!Wilder-Technologies
!FILE: OSFP1p6T_Mated_File_HCB-WT32954_MCB-OCONN1_RX1.s4p
!OSFP1p6T HCB/MCB
!Port1=HCB Coax Connector P
!Port3=HCB Coax Connector N
!Port2=MCB Coax Connector P
!Port4=MCB Coax Connector N
# HZ S  RI   R 50
```

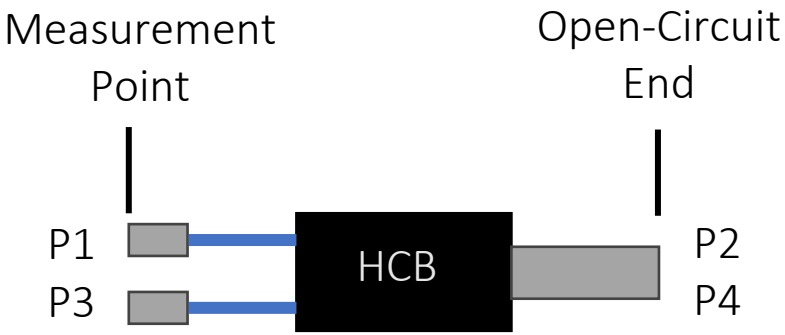
All touchstone files are not renormalized and remain at 50-ohm port impedance.

All plots are renormalized to 46.25-ohm port impedance.

Characterization Files in Data Package

OSFP 1.6T HCB

QTY 16 1x Through Characterization File, HCB from MTF Conn #1

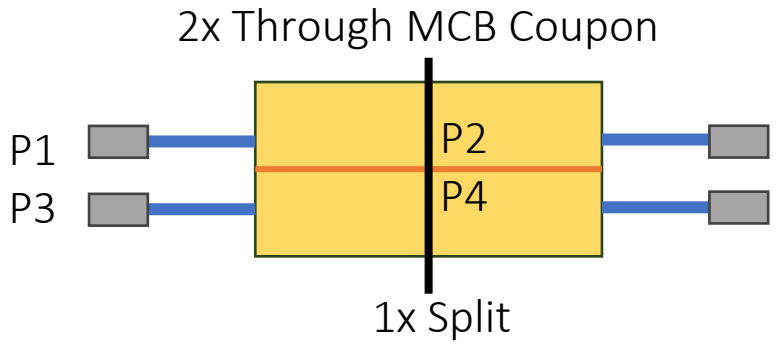


The 1x through characterization files are extracted from the exact HCB used in the mated measurement. 1x throughs are generated from the open-circuit measurement of each differential pair. The edge card fingers are included.

Average Differential Insertion Loss (53.125 GHz) = 3.59 dB

OSFP 1.6T MCB

QTY 1 1x Through Characterization File



(MDI, MDI Pads, and vias are not included)

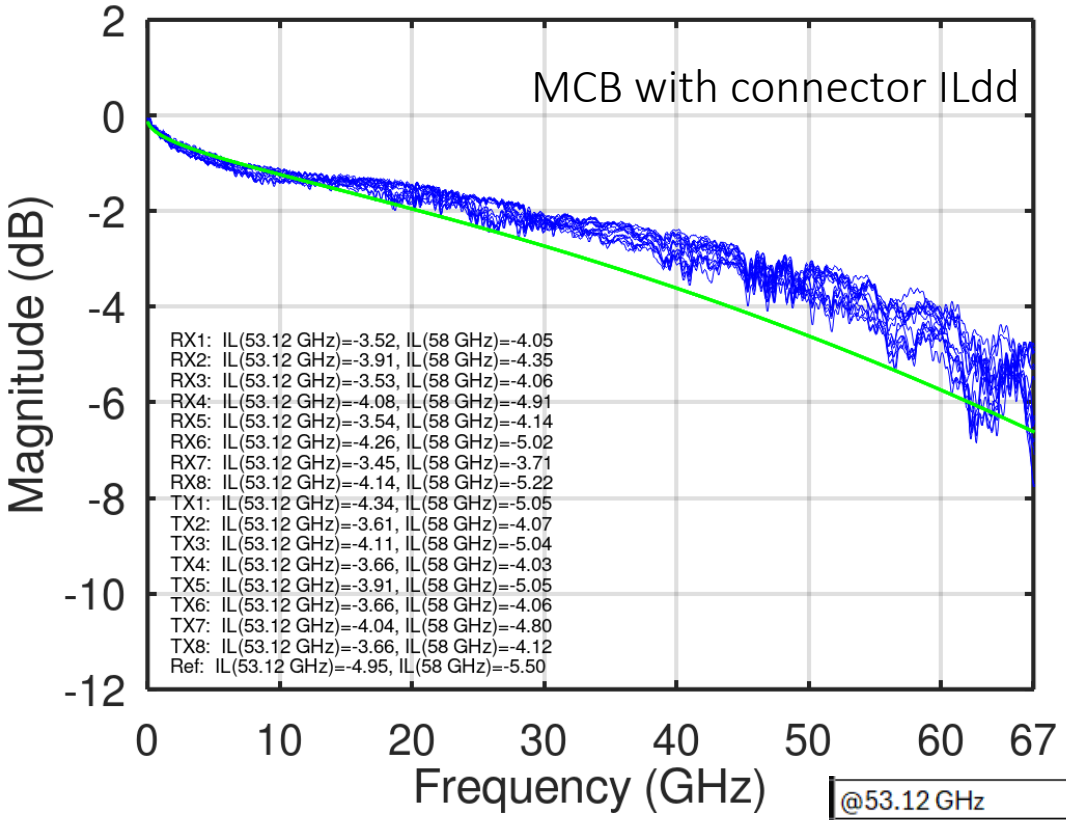
The 1x through characterization file is extracted from a 2x through MCB coupon measurement. It is not extracted from the exact MCB in the MTF measurement, but it is a representation of it.

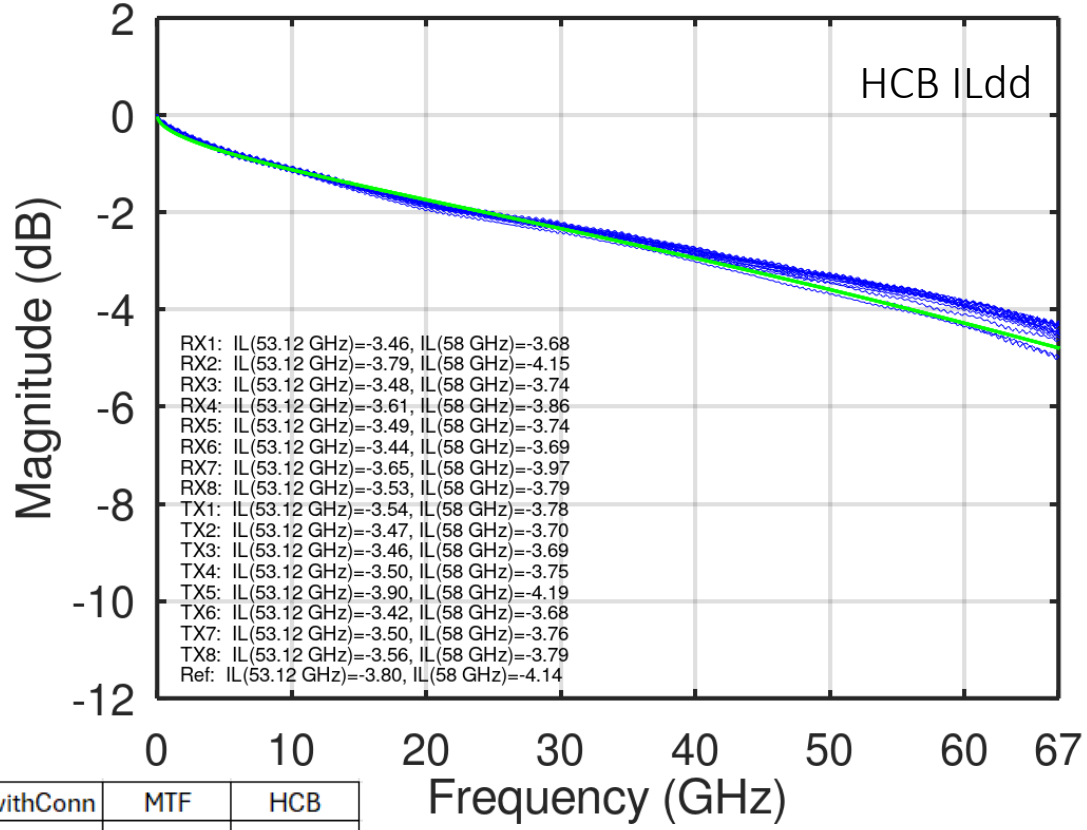
Differential Insertion Loss (53.125 GHz) = 2.64 dB

Test Fixture ILdd

110 GHz data is truncated for specification comparison and calculation. Full 110 GHz data available in data package.

Limits from IEEE P802.3dj™/D2.3





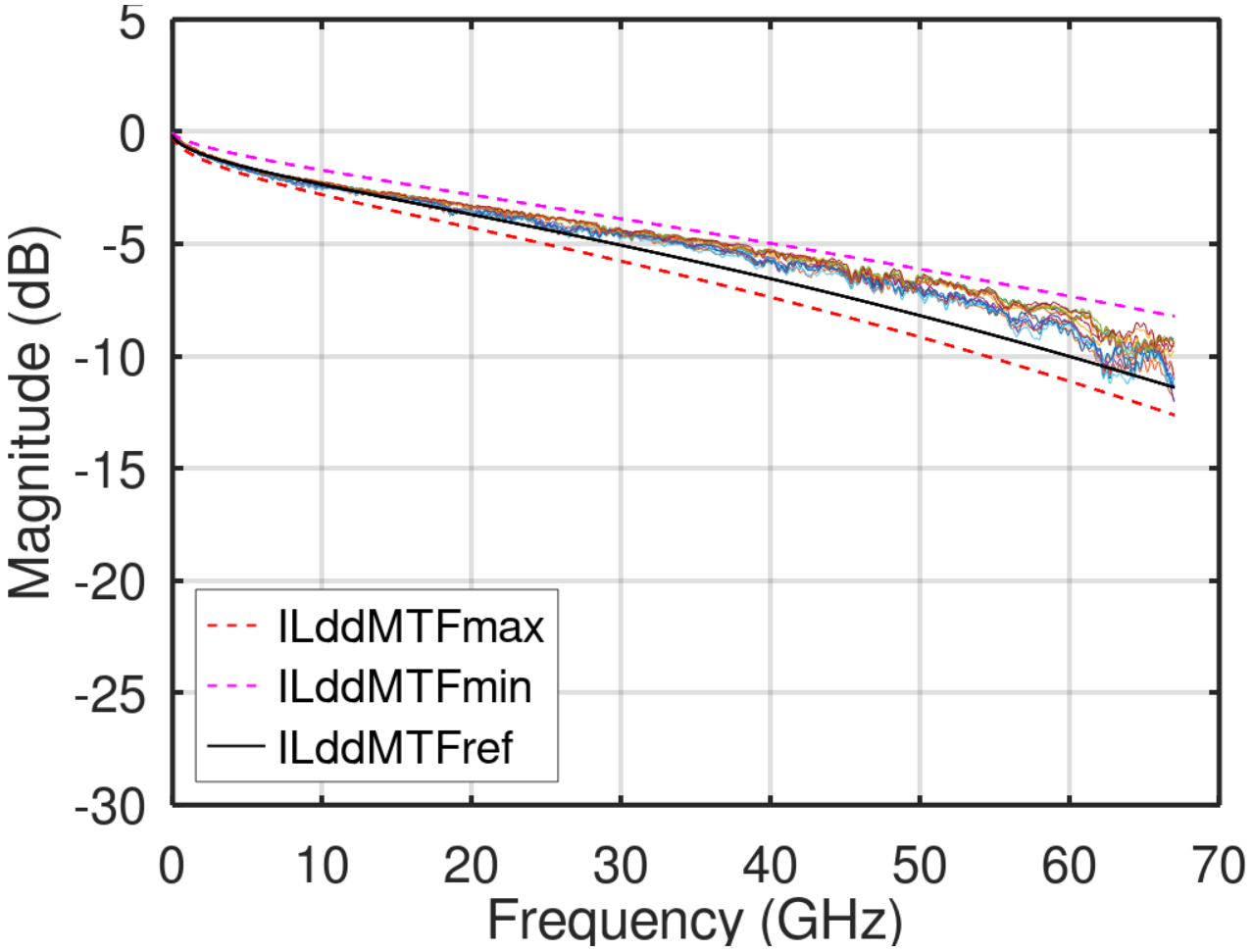
*MCB with connector ILdd, calculated by subtracting HCB ILdd from MTF ILdd

@53.12 GHz	MCBwithConn	MTF	HCB
Average	-3.84	-7.39	-3.55
Highest Loss	-4.34	-7.88	-3.9
Lowest Loss	-3.45	-6.97	-3.42
Range	-0.9	-0.91	-0.47
Average Distance from Spec	-1.11	-1.36	-0.25

Mated Test Fixture (MTF) ILdd

110 GHz data is truncated for specification comparison and calculation. Full 110 GHz data available in data package.

Limits from IEEE P802.3dj™/D2.3



RX1: IL(53.12 GHz)=-6.97, IL(58 GHz)=-7.73
RX2: IL(53.12 GHz)=-7.70, IL(58 GHz)=-8.50
RX3: IL(53.12 GHz)=-7.01, IL(58 GHz)=-7.80
RX4: IL(53.12 GHz)=-7.69, IL(58 GHz)=-8.76
RX5: IL(53.12 GHz)=-7.03, IL(58 GHz)=-7.88
RX6: IL(53.12 GHz)=-7.69, IL(58 GHz)=-8.71
RX7: IL(53.12 GHz)=-7.10, IL(58 GHz)=-7.68
RX8: IL(53.12 GHz)=-7.67, IL(58 GHz)=-9.02
TX1: IL(53.12 GHz)=-7.88, IL(58 GHz)=-8.83
TX2: IL(53.12 GHz)=-7.08, IL(58 GHz)=-7.77
TX3: IL(53.12 GHz)=-7.57, IL(58 GHz)=-8.73
TX4: IL(53.12 GHz)=-7.16, IL(58 GHz)=-7.78
TX5: IL(53.12 GHz)=-7.81, IL(58 GHz)=-9.24
TX6: IL(53.12 GHz)=-7.08, IL(58 GHz)=-7.74
TX7: IL(53.12 GHz)=-7.54, IL(58 GHz)=-8.56
TX8: IL(53.12 GHz)=-7.22, IL(58 GHz)=-7.91

Average Values
@53.125 GHz, 7.39 dB, Range = 0.91 dB
@58 GHz, 8.29 dB

MTF ERL and FOMILD

MTF with Connector #1

	ERL11	ERL22	ERL11tfx	ERL22tfx	FOMILD
RX1	13.14	12.69	14.19	13.81	0.059
RX2	12.21	11.65	13.29	12.40	0.076
RX3	13.50	13.19	14.53	14.36	0.051
RX4	12.86	11.95	13.80	12.87	0.071
RX5	13.74	13.28	15.06	14.48	0.050
RX6	12.14	11.52	13.07	12.22	0.070
RX7	13.30	12.95	14.55	14.03	0.055
RX8	12.35	11.87	13.33	12.70	0.070
TX1	11.97	11.49	12.82	12.31	0.070
TX2	13.40	12.92	14.59	14.10	0.058
TX3	12.19	11.71	12.95	12.55	0.076
TX4	13.51	12.69	14.66	13.85	0.057
TX5	12.52	11.65	13.38	12.40	0.075
TX6	13.00	12.24	14.01	13.38	0.060
TX7	11.88	11.41	12.78	12.19	0.080
TX8	13.61	12.80	14.66	13.51	0.058

ERL Pass:
>=9 dB

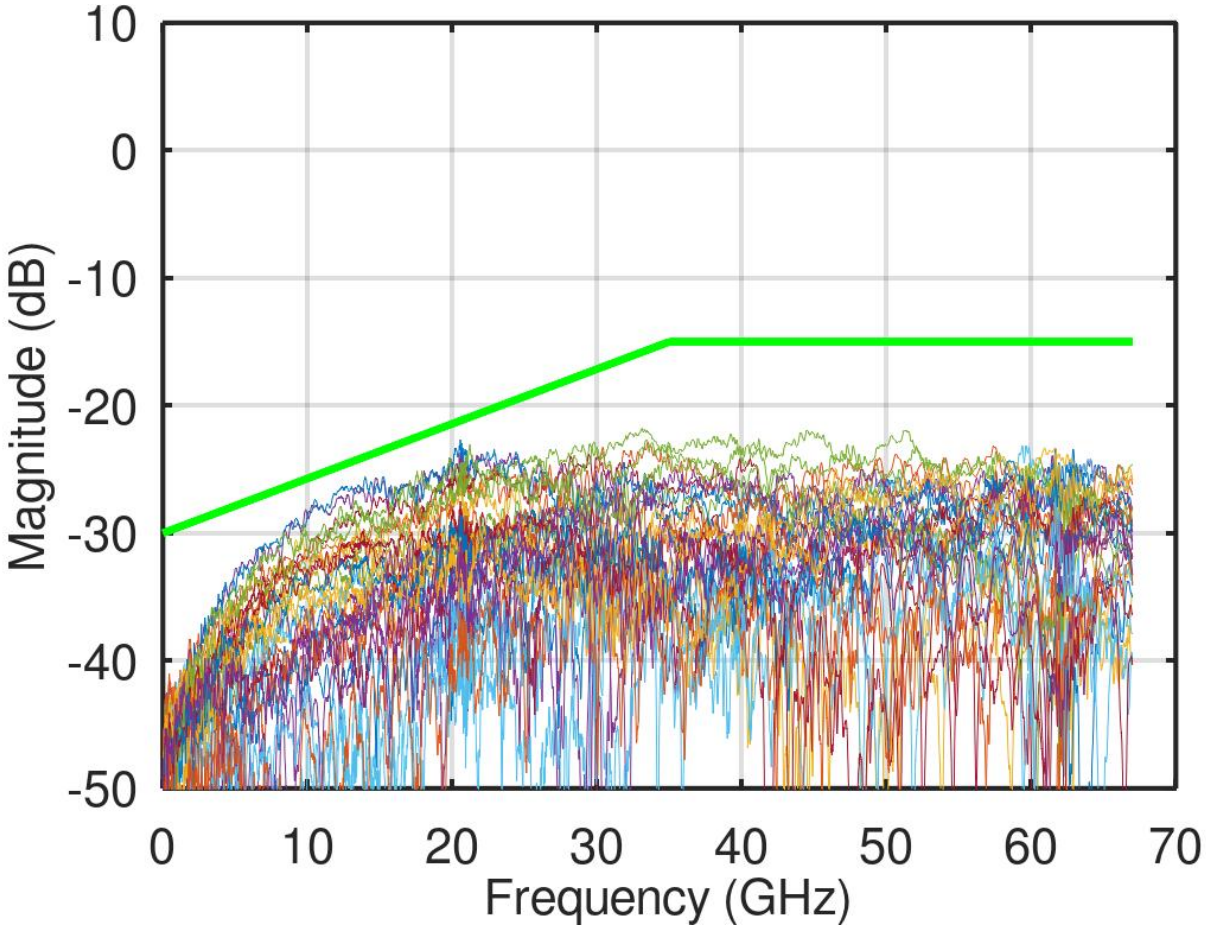
ERL tfx Pass:
>=10.3 dB

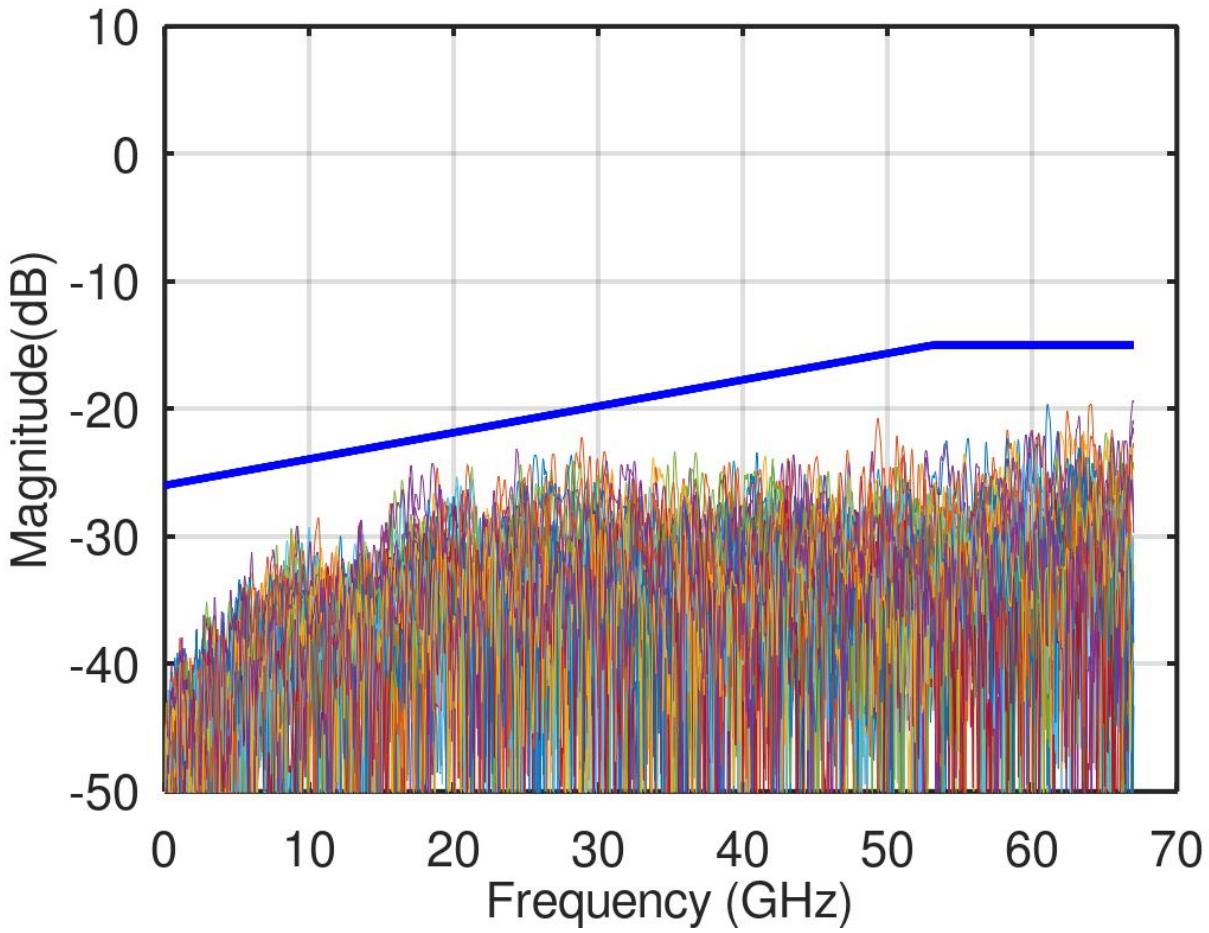
FOMILD Pass:
<=0.15 dB

For columns
labeled with tfx.
tfx = 0.15 ns
instead of 0 s

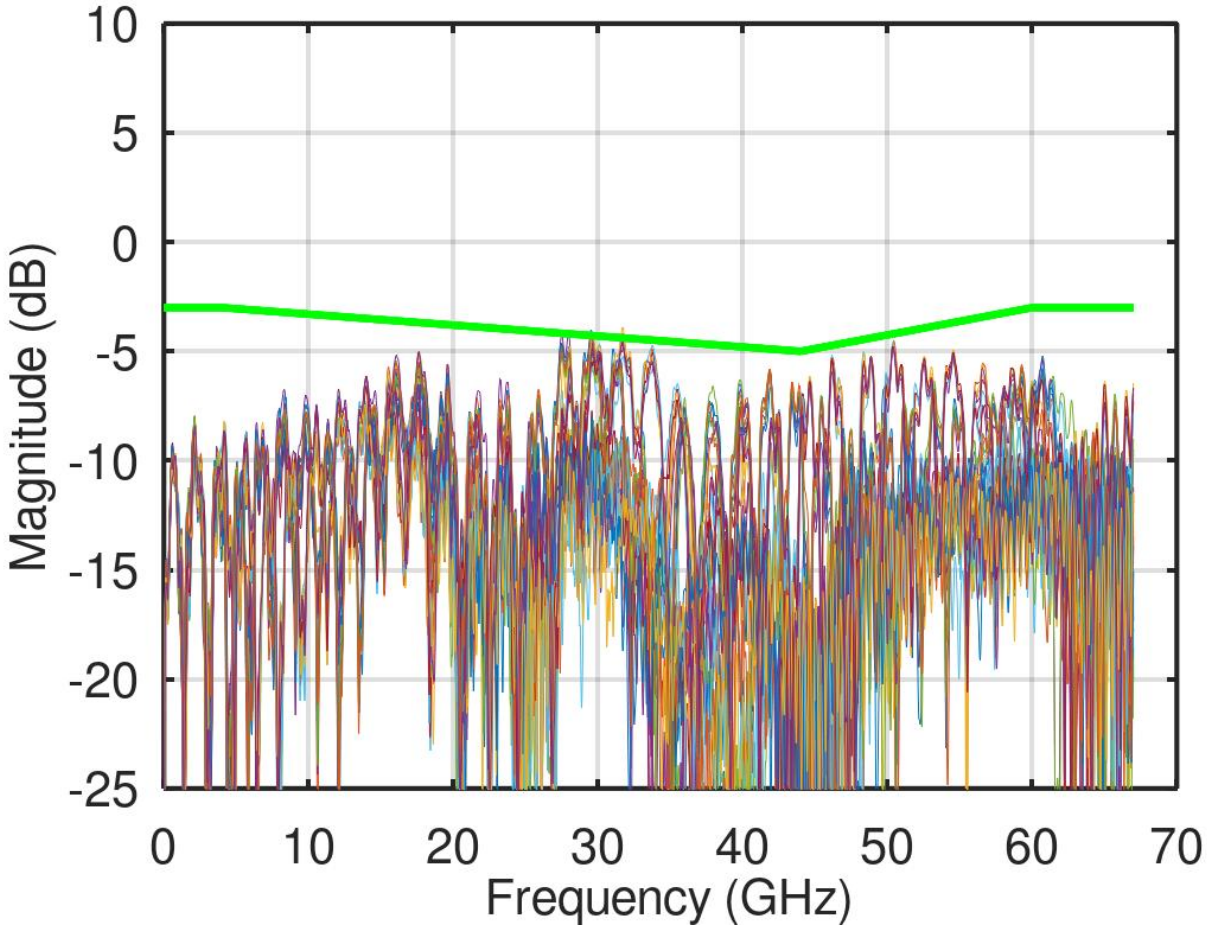
	ERL	ERL tfx	FOMILD
Minimum	11.41	12.19	0.050
Maximum	13.74	15.06	0.080
Average	12.54	13.52	0.065

MTF ILdc and RLdc





MTF RLcc

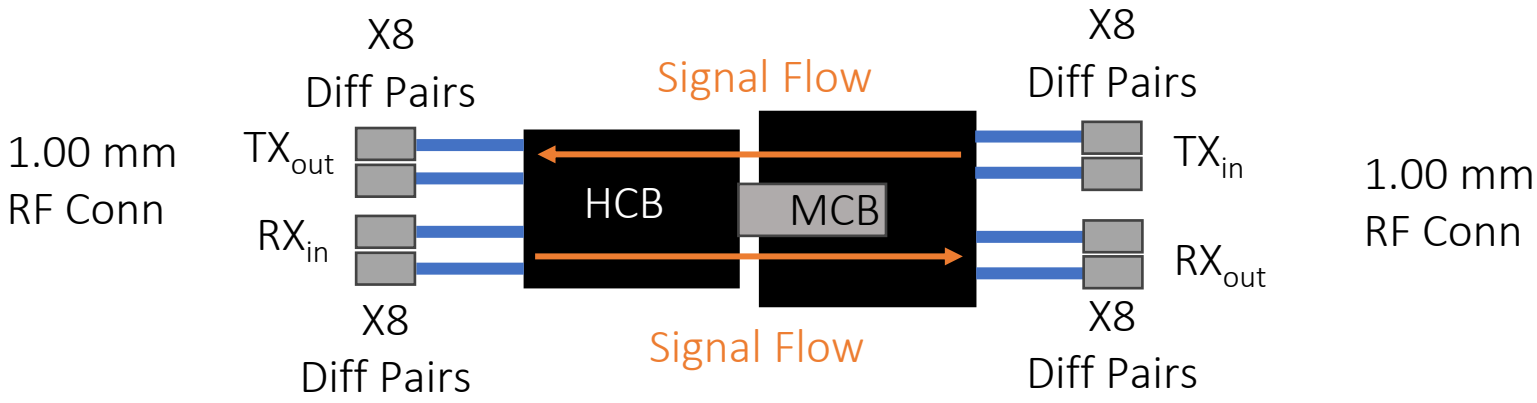

10
5
0
-5
-10
-15
-20
-25
Magnitude (dB)
0
10
20
30
40
50
60
70
Frequency (GHz)

MTF Crosstalk Setup

VNA Information:

Keysight 110 GHz VNA using Port Extenders, 1.00 mm cable (300 mm)
IFBW = 1 kHz
Frequency Start: 10 MHz
Frequency Stop: 110 GHz
Frequency Step: 10 MHz

OSFP 1.6T MTF using Connector #1



NEXT Measurements:

	Aggressor		Victim	
Ports 1 & 3	TX_{MCB}	→	RX_{MCB}	Ports 2 & 4
	RX_{HCB}	→	TX_{HCB}	

FEXT Measurements:

	Aggressor		Victim	
Ports 1 & 3	RX_{HCB}	→	RX_{MCB}	Ports 2 & 4
	TX_{MCB}	→	TX_{HCB}	

QTY 112 FEXT, QTY 128 NEXT Files

File Name Example: HCB_vic_TX1_MCB_aggr_TX2_FEXT.s4p

TX1 on HCB is Victim

TX2 on MCB is Aggressor

4-port touchstone format

Termination:
The Victim and Aggressor Differential Pairs, 1.00 mm Nearest Neighbors, 1.85 mm

Multiple Disturber, ICN, and Impedance Calculations

Equations below from the IEEE 802.3 specification 92-44 through 92-48, 178A1.3

Multiple Disturber Crosstalk Equations (92-42, 92-43):

- $MDNEXT_{loss}\,(f) = -10log_{10}(\sum_{i=0}^{i=7} 10^{-NL_i(f)/10})$
- $MDFEXT_{loss}\,(f) = -10log_{10}(\sum_{i=0}^{i=6} 10^{-NL_i(f)/10})$

Reference Impedance Transform Equation (178A-4):

$$S = A^{-1}(S^{(m)} - \rho)(I - \rho S^{(m)})^{-1}A$$

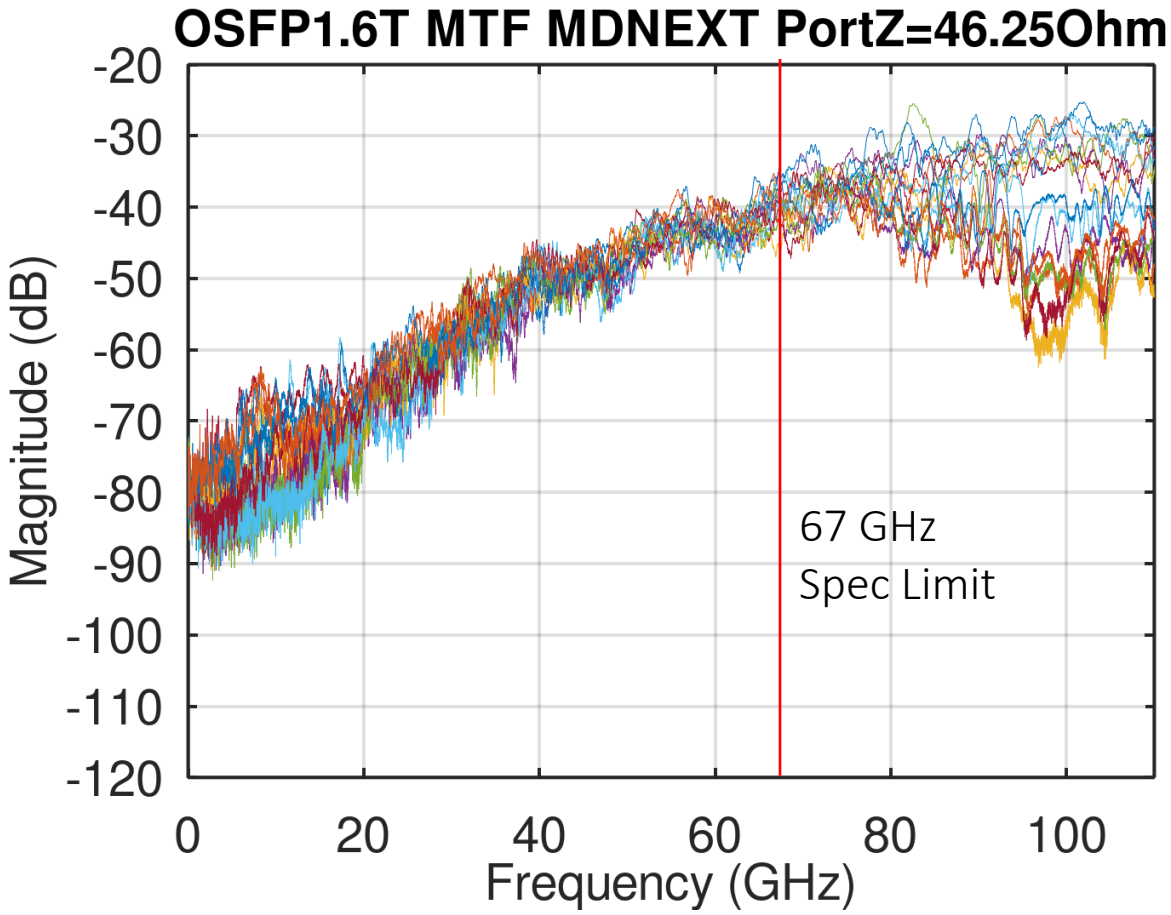
ICN Equations (92-44, 92-46):

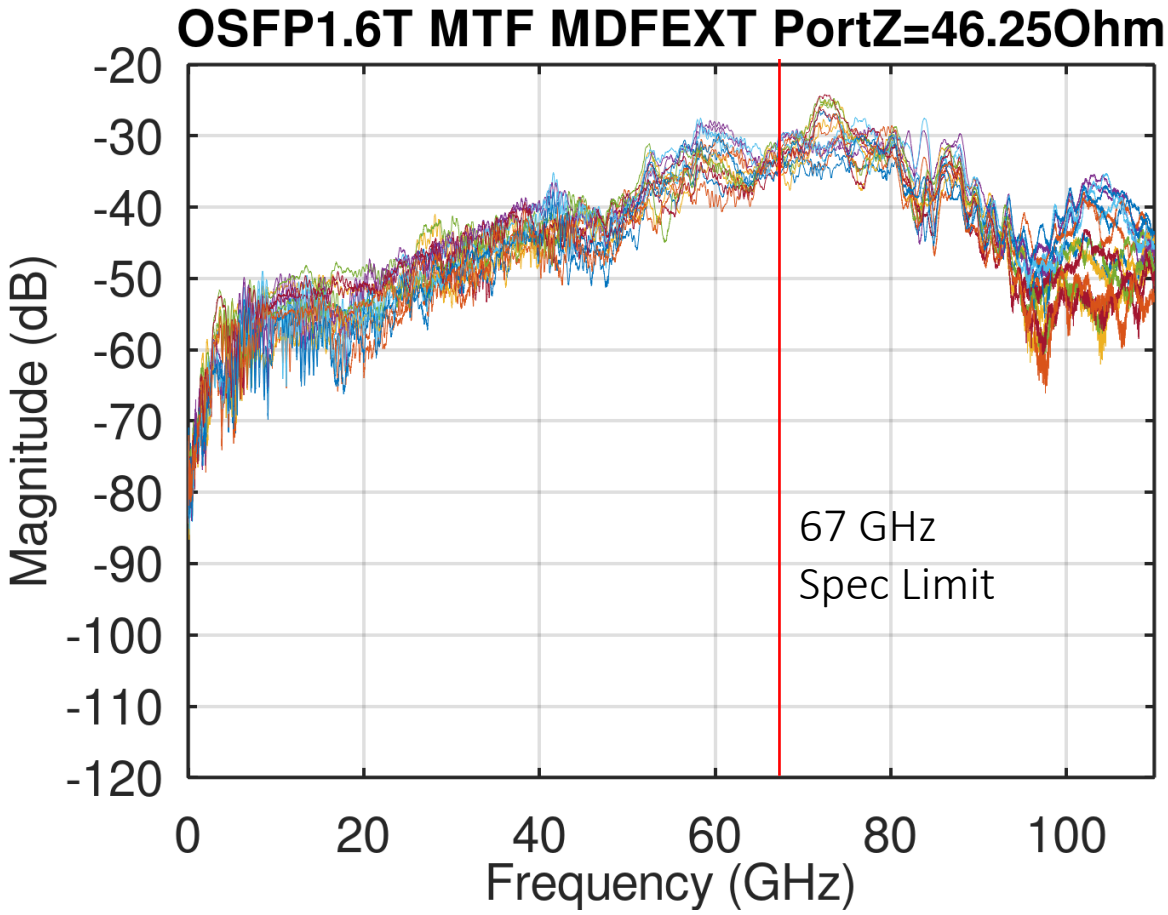
- $W_{nt}\,(f) = \left(\frac{A_{nt}{}^2}{f_b}\right) sinc^2\left(\frac{f}{f_b}\right)\left[1/((1+\frac{f}{f_{nt}})\text{^}4)\right]\left[1/((1+\frac{f}{f_r})\text{^}8)\right]$
  - Applies the same for ft
- $\sigma_{nx} = \left(2\Delta f \sum_n W_{nt}\,(f_n) 10^{-\frac{MDNEXT_{loss}\,(f_n)}{10}}\right)^{1/2}$

dj Parameters

$f_b = 106.25\ GBd$
$f_r = 58.4375\ GHz$
$A_{nt} = 600\ mV$
$T_{nt} = 4.25\ ps$
$f_{start} = 50\ MHz$
$f_{stop} = 67\ GHz$

Multiple Disturber Plotted Data





ICN Table TX

ICN (mV) from TX FEXT

Last value is accumulated	Accumulating Victim (HCB) p=port3, n=port4, mV							
Aggressor (MCB) p=port1, n-port2	TX1	TX2	TX3	TX4	TX5	TX6	TX7	TX8
TX1		0.75	1.36	0.58	0.73	0.51	0.58	0.33
TX2	1.02		1.03	2.35	0.82	0.74	0.64	0.59
TX3	1.31	0.70		0.67	1.79	0.61	0.77	0.40
TX4	0.69	1.81	1.02		0.91	2.16	0.67	0.87
TX5	0.77	0.55	1.40	0.51		0.62	1.89	0.53
TX6	0.51	0.91	0.78	1.94	1.15		0.90	1.54
TX7	0.64	0.42	0.76	0.35	1.62	0.47		0.55
TX8	0.47	0.63	0.51	0.69	0.79	1.59	0.87	
TX MDFEXT ICN	2.17	2.46	2.71	3.31	3.14	3.00	2.64	2.08

ICN (mV) from TX NEXT

Last value is accumulated	Accumulating Victim (HCB) p=port3, n=port4, mV							
Aggressor (HCB) p=port1, n=port2	TX1	TX2	TX3	TX4	TX5	TX6	TX7	TX8
RX1	0.33	0.50	0.31	0.33	0.29	0.32	0.27	0.36
RX2	0.55	0.41	0.31	0.22	0.42	0.24	0.44	0.24
RX3	0.26	0.33	0.24	0.33	0.25	0.29	0.22	0.33
RX4	0.33	0.33	0.38	0.23	0.41	0.21	0.41	0.20
RX5	0.26	0.37	0.27	0.36	0.28	0.40	0.27	0.43
RX6	0.48	0.36	0.38	0.30	0.40	0.28	0.42	0.32
RX7	0.26	0.35	0.23	0.29	0.34	0.42	0.33	0.43
RX8	0.45	0.32	0.39	0.26	0.54	0.25	0.57	0.33
TX MDNEXT ICN	1.07	1.06	0.91	0.83	1.07	0.88	1.08	0.95

ICN FEXT Pass:
<= 4.2 mV
Margin = 0.89 mV

ICN NEXT Pass:
<= 1.5 mV
Margin = 0.43 mV

Worst case crosstalk noise is highlighted in yellow.

ICN Table RX

ICN (mV) for RX FEXT

Last value is accumulated	Accumulating Victim (MCB) p=port3, n=port4, mV							
Aggressor (HCB) p=port1, n-port2	RX1	RX2	RX3	RX4	RX5	RX6	RX7	RX8
RX1		0.98	2.24	0.63	0.81	0.48	0.55	0.44
RX2	0.85		0.81	1.28	0.60	0.94	0.48	0.83
RX3	1.58	0.74		0.58	1.92	0.56	0.71	0.36
RX4	0.77	1.13	1.02		0.83	1.09	0.72	0.82
RX5	0.63	0.57	1.86	0.62		0.64	1.84	0.54
RX6	0.59	0.74	0.81	1.39	1.20		0.89	1.18
RX7	0.62	0.42	0.85	0.56	1.45	0.51		0.56
RX8	0.60	0.53	0.57	0.94	0.88	1.68	0.85	
RX MDFEXT ICN	2.30	2.03	3.45	2.43	3.12	2.48	2.54	1.92

ICN (mV) for RX NEXT

Last value is accumulated	Accumulating Victim (MCB) p=port3, n=port4, mV							
Aggressor (MCB) p=port1, n=port2	RX1	RX2	RX3	RX4	RX5	RX6	RX7	RX8
TX1	0.38	0.41	0.35	0.26	0.34	0.34	0.33	0.42
TX2	0.43	0.37	0.33	0.26	0.34	0.31	0.44	0.34
TX3	0.30	0.32	0.20	0.34	0.21	0.42	0.32	0.50
TX4	0.43	0.33	0.32	0.23	0.35	0.27	0.31	0.31
TX5	0.29	0.33	0.24	0.34	0.27	0.46	0.28	0.57
TX6	0.28	0.37	0.37	0.21	0.53	0.26	0.43	0.30
TX7	0.37	0.40	0.28	0.49	0.26	0.53	0.31	0.61
TX8	0.46	0.29	0.37	0.30	0.39	0.26	0.53	0.34
RX MDNEXT ICN	1.06	1.00	0.89	0.89	0.98	1.04	1.07	1.23

ICN FEXT Pass:
<= 4.2 mV
Margin = 0.75 mV

ICN NEXT Pass:
<= 1.5 mV
Margin = 0.27 mV

Worst case crosstalk noise is highlighted in yellow.

Questions