Channel Operating Margin Program Usage

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Operation

- Running com2l
  - Interactive file input (Q/A)
    - Spreadsheet selection windows
    - File selection windows
  - Scriptable single line entry
- Spreadsheet (XLS file) configures parameters
- Output
  - Display to MatLab® window
  - Frequency plots to floating window
  - Floating progress windows
- The COM2L runs in MatLab® version 7
- First step – check/edit configuration spreadsheet
- Next step – run com2l in MatLab®

Configuration Spreadsheet: Select Port Type

	A	B	C	D	E	F	G
1	**Parameter**	**Setting**		**Config/Interface Types**		**Operational Control**	
2	Coding/Port Type	NRZ Clause 93 D1.1		NRZ Clause 93	INCLUDE_CTLE	1	
3	Unit Interval (UI)	3.87879E-11		NRZ/FEC Clause 93	INCLUDE_FILTER	1	
4	tx_ffe	[.1 .4]		PAM4 Clause 94	DEBUG	0	
5	ndfe	12		NRZ Clause 93 D1.1	DISPLAY_WINDOW	1	
6	max_ctle	12		NRZ/FEC Clause 93 D1.1	CSV_REPORT	1	
7	a_thru	0.4		PAM4 Clause 94 D1.1	SAVE_RESP	0	
8	a_fext	0.4			GET_FD	1	
9	a_next	0.6			INC_PACKAGE	4	
10	AG	1			USE_EXTERNAL_PARAM	0	
11	specBER				RESULT_DIR	./result1/	
12	Allowance						
13	G_s_noise						
14	g_dd_noise						
15	Na_rms						
16	Samples Per UI	32					
17	Port Order	[1 3 2 4]					
18	G01	0.01					
19	G02	0.01					
20	Fscale1	2					
21	Fscale2	2					
22	ctle_step	1					
23	tx_ffe_step	0.02					
24	maxc1	1					
25	maxcx	1					
26	f_v	0.55					
27	f_f	0.55					
28	f_n	1					
29	f_r	0.75					
30							

Coding and port type selection roller

	D	E	F	G	H	I	J	K	L
	ndfe	max_ctle	a_thru	a_fext	a_next	AG	specBER	Allowance	G_s_noise
3	NRZ/FEC Clause 93	3.879E-11	[.1 .4]	12	12	0.4	0.4	0.6	1	1.00E-05	3	0.01
4	PAM4 Clause 94	7.356E-11	[.1 .4]	16	12	0.4	0.4	0.6	0.33333	1.00E-05	3	0.005
5	NRZ Clause 93 D1.1	3.879E-11	[.1 .4]	12	12	0.4	0.4	0.6	1	1.00E-12	0	0.01
6	NRZ/FEC Clause 93 D1.1	3.879E-11	[.1 .4]	12	12	0.4	0.4	0.6	1	1.00E-05	0	0.01
7	PAM4 Clause 94 D1.1	7.356E-11	[.1 .4]	16	12	0.4	0.4	0.6	0.33333	1.00E-05	0	0.01
8												
9												
10												
11												
12												
13												

Settings | Lookup Tables

Data can be directly entered or defaults can be set in the lookup data table tab when using the selection roller.

Configuration Spreadsheet

Parameter	Setting		Config/Interface Types		Operational Control
Coding/Port Type	NRZ Clause 93 D1.1		NRZ Clause 93	INCLUDE_CTLE	1
Unit Interval (UI)	3.87879E-11		NRZ/FEC Clause 93	INCLUDE_FILTER	1
tx_ffe	[.1 .4]		PAM4 Clause 94	DEBUG	0
ndfe	12		NRZ Clause 93 D1.1	DISPLAY_WINDOW	0
max_ctle	12		NRZ/FEC Clause 93 D1.1	CSV_REPORT	1
a_thru	0.4		PAM4 Clause 94 D1.1	SAVE_RESP	0
a_fext	0.4			GET_FD	1
a_next	0.6			INC_PACKAGE	1
AG	1			USE_EXTERNAL_PARAM	0
specBER	1.00E-12			RESULT_DIR	./result1/
Allowance	0				
G_s_noise	0.01				
g_dd_noise	0.1				
Na_rms	0				
Samples Per UI	32				
Port Order	[1 3 2 4]				
G01	0.01				
G02	0.01				
Fscale1	2				
Fscale2	2				
ctle_step	1				
tx_ffe_step	0.02				
maxdfe1	1				
maxdfex	1				
f_v	0.55				
f_f	0.55				
f_n	1				
f_r	0.75				

Parameter list

	Draft parameter ref	Example Setting	
Coding/Port Type	Coding/Port Type	NRZ Clause 93 D1.1	selector for port type
Unit Interval (UI)	Unit Interval (UI)	3.87879E-11	unit interval in seconds
tx_ffe	tx_ffe	[.1 .4]	Transmitter equalizer, max pre and post cursor coefficient
ndfe	W	12	Victim single bit response exception window (in UI)
max_ctle	G_DC	12	Continuous time filter, max DC gain
a_thru	A_v	0.4	Transmitter differential peak output voltage for victim
a_fext	A_f	0.4	Transmitter differential peak output voltage for Far-end aggressor
a_next	A_n	0.6	Transmitter differential peak output voltage for Near-end aggressor
AG	1/(L-1)	1	related to number of levels, L (symbol gain)
specBER	SER_0	1.00E-12	Target uncorrected symbol error ratio
Allowance	COM_0	0	Minimum channel operating margin
G_s_noise	sigma_G	0.01	Normalized RMS Gaussian noise
g_dd_noise	A_DD	0.1	Normalized peak dual-Dirac noise
Na_rms	-	0	voltage sensitivey RMS Gaussian noise
Samples Per UI	M	32	
Port Order	Port Order	[1 3 2 4]	for the 4 ports the first two listed are inputs and respective last two are outputs (RX)
G01	Gamma_01	0.01	Transmitter reflection coefficient DC value. Values < .01 disables
G02	Gamma_02	0.01	Receiver reflection coefficient DC value. Values < .01 disables
Fscale1	Fscale1	2	Transmitter reflection coefficient reference frequency scale. Value > 2 disables
Fscale2	Fscale2	2	Receiver reflection coefficient reference frequency scaleV. alue > 2 disables
ctle_step	-	1	Continuous time filter step size dB
tx_ffe_step	-	0.02	Transmitter equalizer, pre/post cursor coefficient step size
maxc1	-	1	max value for DFE1
maxcx	-	1	max in W region
f_v	f_v	0.55	Transmitter 3 dB bandwith for victim. Set to > 2 to deactivate
f_f	f_f	0.55	Transmitter 3 dB bandwith for Far-end aggressor. Set to > 2 to deactivate
f_n	f_n	1	Transmitter 3 dB bandwith for Near-end aggressor. Set to > 2 to deactivate
f_r	f_r	0.75	Receiver 3dB bandwidth

Operational Control

INCLUDE_CTLE	0 = do not include CTLE
	1 = include CTLE. Will eventually be removed
INCLUDE_FILTER	0 = do not include TX/RX filters
	1 = include TX/RX filters. Will eventually be removed
DEBUG	0 = do not print internal data;
	1 = prints and graphs internal data. Will eventually be removed
DISPLAY_WINDOW	0 - do not display FD graphs
	1 - display FD graphs (IL, ILD, ICR, RL, MDPST)
CSV_REPORT	0 - do not create CSV report file
	1- create CSV report file in .\results directory
SAVE_RESP	0 - do no save channel time domian data
	1 - save channel time domian data in mat file
GET_FD	0 - do not report freqency domain metrics
	1 - report some freqency domain metrics
INC_PACKAGE	0 - do not use package models
	1 – use proposal 1 for h21(f) (d1.1)
	2 – use proposal 2 for h21(f)
	3 – use proposal 3 for h21(f)
	4 – use proposal 4 for h21(f)
USE_EXTERNAL_PARAM	set to 0 . Will eventually be removed
RESULT_DIR	Point to the results directory

CSV and display outputs

Output Parameters	
channel_operating_margin_dB: (COM)	Figure of merit. Adjusted so that above zero passes and below fails
peak_interference_mV:	Peak interference on channel include chip and system noise. For a test type of channel, this would be the value for additive rx tolerance injected noise. Since this is peak value of interference, dividing by 7 may be the amount of rms noise from an AWGN generator. Peak interference is measure at the spec BER.
peak_channel_interference_mV:	The peak interference. contribution for residual ISI and crosstalk.
peak_ISI_mV:	The peak interference. contribution for residual ISI.
peak_MDXTK_interference_mV:	The peak interference. contribution for all crosstalk.
icn_mV:	If FD is selected this is the integrated crosstalk noise. Information about channel design may discerned from 7*ICN-peak_MDXTK_interference
peak_MDNEXT_interference_mV:	The peak interference contribution for all NEXT crosstalk.
peak_MDFEXT_interference_mV:	The peak interference contribution for all FEXT crosstalk.
available_signal_after_eq_mV:	Essentially the “zero-first-precursor” signal height after filtering and reference equalization
fit_loss_dB_at_Fnq:	If FD is selected this is the value of the fitted IL loss at Nyquist. Same as SCAT, IL_fit_atNq
IL_dB_at_Fnq:	If FD is selected this is the value of the IL loss at Nyquist.
ILD_RMS:	This may be useful for a quick evaluation of a channel. It is the RMS of the Insertion Loss Deviation in dB
file_names:	List of channel files

Syntax

```
function [ output_args ] =com2l(coding, num_fext, num_next,
pkg, varargin)
```

- output_args is a structure with results
- coding is string containing the full path name of the configuration spreadsheet
- num_fext is the number for fext s4p files
- num_next is the number for next s4p files
- pkg should be equal to 1 and is set by the spreadsheet
- All the reset of the argument are strings containing the respective full path names of through, fext, and next files

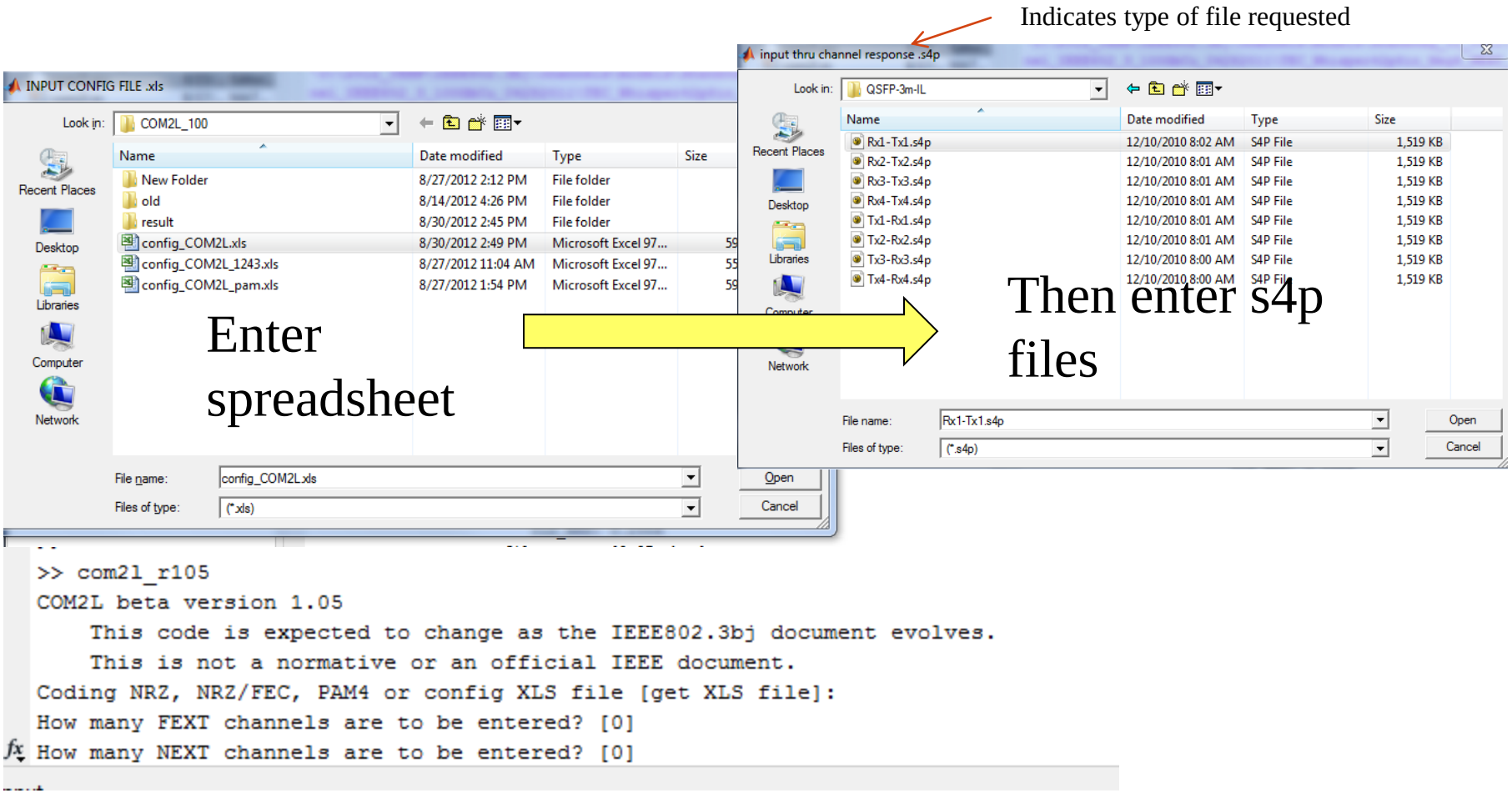
Result screen

```
output_args =

     channel_operating_margin_dB: -3.7149
            peak_interference_mV: 308.1000
    peak_channel_interference_mV: 301.5000
                  peak_ISI_mV: 297.1000
     peak_MDXTK_interference_mV: 30.2000
                        icn_mV: 5.3319
     peak_MDNEXT_interference_mV: 19.1000
     peak_MDFEXT_interference_mV: 19.3000
    available_signal_after_eq_mV: 283.7581
              fit_loss_dB_at_Fnq: 3.3530
                    IL_dB_at_Fnq: 2.0177
                baud_rate_GHz: 25.7813
                     ILD_RMS: 2.5216
                file names: [8x80 char]
```

```
>> com2l_r105('config_COM2L.xls',   3,  4,1,
'C:\Users\rimellit\Documents\2012_TEMP\IEEE802.3bj\channels\models\FCI_CC_Long_Link\FCI_CC_Long_Link\
FCI_CC_Long_Link_Pair_15_to_Pair_7\FCI_CC_Long_Link_Pair_15_to_Pair_7_Through.s4p',
'C:\Users\rimellit\Documents\2012_TEMP\IEEE802.3bj\channels\models\FCI_CC_Long_Link\FCI_CC_Long_Link\
FCI_CC_Long_Link_Pair_15_to_Pair_7\FCI_CC_Long_Link_Pair_11_to_Pair_7_FEXT.s4p',
'C:\Users\rimellit\Documents\2012_TEMP\IEEE802.3bj\channels\models\FCI_CC_Long_Link\FCI_CC_Long_Link\
FCI_CC_Long_Link_Pair_15_to_Pair_7\FCI_CC_Long_Link_Pair_12_to_Pair_7_FEXT.s4p',
'C:\Users\rimellit\Documents\2012_TEMP\IEEE802.3bj\channels\models\FCI_CC_Long_Link\FCI_CC_Long_Link\
FCI_CC_Long_Link_Pair_15_to_Pair_7\FCI_CC_Long_Link_Pair_14_to_Pair_7_FEXT.s4p',
'C:\Users\rimellit\Documents\2012_TEMP\IEEE802.3bj\channels\models\FCI_CC_Long_Link\FCI_CC_Long_Link\
FCI_CC_Long_Link_Pair_15_to_Pair_7\FCI_CC_Long_Link_Pair_1_to_Pair_7_NEXT.s4p',
'C:\Users\rimellit\Documents\2012_TEMP\IEEE802.3bj\channels\models\FCI_CC_Long_Link\FCI_CC_Long_Link\
FCI_CC_Long_Link_Pair_15_to_Pair_7\FCI_CC_Long_Link_Pair_2_to_Pair_7_NEXT.s4p',
'C:\Users\rimellit\Documents\2012_TEMP\IEEE802.3bj\channels\models\FCI_CC_Long_Link\FCI_CC_Long_Link\
FCI_CC_Long_Link_Pair_15_to_Pair_7\FCI_CC_Long_Link_Pair_5_to_Pair_7_NEXT.s4p',
'C:\Users\rimellit\Documents\2012_TEMP\IEEE802.3bj\channels\models\FCI_CC_Long_Link\FCI_CC_Long_Link\
FCI_CC_Long_Link_Pair_15_to_Pair_7\FCI_CC_Long_Link_Pair_8_to_Pair_7_NEXT.s4p')
```

Interactive file input example



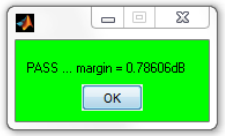
Example for single line entry

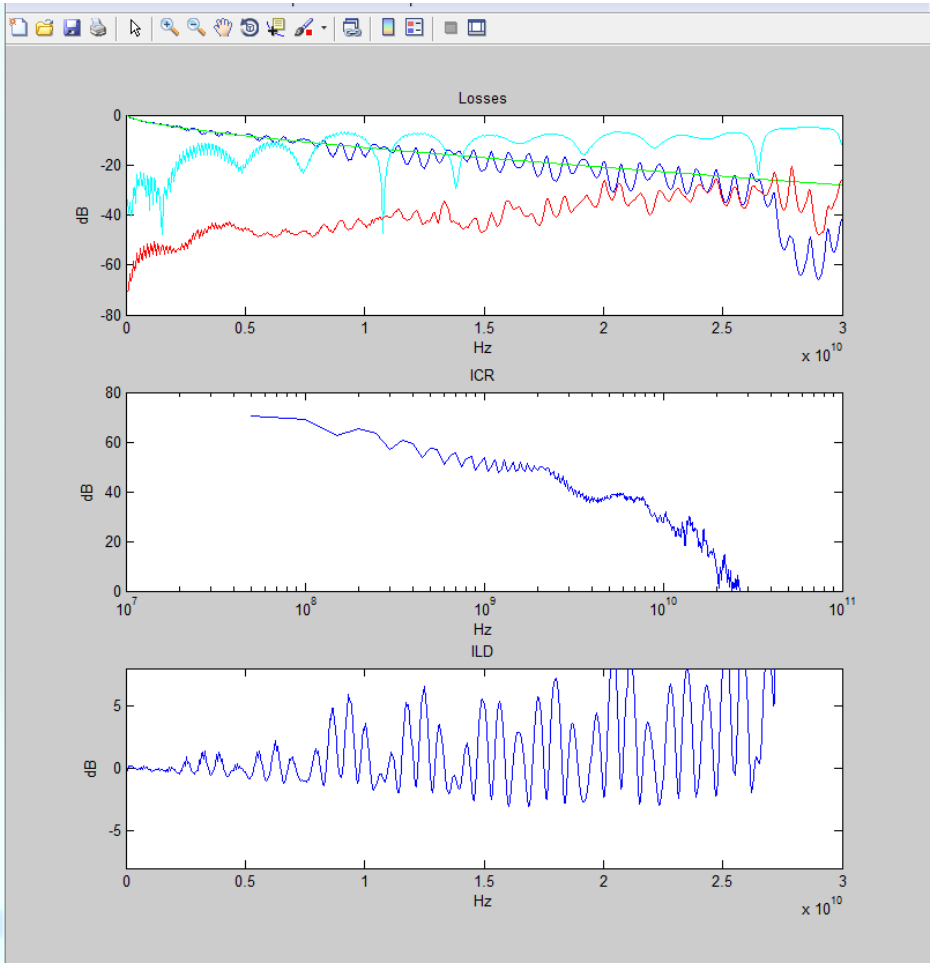
```
>> com2l_r105('config_COM2L.xls',   3,  4,1,
'C:\Users\rimellit\Documents\2012_TEMP\IEEE802.3bj\channels\models\FCI_CC_Long_Link\FCI_CC
_Long_Link\FCI_CC_Long_Link_Pair_15_to_Pair_7\FCI_CC_Long_Link_Pair_15_to_Pair_7_Through.s
4p',
'C:\Users\rimellit\Documents\2012_TEMP\IEEE802.3bj\channels\models\FCI_CC_Long_Link\FCI_CC
_Long_Link\FCI_CC_Long_Link_Pair_15_to_Pair_7\FCI_CC_Long_Link_Pair_11_to_Pair_7_FEXT.s4p'
,
'C:\Users\rimellit\Documents\2012_TEMP\IEEE802.3bj\channels\models\FCI_CC_Long_Link\FCI_CC
_Long_Link\FCI_CC_Long_Link_Pair_15_to_Pair_7\FCI_CC_Long_Link_Pair_12_to_Pair_7_FEXT.s4p'
,
'C:\Users\rimellit\Documents\2012_TEMP\IEEE802.3bj\channels\models\FCI_CC_Long_Link\FCI_CC
_Long_Link\FCI_CC_Long_Link_Pair_15_to_Pair_7\FCI_CC_Long_Link_Pair_14_to_Pair_7_FEXT.s4p'
,
'C:\Users\rimellit\Documents\2012_TEMP\IEEE802.3bj\channels\models\FCI_CC_Long_Link\FCI_CC
_Long_Link\FCI_CC_Long_Link_Pair_15_to_Pair_7\FCI_CC_Long_Link_Pair_1_to_Pair_7_NEXT.s4p',
'C:\Users\rimellit\Documents\2012_TEMP\IEEE802.3bj\channels\models\FCI_CC_Long_Link\FCI_CC
_Long_Link\FCI_CC_Long_Link_Pair_15_to_Pair_7\FCI_CC_Long_Link_Pair_2_to_Pair_7_NEXT.s4p',
'C:\Users\rimellit\Documents\2012_TEMP\IEEE802.3bj\channels\models\FCI_CC_Long_Link\FCI_CC
_Long_Link\FCI_CC_Long_Link_Pair_15_to_Pair_7\FCI_CC_Long_Link_Pair_5_to_Pair_7_NEXT.s4p',
'C:\Users\rimellit\Documents\2012_TEMP\IEEE802.3bj\channels\models\FCI_CC_Long_Link\FCI_CC
_Long_Link\FCI_CC_Long_Link_Pair_15_to_Pair_7\FCI_CC_Long_Link_Pair_8_to_Pair_7_NEXT.s4p')
COM2L beta version 1.05
    This code is expected to change as the IEEE802.3bj document evolves.
    This is not a normative or an official IEEE document.
Files set is:
FCI_CC_Long_Link_Pair_15_to_Pair_7--FCI_CC_Long_Link_Pair_15_to_Pair_7_Through

ans =

     channel_operating_margin_dB: 0.7861
           peak_interference_mV: 90.2000
    peak_channel_interference_mV: 80.4000
                   peak_ISI_mV: 73
      peak_MDXTK_interference_mV: 21
                        icn_mV: 3.0407
     peak_MDNEXT_interference_mV: 18.8000
     peak_MDFEXT_interference_mV: 4.2000
    available_signal_after_eq_mV: 98.7437
              fit_loss_dB_at_Fnq: 15.4138
                   IL_dB_at_Fnq: 14.1297
                  baud_rate_GHz: 25.7813
                        ILD_RMS: 1.6013
                    file_names: [8x78 char]

>>
```





Results are written to csv file

File set	COM_dB	peak_interference_mV	peak_channel_interference_mV	peak_ISI_mV
FCI_CC_Long_Link_Pair_15_to_Pair_7--FCI_CC_Long_Link_Pair_15_to_Pair_7_Through	0.786056	90.2	80.4	73

peak_MDXTK_interference_mV	ICN	peak_MDNEXT_interference_mV	peak_MDFEXT_interference_mV	fit_loss_dB_at_Fnq
21	3.040654	18.8	4.2	15.413762

peak_MDXTK_inter	ICN	peak_MDNEXT_interference_m	peak_MDFEXT_inte	fit_loss_dB
21	3.040654	18.8	4.2	15.413762