

Channel Operating Margin Program Usage

Richard Mellitz
Intel Corporation
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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_CTL	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_ctl	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	ctl_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							

D	E	F	G	H	I	J	K	L
ndfe	max_ctl	a_thru	a_fext	a_next	AG	specBER	Allowance	G_s_noise
12	12	0.4	0.4	0.6	1	1.00E-12	3	0.01
12	12	0.4	0.4	0.6	1	1.00E-05	3	0.01
16	12	0.4	0.4	0.6	0.33333	1.00E-05	3	0.005
12	12	0.4	0.4	0.6	1	1.00E-12	0	0.01
12	12	0.4	0.4	0.6	1	1.00E-05	0	0.01
16	12	0.4	0.4	0.6	0.33333	1.00E-05	0	0.01

Coding and port type
selection roller

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_CTLT	1
Unit Interval (UI)	3.87879E-11		NRZ/FEC Clause 93	INCLUDE_FILTER	1
tx_ff	[.1 .4]		PAM4 Clause 94	DEBUG	0
ndf	12		NRZ Clause 93 D1.1	DISPLAY_WINDOW	0
max_ctlt	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				
ctl_tstep	1				
tx_ff_tstep	0.02				
maxdf1	1				
maxdfx	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 sensitivity 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 scale. Value > 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 bandwidth for victim. Set to > 2 to deactivate
f_f	f_f	0.55	Transmitter 3 dB bandwidth for Far-end aggressor. Set to > 2 to deactivate
f_n	f_n	1	Transmitter 3 dB bandwidth 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 frequency domain metrics
	1 - report some frequency 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 $7 \times \text{ICN} - \text{peak_MDXTK_interference}$
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 rest 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')  
COM2L base version: 1.05
```

Interactive file input example

INPUT CONFIG FILE.xls

Look in: COM2L_100

Name	Date modified	Type	Size
New Folder	8/27/2012 2:12 PM	File folder	
old	8/14/2012 4:26 PM	File folder	
result	8/30/2012 2:45 PM	File folder	
config_COM2L.xls	8/30/2012 2:49 PM	Microsoft Excel 97...	59
config_COM2L_1243.xls	8/27/2012 11:04 AM	Microsoft Excel 97...	55
config_COM2L_pam.xls	8/27/2012 1:54 PM	Microsoft Excel 97...	59

File name: config_COM2L.xls

Files of type: (*.xls)

input thru channel response.s4p

Look in: QSFP-3m-IL

Name	Date modified	Type	Size
Rx1-Tx1.s4p	12/10/2010 8:02 AM	S4P File	1,519 KB
Rx2-Tx2.s4p	12/10/2010 8:01 AM	S4P File	1,519 KB
Rx3-Tx3.s4p	12/10/2010 8:01 AM	S4P File	1,519 KB
Rx4-Tx4.s4p	12/10/2010 8:01 AM	S4P File	1,519 KB
Tx1-Rx1.s4p	12/10/2010 8:01 AM	S4P File	1,519 KB
Tx2-Rx2.s4p	12/10/2010 8:01 AM	S4P File	1,519 KB
Tx3-Rx3.s4p	12/10/2010 8:00 AM	S4P File	1,519 KB
Tx4-Rx4.s4p	12/10/2010 8:00 AM	S4P File	1,519 KB

File name: Rx1-Tx1.s4p

Files of type: (*.s4p)

Enter spreadsheet

Then enter s4p files

Indicates type of file requested

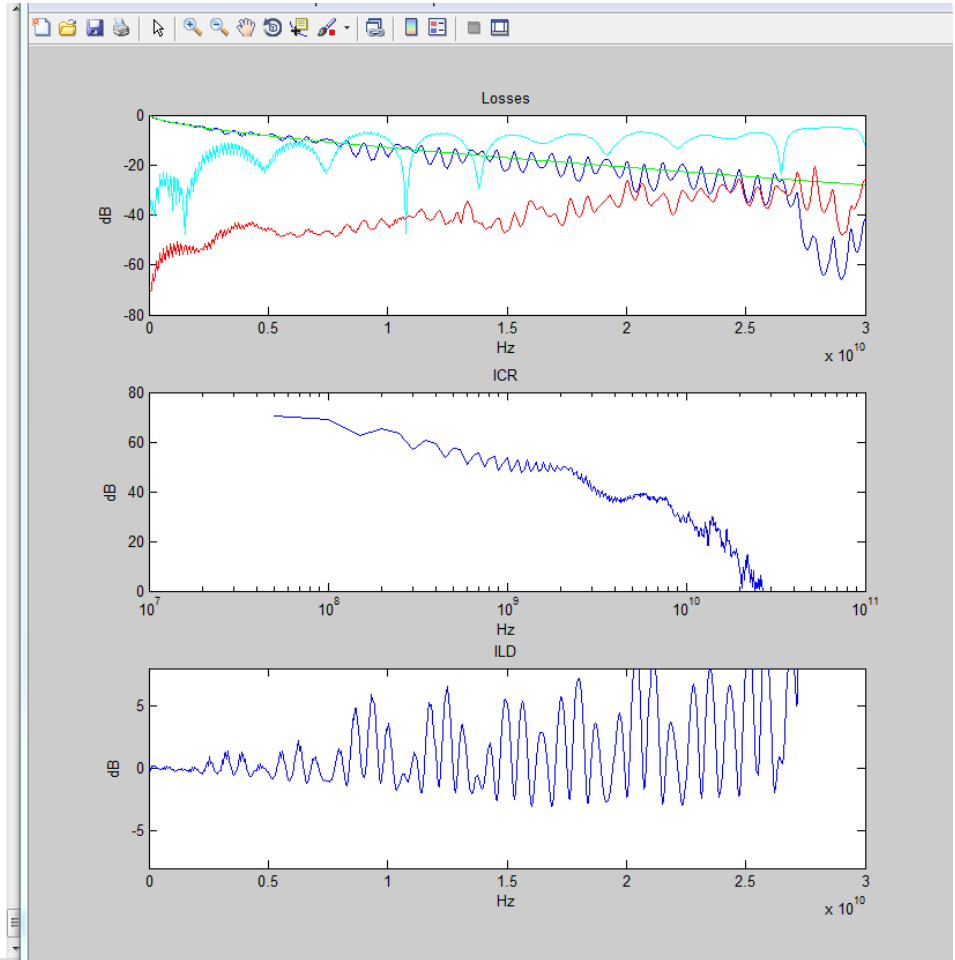
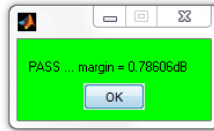
```
>> com2l_r105
COM2L beta version 1.05
This code is expected to change as the IEEE802.3bj document evolves.
This is not a normative or an official IEEE document.
Coding NRZ, NRZ/FEC, PAM4 or config XLS file [get XLS file]:
How many FEXT channels are to be entered? [0]
fx How many NEXT channels are to be entered? [0]
```

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.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')
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_mV	peak_MDFEXT_interference_mV	fit_loss_dB
21	3.040654	18.8	4.2	15.413762