Channel Operating Margin Program Usage, Review, and Plans

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Inclusion of comment resolutions from,

09-2012

IEEE802.3bj Geneva Interim

Operation

- Running com2l
  - Interactive file input (Q/A)
    - Spreadsheet selection windows
    - File selection windows
  - Scriptable single line entry
- Spreadsheet (XLS file) configures parameters
  - Values in most sheet slides are syntax examples unless noted
- Versions
  - 1.05 (com2L_r105) on Geneva, 09-2012 meeting site
  - 1.06 will be updated to Draft 1.2
  - 1.07 proposed changes
- 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®
- Note d1p2 notation replaces r106 to better coordinate with Draft revisions
  - d1p2 is d1.2

Configuration Spreadsheet: Select Port Type, d1p2

	A	B	C	D	E	F	G
1	Parameter	Setting		Coding/Port Type	Operational Control		
2	Coding/Port Type	NRZ Clause 93 d1.2		NRZ Clause 93 d1.2	INCLUDE_CTLE	1	
3	Signal Rate (fb)	25.78125	GHz	NRZ/FEC Clause 93 d1.2	INCLUDE_TX_RX_FILTER	1	
4	[c(-1) c(1)]	[-.1 -.4]		PAM4 Clause 94 d.1.2	DEBUG	1	
5	Nb	14	UI	NRZ Clause 93 alt	DISPLAY_WINDOW	1	
6	Gdc, for CTF	-12	dB	NRZ/FEC Clause 93 alt	CSV_REPORT	1	
7	Av	0.4	V	PAM4 Clause 94 alt	SAVE_RESP	0	
8	Af	0.4	V		GET_FD	1	
9	An	0.6	V		INC_PACKAGE_RL	1	
10	L	2			USE_EXTERNAL_PARAM	0	
11	SER0	1.00E-12			RESULT_DIR	est_results\	
12	CC1	3			INC_PACKAGE_IL	1	
13	sigma_rj	0.01					
14	Add	0.1					
15	sigma_r						
16	Samples Per UI						
17	Port Order						
18	Gamma_01						
19	Gamma_02						
20	f1						
21	f2						
22	CTF_step						
23	TXFFE_step						
24	bmax						
25	f_v	0.55	*fb				
26	f_f	0.55	*fb				
27	f_n	1	*fb				
28	f_r	0.75	*fb				
29	PKG_a1	2.91E+00	ers/m/GHz^1/2				
30	PKG_a2	4.84E-01	epers/m/GH				
31	PKG_a4	5.87E-02	ers/m/GH				
32	PKG_L_tl	7.07E-03	m				
33	PKG_C_d	2.50E-04	nF				
34	PKG_C_b	2.20E-04	nF				
35	PKG_vp	0.182	m/ns				
36	PKG_R0	50	ohm				
	PKG_Ed	11.9	%				

Grey areas are new

Coding and port type selection roller

	A	B	C	D	E	F	G	H	I	J	K	L
1	Coding/Port					Av	Af	An	L	SER0	CC1	sigma
2	NRZ Clause 93 d1.2	25.78125	[-.1 -.4]	14	-12	0.4	0.4	0.6	2	1.00E-12	3	0.0
3	NRZ/FEC Clause 93 d1.2	25.78125	[-.1 -.4]	14	-12	0.4	0.4	0.6	2	1.00E-05	3	0.0
4	PAM4 Clause 94 d.1.2	13.59375	[-.1 -.4]	16	-12	0.4	0.4	0.6	4	1.00E-05	3	0.0
5	NRZ Clause 93 alt	25.78125	[-.1 -.4]	14	-12	0.4	0.4	0.6	2	1.00E-12	3	0.0
6	NRZ/FEC Clause 93 alt	25.78125	[-.1 -.4]	14	-12	0.4	0.4	0.6	2	1.00E-05	3	0.0
7	PAM4 Clause 94 alt	13.59375	[-.1 -.4]	16	-12	0.4	0.4	0.6	4	1.00E-05	3	0.0

Settings | Lookup Tables | Help - Operational Control | Help - Parameter

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

d1p2

	A	B	C	D	E	F	G
1	**Parameter**	**Setting**		**Coding/Port Type**	**Operational Control**		
2	Coding/Port Type	NRZ Clause 93 d1.2		NRZ Clause 93 d1.2	INCLUDE_CTLE	1	
3	Signal Rate (fb)	25.78125	GHz	NRZ/FEC Clause 93 d1.2	INCLUDE_TX_RX_FILTER	1	
4	[c(-1) c(1)]	[-.1 -.4]		PAM4 Clause 94 d.1.2	DEBUG	1	
5	Nb	14	UI	NRZ Clause 93 alt	DISPLAY_WINDOW	1	
6	Gdc, for CTF	-12	dB	NRZ/FEC Clause 93 alt	CSV_REPORT	1	
7	Av	0.4	V	PAM4 Clause 94 alt	SAVE_RESP	0	
8	Af	0.4	V		GET_FD	1	
9	An	0.6	V		INC_PACKAGE_RL	1	
10	L	2			USE_EXTERNAL_PARAM	0	
11	SER0	1.00E-12			RESULT_DIR	est_results\	
12	CC1	3			INC_PACKAGE_IL	1	
13	sigma_rj	0.01	UI				
14	Add	0.1	UI				
15	sigma_r	0.001	V				
16	Samples Per UI	32					
17	Port Order	[1 3 2 4]					
18	Gamma_01	0.315	V/V				
19	Gamma_02	0.315	V/V				
20	f1	20.625	GHz				
21	f2	20.625	GHz				
22	CTF_step	1	dB				
23	TXFFE_step	0.02					
24	bmax	1					
25	f_v	0.55	*fb				
26	f_f	0.55	*fb				
27	f_n	1	*fb				
28	f_r	0.75	*fb				
29	PKG_a1	2.91E+00	ers/m/GHz^1/2				
30	PKG_a2	4.84E-01	epers/m/GH				
31	PKG_a4	5.87E-02	ers/m/GHz^2				
32	PKG_L_tl	7.07E-03	m				
33	PKG_C_d	2.50E-04	nF				
34	PKG_C_b	2.20E-04	nF				
35	PKG_vp	0.182	m/ns				
36	PKG_R0	50	ohm				
37	PKG_Ed	11.9	%				

D1.2 Sheet: KR4 for d1p2

	A	B	C	D	E	F	G
1	**Parameter**	**Setting**		**Coding/Port Type**	**Operational Control**		
2	Coding/Port Type	NRZ/FEC Clause 93 d1.2		NRZ Clause 93 d1.2	INCLUDE_CTLE	1	
3	Signal Rate (fb)	25.78125	GHz	NRZ/FEC Clause 93 d1.2	INCLUDE_TX_RX_FILTER	1	
4	[c(-1) c(1)]	[-.1 -.4]		PAM4 Clause 94 d.1.2	DEBUG	1	
5	Nb	14	UI	NRZ Clause 93 alt	DISPLAY_WINDOW	1	
6	Gdc, for CTF	-12	dB	NRZ/FEC Clause 93 alt	CSV_REPORT	1	
7	Av	0.4	V	PAM4 Clause 94 alt	SAVE_RESP	0	
8	Af	0.4	V		GET_FD	1	
9	An	0.6	V		INC_PACKAGE_RL	1	
10	L	2			USE_EXTERNAL_PARAM	0	
11	SER0	1.00E-05			RESULT_DIR	est_results\	
12	CC1	3			INC_PACKAGE_IL	1	
13	sigma_rj	0.01	UI				
14	Add	0.1	UI				
15	sigma_r	0.001	V				
16	Samples Per UI	32					
17	Port Order	[1 3 2 4]					
18	Gamma_01	0.315	V/V				
19	Gamma_02	0.315	V/V				
20	f1	20.625	GHz				
21	f2	20.625	GHz				
22	CTF_step	1	dB				
23	TXFFE_step	0.02					
24	bmax	1					
25	f_v	0.55	*fb				
26	f_f	0.55	*fb				
27	f_n	1	*fb				
28	f_r	0.75	*fb				
29	PKG_a1	2.91E+00	ers/m/GHz^1/2				
30	PKG_a2	4.84E-01	epers/m/GH				
31	PKG_a4	5.87E-02	ers/m/GHz^2				
32	PKG_L_tl	7.07E-03	m				
33	PKG_C_d	2.50E-04	nF				
34	PKG_C_b	2.20E-04	nF				
35	PKG_vp	0.182	m/ns				
36	PKG_R0	50	ohm				
37	PKG_Ed	11.9	%				

D1.2 Sheet: KR4/FEC for d1p2

	A	B	C	D	E	F	G
1	**Parameter**	**Setting**		**Coding/Port Type**	**Operational Control**		
2	Coding/Port Type	PAM4 Clause 94 d.1.2		NRZ Clause 93 d1.2	INCLUDE_CTLE	1	
3	Signal Rate (fb)	13.59375	GHz	NRZ/FEC Clause 93 d1.2	INCLUDE_TX_RX_FILTER	1	
4	[c(-1) c(1)]	[-.1 -.4]		PAM4 Clause 94 d.1.2	DEBUG	1	
5	Nb	16	UI	NRZ Clause 93 alt	DISPLAY_WINDOW	1	
6	Gdc, for CTF	-12	dB	NRZ/FEC Clause 93 alt	CSV_REPORT	1	
7	Av	0.4	V	PAM4 Clause 94 alt	SAVE_RESP	0	
8	Af	0.4	V		GET_FD	1	
9	An	0.6	V		INC_PACKAGE_RL	1	
10	L	4			USE_EXTERNAL_PARAM	0	
11	SER0	1.00E-05			RESULT_DIR	est_results\	
12	CC1	3			INC_PACKAGE_IL	1	
13	sigma_rj	0.005	UI				
14	Add	0.05	UI				
15	sigma_r	0.001	V				
16	Samples Per UI	32					
17	Port Order	[1 3 2 4]					
18	Gamma_01	0.315	V/V				
19	Gamma_02	0.315	V/V				
20	f1	20.625	GHz				
21	f2	20.625	GHz				
22	CTF_step	1	dB				
23	TXFFE_step	0.02					
24	bmax	0.2					
25	f_v	0.55	*fb				
26	f_f	0.55	*fb				
27	f_n	1	*fb				
28	f_r	0.75	*fb				
29	PKG_a1	2.91E+00	ers/m/GHz^1/2				
30	PKG_a2	4.84E-01	epers/m/GH				
31	PKG_a4	5.87E-02	ers/m/GHz^2				
32	PKG_L_tl	7.07E-03	m				
33	PKG_C_d	2.50E-04	nF				
34	PKG_C_b	2.20E-04	nF				
35	PKG_vp	0.182	m/ns				
36	PKG_R0	50	ohm				
37	PKG_Ed	11.9	%				

D1.2 Sheet: KP4 for d1p2

Parameter list (d1p2)

Example Setting		
Coding/Port Type	NRZ Clause 93 D1.1	selector for port type name
Signal Rate (fb)	25.78125	Signal. Used to calculate unit interval
[c(-1) c(1)]	[-.1 -.4]	Transmitter equalizer, max pre and post cursor coefficient
Nb	14	Victim single bit response exception window (in UI). Decision feedback equalizer (DFE) length
Gdc, for CTF	-12	Continuous time filter, max DC gain
Av	0.4	
Af	0.4	Transmitter differential peak output voltage for Far-end aggressor
An	0.6	Transmitter differential peak output voltage for Near-end aggressor
L	2	related to number of levels, L (symbol gain)
SER0	1.00E-12	Target uncorrected symbol error ratio
CC1	3	Minimum channel operating margin
sigma_rj	0.01	Normalized RMS Gaussian noise
Add	0.1	Normalized peak dual-Dirac noise
sigma_r	0.001	voltage sensitivey RMS Gaussian noise
Samples Per UI	32	
Port Order	[1 3 2 4]	for the 4 ports the first two listed are inputs and respective last two are outputs (RX)
Gamma_01	0.315	Transmitter reflection coefficient DC value. Values < .01 disables
Gamma_02	0.315	Receiver reflection coefficient DC value. Values < .01 disables
f1	20.625	Transmitter reflection coefficient reference frequency scale. Value > 2 disables
f2	20.625	Receiver reflection coefficient reference frequency scale.Value > 2 disables
CTF_step	1	Continuous time filter step size dB
TXFFE_step	0.02	Transmitter equalizer, pre/post cursor coefficient step size
bmax	1	max in W region
f_v	0.55	Transmitter 3 dB bandwith for victim. Set to > 2 to deactivate
f_f	0.55	Transmitter 3 dB bandwith for Far-end aggressor. Set to > 2 to deactivate
f_n	1	Transmitter 3 dB bandwith for Near-end aggressor. Set to > 2 to deactivate
f_r	0.75	Receiver 3dB bandwidth
PKG_a1	2.91E+00	package loss fit a1
PKG_a2	4.84E-01	package loss fit a2
PKG_a4	5.87E-02	package loss fit a3
PKG_L_tl	7.07E-03	package lenght (m)
PKG_C_d	2.50E-04	die capacitance load (nF)
PKG_C_b	2.20E-04	BGA/interconnect capacitance load (nF)
PKG_vp	0.182	propation velocity
PKG_R0	50	ref impedance
PKG_Ed	11.9	possibe % impedance variation

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. Shows equalization settings
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), benartsi_3bj_02_0912, p 9
	2 – use proposal 2 for h21(f), benartsi_3bj_02_0912, p 9
	3 – use proposal 3 for h21(f), benartsi_3bj_02_0912, p 9
	4 – use proposal 4 for h21(f), benartsi_3bj_02_0912, p 9
USE_EXTERNAL_PARAM	set to 0 . Will eventually be removed
RESULT_DIR	Point to the results directory. Full directory path ending in "\ " or "/ " is recommended
PKG_LOSS	0 – do not include package insertion loss **1- include package insertion loss**

CSV and display outputs

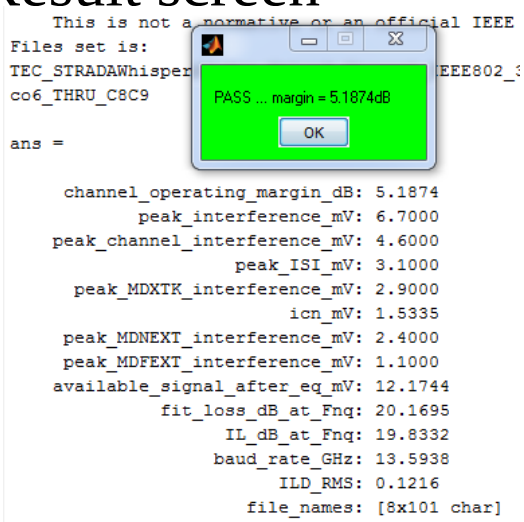
Output Parameters	
channel_operating_margin_dB: (COM)	Figure of merit. Adjusted so that above zero passes and below fails
peak_interference_mV:	Peak interference on channel include chip and system noise. For a test type of channel, this would be the value for additive rx tolerance injected noise. Since 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 d1p2 example

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

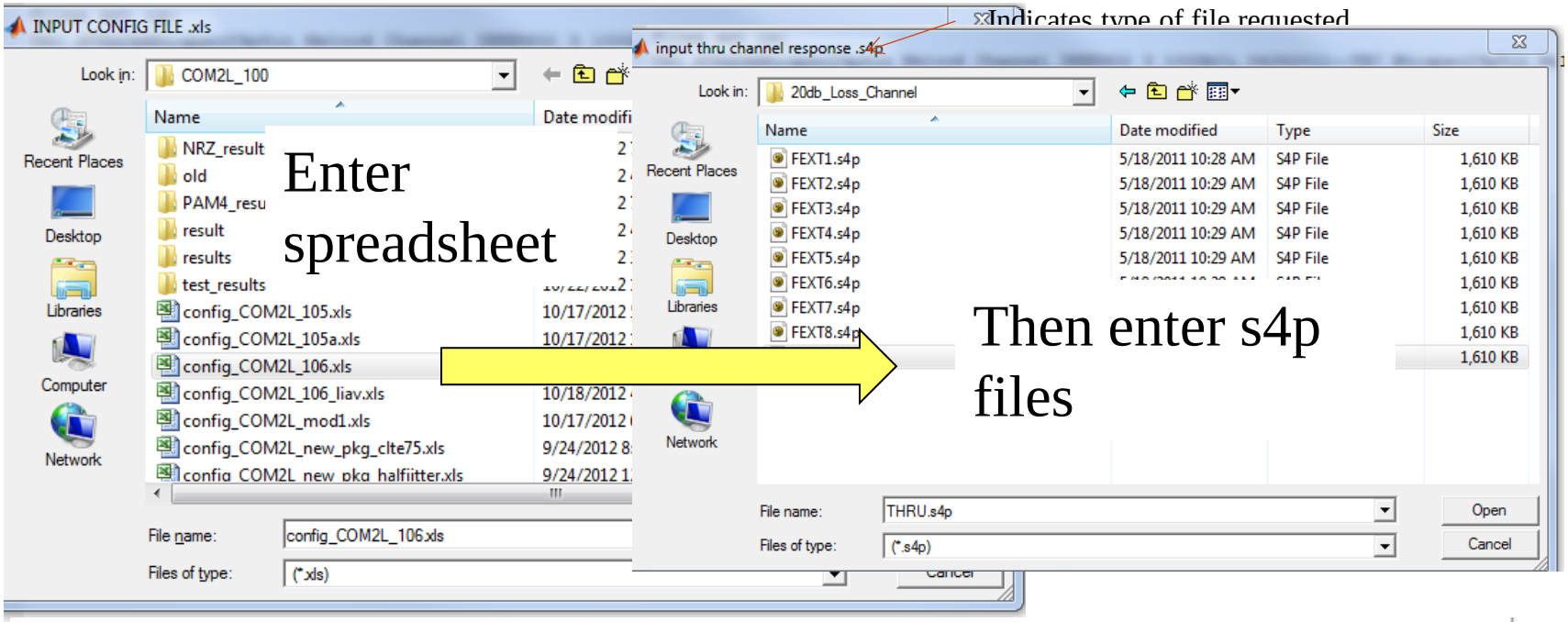
- output_args is a structure with results
- coding is string containing the full path name of the configuration spreadsheet
- num_fext is the number for fext s4p files
- num_next is the number for next s4p files
- All the reset of the arguments are strings containing the respective full path names of through, fext, and next files

Result screen




```
>> com2l_d1p2('config_COM2L_d1p2.xls',  3,
4,'J:\2012_TEMP\IEEE802.3bj\channels\models\shanbhag_02_0411\TEC_STRADAWhisper29p8in_Nel
co6_Channel_IEEE802_3_100GbCu_04282011\TEC_Whisper29p8in_Nelco6_THRU_C8C9.s4p',
'J:\2012_TEMP\IEEE802.3bj\channels\models\shanbhag_02_0411\TEC_STRADAWhisper29p8in_Nelco
6_Channel_IEEE802_3_100GbCu_04282011\TEC_Whisper29p8in_Nelco6_FEXT_B8B9_C8C9.s4p',
'J:\2012_TEMP\IEEE802.3bj\channels\models\shanbhag_02_0411\TEC_STRADAWhisper29p8in_Nelco
6_Channel_IEEE802_3_100GbCu_04282011\TEC_Whisper29p8in_Nelco6_FEXT_C11C12_C8C9.s4p',
'J:\2012_TEMP\IEEE802.3bj\channels\models\shanbhag_02_0411\TEC_STRADAWhisper29p8in_Nelco
6_Channel_IEEE802_3_100GbCu_04282011\TEC_Whisper29p8in_Nelco6_FEXT_D8D9_C8C9.s4p',
'J:\2012_TEMP\IEEE802.3bj\channels\models\shanbhag_02_0411\TEC_STRADAWhisper29p8in_Nelco
6_Channel_IEEE802_3_100GbCu_04282011\TEC_Whisper29p8in_Nelco6_NEXT_B8B9_C8C9.s4p',
'J:\2012_TEMP\IEEE802.3bj\channels\models\shanbhag_02_0411\TEC_STRADAWhisper29p8in_Nelco
6_Channel_IEEE802_3_100GbCu_04282011\TEC_Whisper29p8in_Nelco6_NEXT_C11C12_C8C9.s4p',
'J:\2012_TEMP\IEEE802.3bj\channels\models\shanbhag_02_0411\TEC_STRADAWhisper29p8in_Nelco
6_Channel_IEEE802_3_100GbCu_04282011\TEC_Whisper29p8in_Nelco6_NEXT_C5C6_C8C9.s4p',
'J:\2012_TEMP\IEEE802.3bj\channels\models\shanbhag_02_0411\TEC_STRADAWhisper29p8in_Nelco
6_Channel_IEEE802_3_100GbCu_04282011\TEC_Whisper29p8in_Nelco6_NEXT_D8D9_C8C9.s4p')
```

Interactive file input example

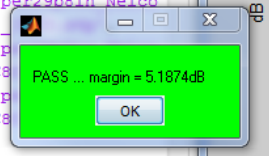


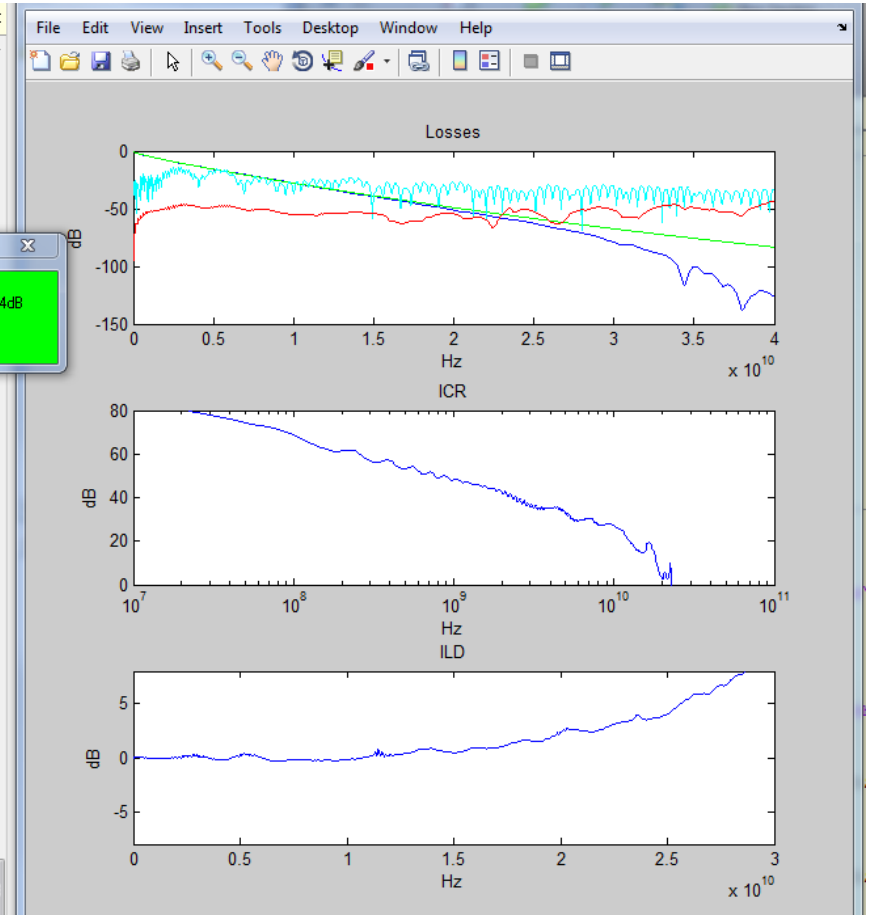

```
>> com2l_d1p2
COM2L for Draft 1.2
    This code is expected to change as the IEEE802.3bj document evolves.
    This is not a normative or an official IEEE document.
Enter config XLS file or return will just pop a window to ask for the XLS file]:
```

Example for single line entry

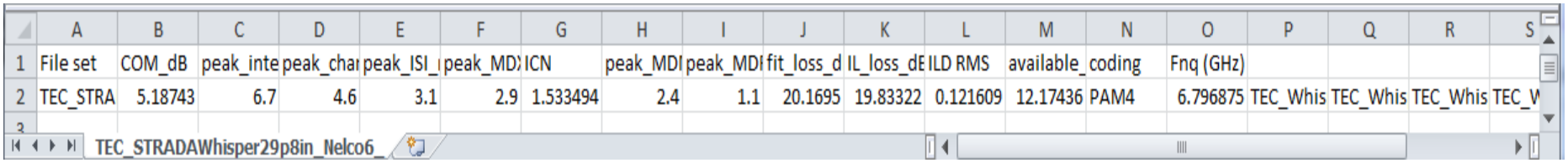
New to MATLAB? Watch this Video, see Examples, or read Getting Started.

```
'J:\2012_TEMP\IEEE802.3bj\channels\models\shanbhag_02_0411\TEC_STRADAWhisper29p8in_Nelco
6_Channel_IEEE802_3_100GbCu_04282011\TEC_Whisper29p8in_Nelco6_FEXT_B8B9_C8C9.s4p',
'J:\2012_TEMP\IEEE802.3bj\channels\models\shanbhag_02_0411\TEC_STRADAWhisper29p8in_Nelco
6_Channel_IEEE802_3_100GbCu_04282011\TEC_Whisper29p8in_Nelco6_FEXT_C11C12_C8C9.s4p',
'J:\2012_TEMP\IEEE802.3bj\channels\models\shanbhag_02_0411\TEC_STRADAWhisper29p8in_Nelco
6_Channel_IEEE802_3_100GbCu_04282011\TEC_Whisper29p8in_Nelco6_FEXT_D8D9_C8C9.s4p',
'J:\2012_TEMP\IEEE802.3bj\channels\models\shanbhag_02_0411\TEC_STRADAWhisper29p8in_Nelco
6_Channel_IEEE802_3_100GbCu_04282011\TEC_Whisper29p8in_Nelco6_NEXT_B8B9_C8C9.s4p',
'J:\2012_TEMP\IEEE802.3bj\channels\models\shanbhag_02_0411\TEC_STRADAWhisper29p8in_Nelco
6_Channel_IEEE802_3_100GbCu_04282011\TEC_Whisper29p8in_Nelco6_NEXT_C11C12_
'J:\2012_TEMP\IEEE802.3bj\channels\models\shanbhag_02_0411\TEC_STRADAWhisp
6_Channel_IEEE802_3_100GbCu_04282011\TEC_Whisper29p8in_Nelco6_NEXT_C5C6_C8
'J:\2012_TEMP\IEEE802.3bj\channels\models\shanbhag_02_0411\TEC_STRADAWhisp
6_Channel_IEEE802_3_100GbCu_04282011\TEC_Whisper29p8in_Nelco6_NEXT_D8D9_C8
COM2L for Draft 1.2
    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:
TEC_STRADAWhisper29p8in_Nelco6_Channel_IEEE802_3_100GbCu_04282011--TEC_Whisper29p8in_Nel
co6_THRU_C8C9

ans =

     channel_operating_margin_dB: 5.1874
           peak_interference_mV: 6.7000
    peak_channel_interference_mV: 4.6000
                  peak_ISI_mV: 3.1000
      peak_MDXTK_interference_mV: 2.9000
                         icn_mV: 1.5335
     peak_MDNEXT_interference_mV: 2.4000
     peak_MDFEXT_interference_mV: 1.1000
    available_signal_after_eq_mV: 12.1744
              fit_loss_dB_at_Fnq: 20.1695
                   IL_dB_at_Fnq: 19.8332
                baud_rate_GHz: 13.5938
                     ILD_RMS: 0.1216
                  file_names: [8x101 char]
```





Results are written to csv file (data is example only)



	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S
1	File set	COM_dB	peak_inte	peak_cha	peak_ISI_	peak_MDI	ICN	peak_MDI	peak_MDI	fit_loss_d	IL_loss_dE	ILD RMS	available_	coding	Fnq (GHz)				
2	TEC_STRA	5.18743	6.7	4.6	3.1	2.9	1.533494	2.4	1.1	20.1695	19.83322	0.121609	12.17436	PAM4	6.796875	TEC_Whis	TEC_Whis	TEC_Whis	TEC_W
3																			

TEC_STRADAWhisper29p8in_Nelco6_