Commit Request 4p17_3: FOM_SILD and FOM_SILD_RMS as Output Parameters

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IEEE 802.3 Channel Operating Margin (COM) Open Source Project Ad Hoc

History

Revision	Date	Comment
0.5	15-Oct-2026	▪ Initial Draft.
1.0	20-Oct-2026	▪ Added backup slides on the calculation of single-ended through response from the mixed mode through response. ▪ Revised the slide titled ‘List of parameters in calculating FOM_SILD’ in adding a screen capture.

Purpose for Commit Request

- Commit request related to calculating Skew-Induced Insertion Loss Deviation.
- This is a follow-up to the below presentation titled ‘Intra-pair skew metric (SILD): Skew-Induced Insertion Loss Deviation’ in bringing the calculation of FOM_SILD and FOM_SILD_RMS as output parameters to the COM tool.
  https://www.ieee802.org/3/400GPL/public/260820/nozadze_400GPL_01_260820.pdf
- It is a food for thought when it comes to intra-pair skew and not vetted for IEEE 802.3dv- 400G. May be there is a world where SCMR_CH and FOM_SILD may co-exist?
- Branch: fom_sild.
  https://opensource.ieee.org/hansel.dsilva/com_code/-/tree/fom_sild?ref_type=heads
- Git branch file pointer:
  https://opensource.ieee.org/hansel.dsilva/com_code/-/blob/fom_sild/release/com_ieee8023_4p17p0_sild.m?ref_type=heads

Code Updates

- 2 m file changed.
- 3 m files added.
- No additional config csv and xlsx files are included.

Files changed,
src/read_ParamConfigFile.m
src/FD_Processing.m

Files added,
src/get_SILD.m
src/solve_sild_band.m
src/calculate_fom_sild.m

New or changed keywords

- Configuration file parameters.

Keywords (not case sensitive)	Default	Units	Comment
SILD	0	None	▪ It may take a value of 0 or 1. ▪ If 1 then calculate SILD else do not.

New Outputs

Keywords	Units	Comment
FOM_SILD	decibel	▪ It is the figure of merit of skew-induced insertion loss deviation using the weighting function.
FOM_SILD_RMS	decibel	▪ It is the figure of merit of skew-induced insertion loss deviation using the weighting function of unity.

Summary of code changes page 1

src/read_ParamConfigFile.m

View file @ 5d30e901

```
...  @@ -628,6 +628,7 @@ if OP.RX_CALIBRATION
628      end
629  end
630  OP.ACBW = xls_parameter(parameter, 'ACBW', false, 0); % report
     apperant channel bandwidth
631  % Trigger some errors on bad parameter combinations
632  if OP.PSDRXCAL
633      if OP.RX_CALIBRATION
...
```

```
...  @@ -628,6 +628,7 @@ if OP.RX_CALIBRATION
628      end
629  end
630  OP.ACBW = xls_parameter(parameter, 'ACBW', false, 0); % report
     apperant channel bandwidth
631  + OP.fom_sild = xls_parameter(parameter, 'SILD', false, 1); %
     Computes SILD default is 0.  fom_sild reported
632  % Trigger some errors on bad parameter combinations
633  if OP.PSDRXCAL
634      if OP.RX_CALIBRATION
...
```

- Keyword used is SILD in the COM spreadsheet.

Summary of code changes page 2

src/FD_Processing.m

View file @ 5d30e901

```
...  @@ -195,6 +195,12 @@ for i=1:param.number_of_s4p_files
195              output_args.ACBW_GHz=chdata(i).Bch_GHz;
196          end
197          %%
198  +       if OP.fom_sild
199  +           [results_fom_sild] = get_SILD(chdata(i), OP, param);
200  +           output_args.FOM_SILD= results_fom_sild.fom_sild_db;
201  +           output_args.FOM_SILD_RMS=
     results_fom_sild.fom_sild_rms_db;
202  +       end
203  +       %%
198          [ILD_magft chdata(i).fit_f2_ild] =
     get_ILN(chdata(i).sdd21f(index_f1:index_f2_ild),
     chdata(i).faxis(index_f1:index_f2_ild));
199          % find fitted loss values by interpolation using full data,
     no indexing - Adee 2022-08-28
200          [~, chdata(i).fit_orig] = get_ILN(chdata(i).sdd21f,
     chdata(i).faxis);
...
```

```
...  @@ -195,6 +195,12 @@ for i=1:param.number_of_s4p_files
195              output_args.ACBW_GHz=chdata(i).Bch_GHz;
196          end
197          %%
198          [ILD_magft chdata(i).fit_f2_ild] =
     get_ILN(chdata(i).sdd21f(index_f1:index_f2_ild),
     chdata(i).faxis(index_f1:index_f2_ild));
199          % find fitted loss values by interpolation using full data,
     no indexing - Adee 2022-08-28
200          [~, chdata(i).fit_orig] = get_ILN(chdata(i).sdd21f,
     chdata(i).faxis);
...
```

- FOM_SILD support in FD_Processing().

List of parameters in calculating FOM_SILD

- R_0: Single-ended Reference impedance [Ohm].
- f_b: Baud rate [Gbd].
- f_v: Transition rate cut off frequency for ICN/ILD/FOM_SILD calculation in terms of fb [GHz].
  - It is related to the transmitter time T_t by:
    T_t= 0.2365/(f_b*f_v).
    where, T_t is the 20-80% transition time.
  - Note. In the COM spreadsheet, the user typically specifies T_t [in ps] rather than f_v [in GHz].
- f_r: Receiver bandwidth scaled to f_b [unitless].
- f_1: Start frequency [GHz].
- f_2: End frequency [GHz].

	A	B	C	D
1	data rate, die load, ref impedance			
2	**Parameter**	**Setting**	**Units**	**Information**
3	f_b	106.25	GBd	
4	f_min	0.0885	GHz	
5	Delta_f	0.01	GHz	
6	C_d	[0.4e-4 0.9e-4 1.1e-4 ;0.4e-4 0.9e-4 1.1e-4]	nF	[TX RX]
7	L_s	[0.13 0.15 0.14; 0.13 0.15 0.14]	nH	[TX RX]
8	C_b	[0.3e-4 0.3e-4]	nF	[TX RX]
9	R_0	50	Ohm	
10	PKG_NAME	**PKG_LowR_CLASSA PKG_LowR_CLASSA**		TX RX
11	z_p select	[1]		
12	L	4		
13	M	32		
14	filter and Eq			
15	f_r	0.75	*fb	

	D	E	O	P	Q	R
			SAVE_CONFIG2MAT	0		
	Information		Receiver testing			
			RX_CALIBRATION	0	logical	
			Sigma BBN step	5.00E-03	V	
			ICN parameters			
	[TX RX]		T_t	4.000	ps	
	[TX RX]		f_v	=1/P6/B3*0.2365*1000	59.13	
	[TX RX]		T_ft	4.250	ps	Table 179B–2
			T_nt	4.250	ps	
	TX RX		f_f	0.524	55.65	
			f_n	0.524	55.65	
			f_1	0.050	GHz	
			f_2	53.125	GHz	
			A_ft	0.600	V	
			A_nt	0.600	V	

Thank You

Mixed-Mode to Single-ended Through Response

SDD21= 0.5*(S21-S23+S43-S41)

SDC21= 0.5*(S21+S23-S43-S41)

SCD21= 0.5*(S21-S23-S43+S41)

SCC21= 0.5*(S21+S23+S43+S41)

S21= 0.5*(+SDD21+ SDC21+ SCD21+ SCC21)

S23= 0.5*(-SDD21+ SDC21- SCD21+ SCC21)

S41= 0.5*(-SDD21- SDC21+ SCD21+ SCC21)

S43= 0.5*(+SDD21- SDC21- SCD21+ SCC21)

- SILD requires single-ended through responses while COM reads a touchstone file and converts to mixed-mode S-parameters.

Step 1. Multiply by 2

2*SDD21= (S21-S23+S43-S41)

2*SDC21= (S21+S23-S43-S41)

2*SCD21= (S21-S23-S43+S41)

2*SCC21= (S21+S23+S43+S41)

Step 2. Solve for S21

2*SDD21+ 2*SDC21+ 2*SCD21+ 2*SCC21= 4*S21

Hence, S21= 0.5*(SDD21+ SDC21+ SCD21+ SCC21)

2*SDD21= (S21-S23+S43-S41)
2*SDC21= (S21+S23-S43-S41)
2*SCD21= (S21-S23-S43+S41)
2*SCC21= (S21+S23+S43+S41)

Step 3. Solve for S23

-2*SDD21+ 2*SDC21- 2*SCD21+ 2*SCC21= 4*S23

Hence, S23= 0.5*(-SDD21+ SDC21- SCD21+ SCC21)

2*SDD21= (S21-S23+S43-S41)
2*SDC21= (S21+S23-S43-S41)
2*SCD21= (S21-S23-S43+S41)
2*SCC21= (S21+S23+S43+S41)

Step 4. Solve for S41

-2*SDD21- 2*SDC21+ 2*SCD21+ 2*SCC21= 4*S41

Hence, S41= 0.5*(-SDD21- SDC21+ SCD21+ SCC21)

2*SDD21= (S21-S23+S43-S41)
2*SDC21= (S21+S23-S43-S41)
2*SCD21= (S21-S23-S43+S41)
2*SCC21= (S21+S23+S43+S41)

Step 5. Solve for S43

2*SDD21- 2*SDC21- 2*SCD21+ 2*SCC21= 4*S43

Hence, S43= 0.5*(SDD21- SDC21- SCD21+ SCC21)

2*SDD21= (S21-S23+S43-S41)
2*SDC21= (S21+S23-S43-S41)
2*SCD21= (S21-S23-S43+S41)
2*SCC21= (S21+S23+S43+S41)