COM Calculator
Quick Start Guide

Your first COM evaluation in nine steps, using the bundled demo scenarios

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Before you start: how to use this guide

Welcome to the COM Calculator. In one sentence, the problem it solves: can this high-speed link (backplane trace, cable, connector, package...) reliably run at a given data rate? "The loss looks fine" is not an answer - IEEE 802.3 defines a single scoring method called COM (Channel Operating Margin): loss, reflections, crosstalk and noise are folded into one number in dB, and COM >= 3 dB is the usual pass criterion.

The tool does two things, and this guide walks you through both:

- COM calculation - scores a channel, answering "can this link carry this data rate?"
- Interference tolerance calibration (ITOL) - the inverse question: "how much noise can this link still take?"

The software searches for the noise amplitude that lands COM exactly on the pass threshold; that amplitude is what you inject during receiver compliance testing.

This guide assumes you have never used the software and do not know MATLAB. In ten steps you will produce your first COM number, read the results, inspect the channel response, switch between three generations of data rate, run a calibration, override a parameter, add crosstalk and export a PDF report.

Everything uses the bundled demo scenarios in the demo folder of the installation directory. Each scenario is a .json file saying "use this configuration with this channel, and compute this":

Scenario in demo\ (in order)	Baud rate (Nyquist)	What it does
scenario_1_…bs_cd_COM	26.5625 GBd (13.28 GHz)	802.3bs/cd 50G/lane COM
scenario_2_…bs_cd_CAL	same	same channel ITOL calibration
scenario_3_…ck_COM	53.125 GBd (26.56 GHz)	802.3ck 100G/lane COM
scenario_4_…ck_CAL	same	same channel ITOL calibration
scenario_5_…dj_COM	106.25 GBd (53.13 GHz)	802.3dj 200G/lane COM
scenario_6_…dj_CAL	same	C2M module input ITOL (PSDRXCAL path, see Step 6)

The numbering is the suggested learning order: data rate low to high, and within a generation, COM first then calibration. The software auto-loads scenario 1 on first launch, so you can calculate right away.

> 提示：What is an .s4p? A channel characterisation file exported by a vector network analyser (VNA) or a simulator, describing transmission and reflection versus frequency. Four ports (s4p) covers one differential pair in and out. The .s4p files used by the scenarios live in demo\; the Excel configurations come from resources\ExcelConfigFiles\, which holds 20+ official standard configurations.

> 注意：Before running, make sure MATLAB Runtime R2024a is installed - it must be R2024a, not newer or older. If it is missing, double-click setup_env.bat one level above the installation folder: it probes the fastest mirror, downloads with resume and installs silently.

Step 1 Start the software and get oriented

Step 1 Double-click COM_Tool.exe. On first launch the software auto-loads scenario 1 from demo\ (26.5625 GBd), with the configuration and channel files already filled in.

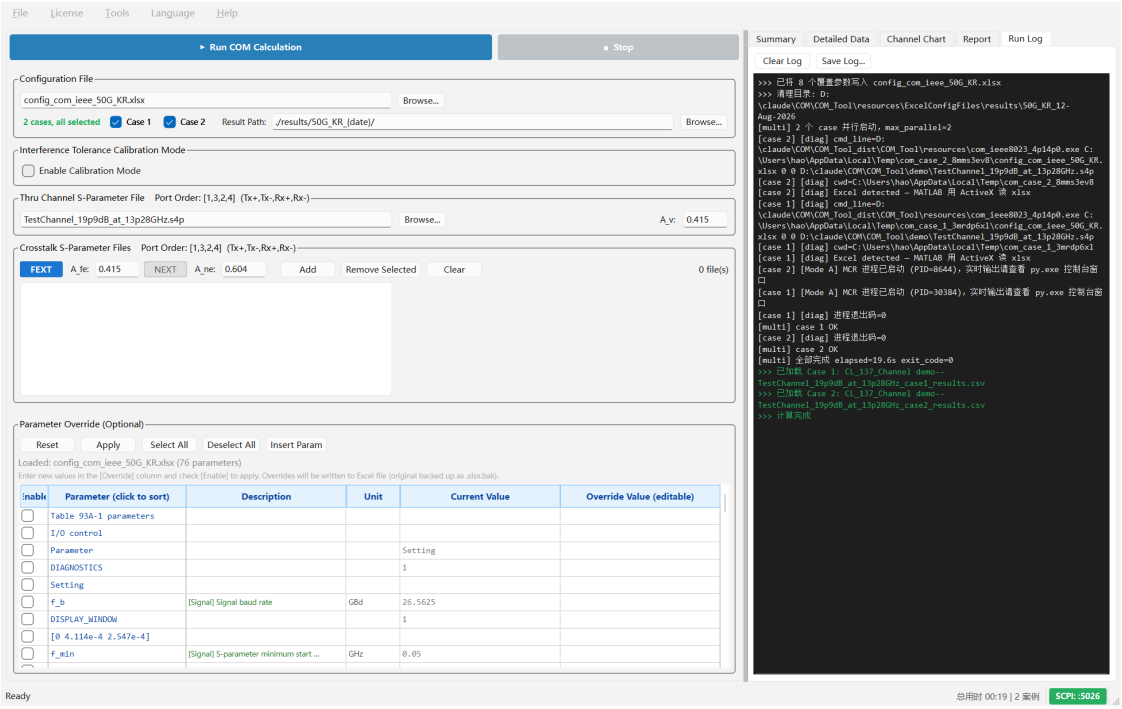

Figure 1-1 Main window: inputs on the left, results on the right

The window has two halves - that is all you need to remember:

Area	Purpose
Top left - Configuration File	The Excel configuration: standard, data rate, package model - all 109 IEEE parameters
Middle left - Thru Channel	The .s4p under test - the link being graded
Middle left - Crosstalk Files	Optional FEXT / NEXT aggressors (Step 8)
Bottom left - Parameter Override	Change a parameter without editing Excel (Step 7)
Bottom left - Run COM Calculation	Starts the calculation
Right - five tabs	Summary / Detail / Chart / Report / Log

> 提示：The splitter between the halves can be dragged. On a small screen, drag it right to give the parameter table more room.

Interface details: User Manual, Chapter 2.

Step 2 Produce your first COM

Change nothing - just calculate. Understand the pieces afterwards.

Step 1 Check that "Configuration File" and "Thru Channel" are already filled in (first launch does this for you).

Step 2 Click Run COM Calculation at the bottom left.

-> What you see: The button greys out, a progress bar and elapsed time appear at the bottom right, and the "Log" tab starts scrolling MATLAB output.

Step 3 Wait for it to finish.

Figure 2-1 Finished: the Summary tab shows COM

-> What you see: The Summary tab shows COM Result (worst case); a green PASS means it passes.

Measured results for the three COM scenarios - you should get the same numbers:

Demo scenario	COM result (two cases)	Typical time
scenario_1 (26.5625 GBd / 802.3bs · cd)	7.44 dB / 7.35 dB	20-50 s
scenario_3 (53.125 GBd / 802.3ck)	5.24 dB / 5.27 dB	15-30 s
scenario_5 (106.25 GBd / 802.3dj)	9.44 dB (both cases)	about 80 s

All three are well above 3 dB, so all three channels pass at their respective data rates.

注意：A black MATLAB console window appears while running. That is normal (the tool calls the official IEEE script on MATLAB Runtime) and it closes by itself.

> 提示：Nothing happens? Check the last few lines of the "Log" tab. The most common cause is a missing or wrong-version MATLAB Runtime (it must be R2024a).

Step 3 Read the results

The large number at the top of the Summary tab is the score. The key figures:

Metric	What it means	How to read it
COM (dB)	Channel operating margin - loss, reflection, crosstalk and noise as one score	>= 3 dB usually passes; higher is better
ERL (dB)	Effective return loss - reflections from impedance discontinuities	Higher is better; the standard sets its own limit
VEO (mV)	Vertical eye opening - voltage margin left	Higher is better
VEC (dB)	Vertical eye closure - how much the eye is squeezed	Lower is better
DER threshold	Detector error ratio	Reference value

When the Excel configuration defines several cases, each is calculated and listed under "Case Comparison"; the Summary shows the worst one, because that is what compliance is judged on.

Step 1 Switch to the Detail tab for every field MATLAB wrote to the result CSV (121 columns, including intermediate quantities).

> 提示："The loss looks fine" is not an acceptance criterion - the industry judges COM. It is defined by IEEE 802.3 Annex 93A/178A, and this tool calls the official script com_ieee8023_4p14p0.m directly, so results match the standard.

Metric details: User Manual, Chapter 6.

Step 4 See what the channel looks like (Chart tab)

COM is one score; the chart shows how the channel behaves at every frequency - the most direct way to judge a channel.

Step 1 Click the Chart tab on the right.

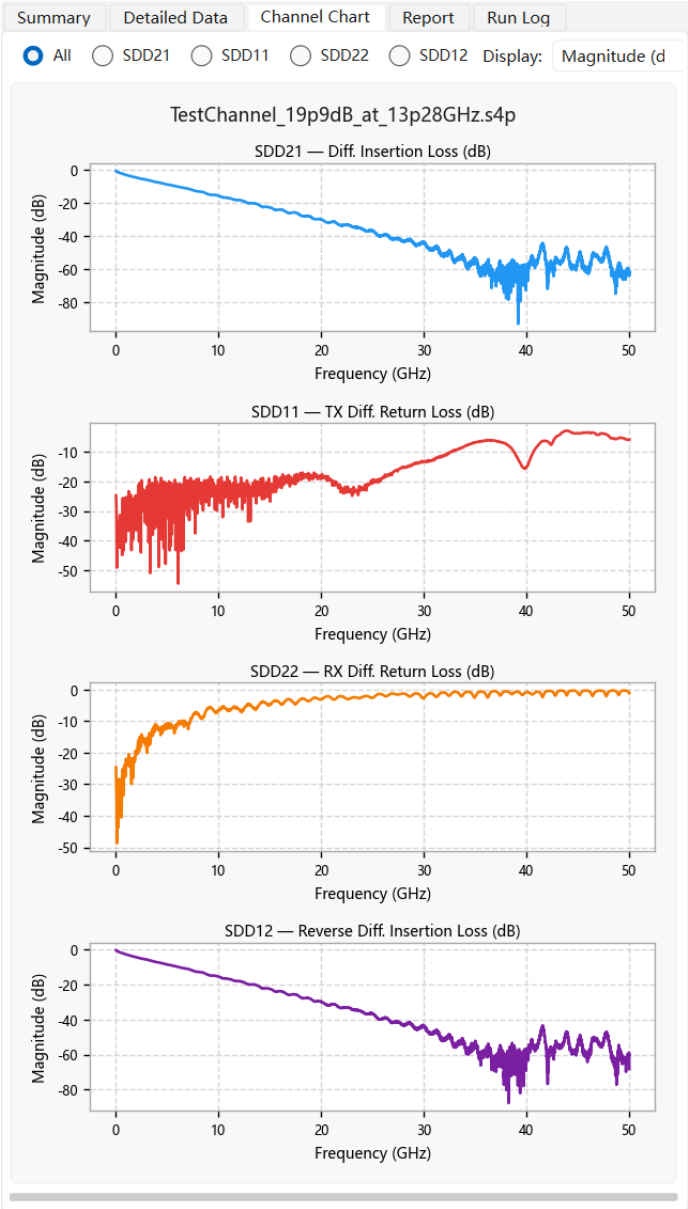

Figure 4-1 Channel chart: differential insertion and return loss

Curve	Meaning	What to look for
SDD21	Differential insertion loss - how much signal survives	Sloping down is normal; a steeper slope means a harder channel
SDD11 / SDD22	TX / RX differential return loss - energy reflected back	Lower is better; a sudden bump usually means an impedance discontinuity
SDD12	Reverse insertion loss	Normally close to SDD21

Step 2 The drop-down at the top right switches between all curves and a single one; next to it you can switch magnitude / phase.

Step 3 Right-click a curve to add a marker (reads the exact value at a frequency) or set the axis range. Markers also appear in the exported PDF report.

> 提示：Nyquist frequency = baud rate / 2. For 26.5625 GBd look at 13.28 GHz - the SDD21 value there best represents how hard this channel is.

Step 5 Try another generation of data rate

The same physical link is a very different problem at a different rate. The demo\ folder ships three generations; switching is just loading another .json.

Step 1 Menu File -> Load Configuration... and open the demo folder in the installation directory.

Step 2 Choose scenario_3_…ck_COM.json (802.3ck, 100G/lane, 53.125 GBd).

-> What you see: The configuration and thru-channel fields switch to that scenario's files.

Step 3 Click Run COM Calculation again and compare.

Step 4 For the highest rate, load scenario_5_…dj_COM.json (802.3dj, 200G/lane, 106.25 GBd). It has far more frequency points and takes noticeably longer (about 80 s) - that is expected.

> 提示：To use your own channel: keep the configuration and replace only the "Thru Channel" with your own .s4p - provided the channel really is designed for that standard's data rate.

> 注意：Port order matters. The software interprets ports using the Port Order field in the configuration, default [1 3 2 4] (1 and 3 are the input side). If your VNA exports a different order, change Port Order in the configuration - otherwise the differential parameters are wrong.

Step 6 Interference tolerance calibration (ITOL)

So far the question has been "does this channel pass?". Receiver compliance testing asks the inverse: how much noise can this link take? The software runs a binary search for the noise amplitude that puts COM exactly on the pass threshold (3 dB by default) - that amplitude is what you set on the BERT or noise source.

> 注意：Calibration mode requires a License Key. The trial version can compute COM but cannot enable calibration. See menu [Licence -> Licence Management] to request one.

6.1 Two calibration paths - the classic trap

The official IEEE script actually has two calibration paths. Which one runs is decided automatically by the configuration, and the script does not announce the switch. The two paths need different input files, and getting it wrong fails the run outright:

Path	When it is used	Files you must provide
Legacy RX_CALIBRATION	The configuration does not enable RxFFE (receiver feed-forward equaliser). Example: the demo 50G KR and 100G C2C scenarios	Exactly one FEXT file (used as the noise path), and zero NEXT files

Path	When it is used	Files you must provide
New PSDRXCAL	The configuration enables RxFFE with FFE method MMSE - which is the norm for 200G/212G-class configurations. Example: the demo dj C2M scenario	A PSDRXCAL Noise file (its own field in the UI); FEXT / NEXT counts are then unrestricted

The good news is that the software works this out for you: after you tick "Enable Calibration Mode" the UI switches its hint text according to the current configuration and shows the "PSDRXCAL Noise" field when it is needed. If that field appears, the configuration uses the new path and the field is mandatory.

> 注意：If the new path is used but the PSDRXCAL Noise file is left empty, the run fails within seconds with no result at all, and the log does not say why (a limitation of the MATLAB Runtime mode). If a calibration ends after a dozen seconds with nothing, check that field first.

6.2 Run one yourself

Step 1 Menu File -> Load Configuration... and choose scenario_2_…bs_cd_CAL.json.

-> What you see: "Enable Calibration Mode" is ticked automatically, one noise channel file appears in the crosstalk list, and the "calibration step" and "Pass threshold" fields appear beside it.

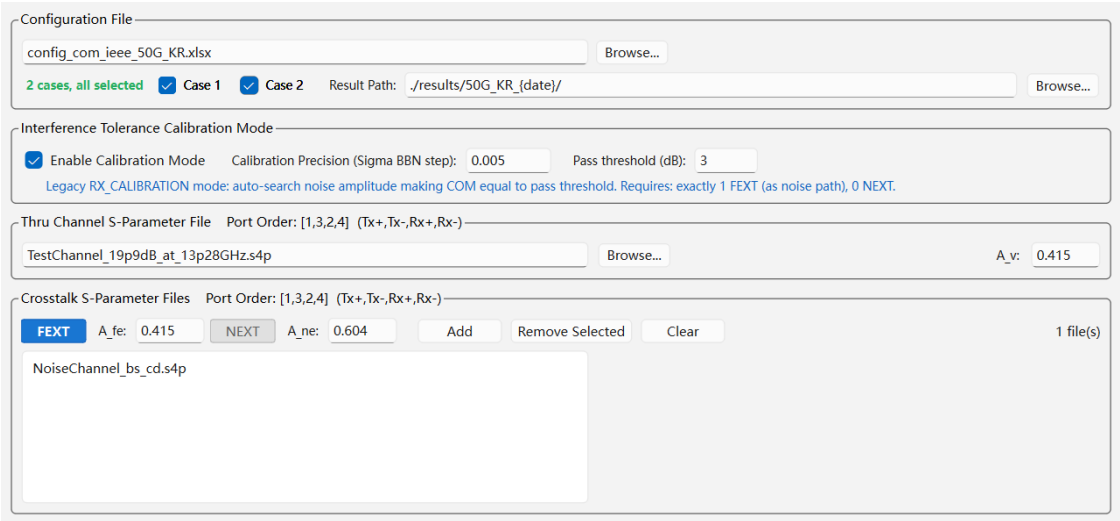

Figure 6-1 Input area after loading a calibration scenario

Step 2 The button now reads Run COM Calibration - click it.

Step 3 Wait for the search to finish - slower than a single COM run, because it tries many noise amplitudes.

-> What you see: The Summary tab gains an "interference tolerance calibration result" section below COM, giving the noise amplitude.

Measured results for the three calibration scenarios:

Demo scenario	Path taken	Noise amplitude found	Typical time
scenario_2 (26.5625 GBd)	legacy RX_CALIBRATION	0.0175 V	about 30 s
scenario_4 (53.125 GBd)	legacy RX_CALIBRATION	0.01 V	about 30 s
scenario_6 (106.25 GBd)	new PSDRXCAL	0.0575 V	about 200 s

提示："Calibration step" is the search step size (Sigma BBN step): smaller is finer and slower. "Pass threshold" is the COM value the search aims at, read from the configuration by default (normally 3 dB).

Calibration details: User Manual, Chapter 10.

Step 7 Override a parameter

The Excel configuration holds 109 IEEE parameters. To ask "what if the transmit amplitude were lower?", you do not have to edit Excel - use the Parameter Override panel at the bottom left.

Step 1 Find the parameter in the table (click the column header to sort).

Step 2 Type the new value in the Override Value column and tick Enable on that row.

-> What you see: The row turns yellow and moves to the top.

Step 3 Click Run COM Calculation and see how COM changes.

Step 4 To undo: click Reset, or untick the row.

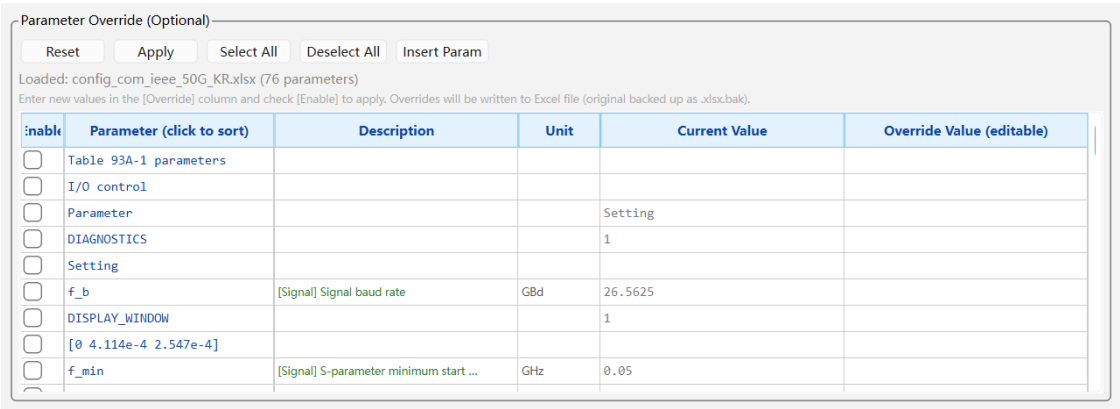

Figure 7-1 Parameter override: an enabled row turns yellow

注意：Override values are written into the Excel configuration file (the original is backed up as .xlsx.bak). Keep this in mind with your own files.

提示：Parameters missing from the template (AUTO_TFX, for example) can be added with the Insert Parameter button.

Parameter reference: User Manual, Appendix A.

Step 8 Add crosstalk (FEXT / NEXT)

In a real system neighbouring lanes couple into the channel under test. COM includes crosstalk in the score, so a realistic margin needs them.

Type	Full name	In plain terms
FEXT	Far-End Crosstalk	Aggressor travels in the same direction as the victim
NEXT	Near-End Crosstalk	Aggressor travels in the opposite direction - usually more severe

Step 1 In the "Crosstalk S-Parameter Files" group, use the FEXT / NEXT buttons to switch category.

Step 2 Click Add and pick an aggressor .s4p. Examples ship in demo\ and resources\Sparameters\.

Step 3 Run again and watch how far COM drops - the cost of crosstalk.

> 提示：Aggressor amplitudes are set in the A_fe / A_ne fields (volts), matching the parameters of the same name in Excel.

> 注意：The unlicensed trial allows at most one FEXT and one NEXT.

Step 9 Export a PDF report

Results have to be handed over - the tool exports conditions and results as one PDF.

Step 1 Click the Report tab and review it.

Step 2 Click Export PDF and choose where to save.

-> What you see: The PDF contains run conditions, every configuration parameter, the override record, the channel chart (including your markers) and per-case results.

> 提示：The result CSV files go to the directory named by RESULT_DIR in the configuration (by default a results\ folder next to it) and open directly in Excel.

Report details: User Manual, Chapter 9.

Step 10 Other things worth knowing

Staying up to date

Menu Help -> Check for Updates queries the download site for a newer version, then installs it and restarts with one click. The old version is renamed and kept alongside, so nothing of yours is lost.

S-parameter tools (no licence required)

Tool	When to use it
Tools -> Cascade S-Parameters	Chain cables, connectors and fixtures into one complete link
Tools -> De-embed S-Parameters	Remove a test fixture's effect to recover the true device under test

Talking to a VNA

Tools -> Connect VNA supports Keysight PNA/ENA, R&S and Anritsu: sweep parameters straight off the instrument into a COM calculation instead of exporting files by hand. This layer ships as open Python source.

Automation (SCPI remote control)

A SCPI over TCP/IP service is built in (port 5026 by default) and nearly every GUI action has a matching command. See User Manual, Chapter 15.

Where to go next

I want to...	Go to
Learn every panel and parameter properly	Menu Help -> User Manual (17 chapters plus appendices)
Find out what an IEEE parameter does	User Manual, Appendix A - Excel configuration structure
Understand calibration in depth	User Manual, Chapter 10 (both calibration paths explained)
Write automation scripts	User Manual, Chapter 15 - SCPI remote control
Measure a channel with an instrument	User Manual, Chapter 16 - VNA control
Request a License Key	Menu Licence -> Licence Management
Get the newest version	Menu Help -> Check for Updates

Enjoy!