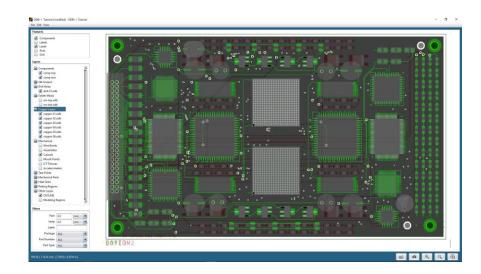
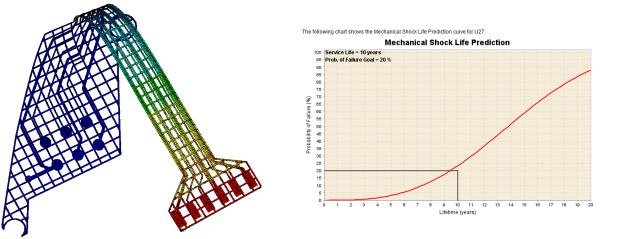
Release 2022 R1 Highlights Ansys Sherlock & Electronics Reliability



Ansys Electronics Reliability Updates – 2022 R1

- Ansys Sherlock
 - Semi-Automated Reinforcement Element Workflow Solution
 - Sherlock-Icepak EDB File Export
 - Import of GDSII/EDB Files
 - Sherlock Automation APIs
 - Sherlock-optiSLang Connection Details
 - General Functionality Enhancements
 - Documentation Updates
- Ansys Mechanical
 - Trace Mapping Support for Solid-Shell Elements
 - Reinforcement Element Enhancements
- Ansys LS-DYNA
 - Multiscale Analyses
 - Solder Reflow Simulations
- Ansys Icepak
- Ansys AEDT Mechanical
- Additional Resources







Ansys Sherlock

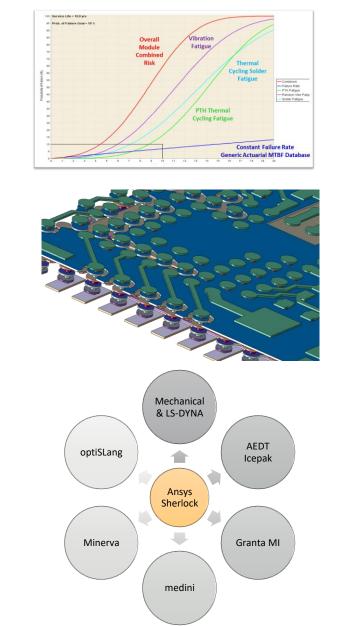


Ansys Sherlock – Typical Uses

Sherlock for Reliability

Sherlock as a Pre-Processor

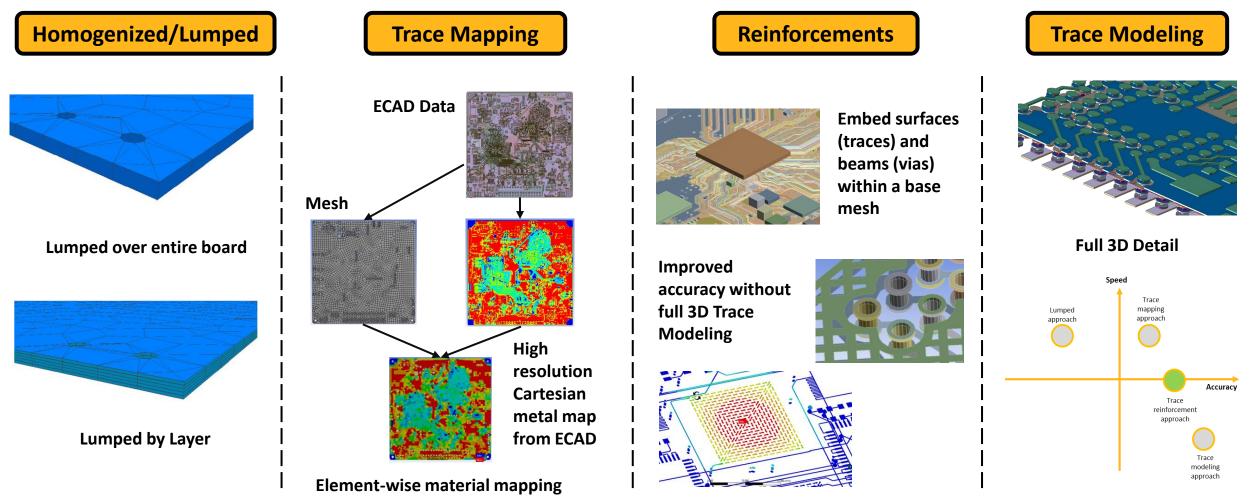
Sherlock Integrations





PCB Modeling Approaches

- Ansys provides leading solutions for the modeling of PCBs and Electronic Components. Multiple levels of fidelity supported.
- Start by importing ECAD files directly into Ansys tools, such as Ansys Sherlock and Ansys Mechanical.

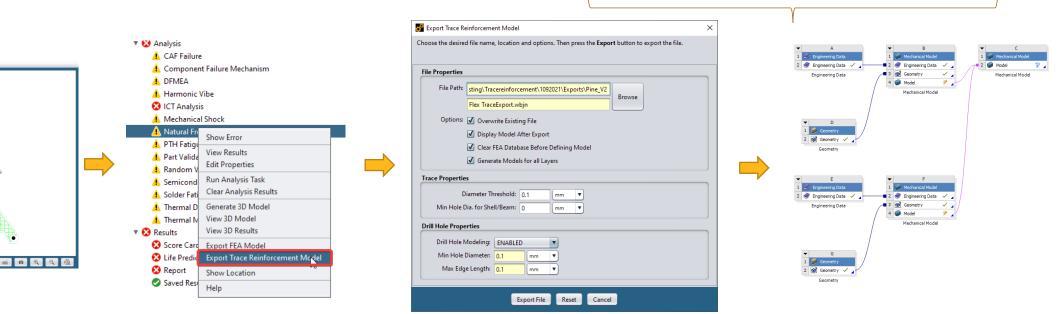


New in 2022 R1: Semi-Automated Reinforcement Element Workflow

Time-Saving automation tasks performed upon export from Ansys Sherlock:

Automation of Ansys Workbench/Mechanical setup with:

- Assigns thickness for Reinforcement Surface Bodies
- Assigns material properties
- Assign cross-section for the reinforcement Beams.
- Contacts between all the reinforcement bodies are automatically been removed.
- Generate layer based Named Selections



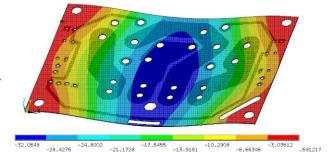
Semi-Automated Export and Model Build

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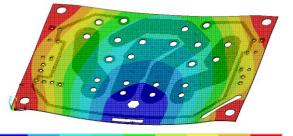
New in 2022 R1: Bending Stiffness for Smeared Reinforcement

- Greatly improves the solution accuracy with 3D smeared reinforcing (REINF) models
- Eliminates the need to use multiple REINF layers to capture the bending stiffness
- Enhances the REINF modeling usability in the new PCP/Chip simulation workflow

Accurate simulation results: REINF with bending vs. full 3D model

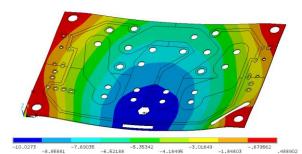


Reinforcing w/o bending stiffness

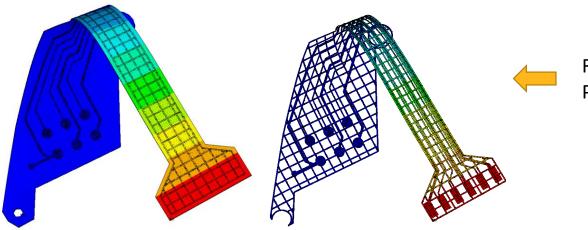


-10.3222 -9.12328 -7.9244 -6.72552 -5.52664 -4.32776 -3.12888 -1.93 -.731125 .467755

Reinforcing with bending stiffness



Full 3D model (trace modeling)

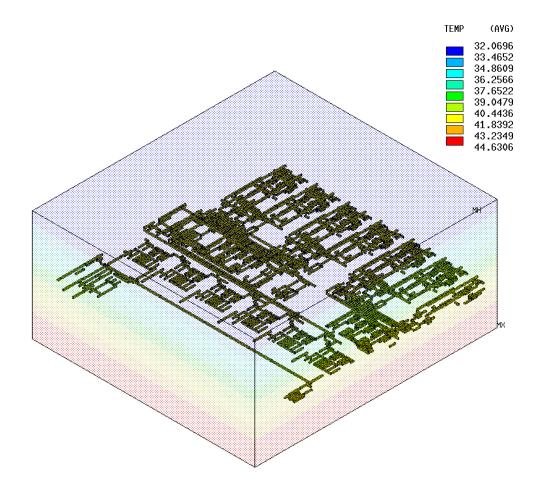


Robust and accurate simulation of flexible PCBs under large deformation



New in 2022 R1: Reinforcing Performance Enhancements

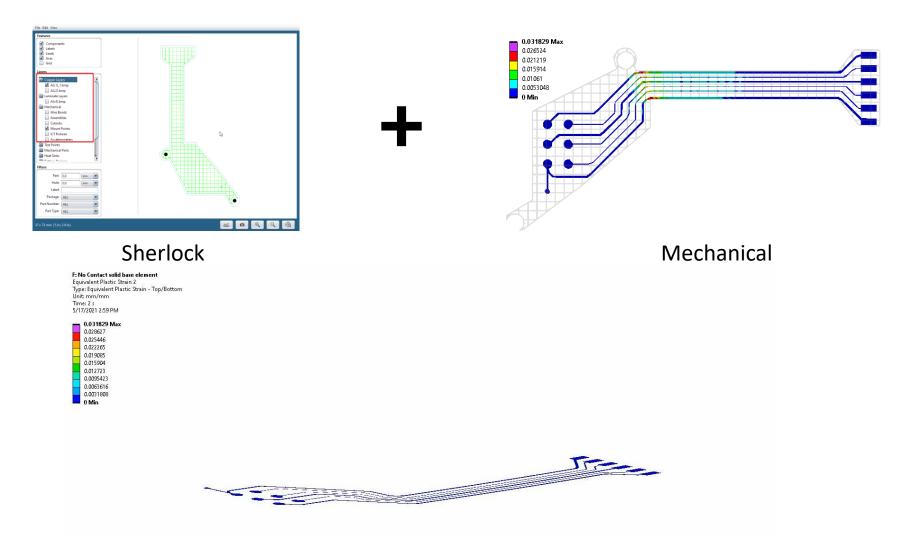
- Motivated by the requirements to account for large models (full PCB and chip models)
- Improved performance in pre-processing
 - Allows large number of reinforcing members in one base element
 - Reduces time needed for load mapping
- Improved solution efficiency
- Improved performance in post-processing
 - Significantly reduced time for querying min/max member results
 - Improved inter-member result smoothing





Application Highlight

Reinforcement Element Workflow Highlight – Flexible PCBs





Sherlock-Icepak Connection EDB File Export

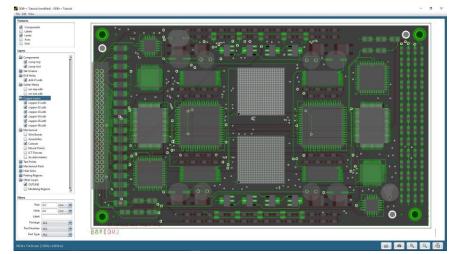


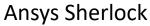
New in 2022 R1: Sherlock-Icepak Connection (EDB File Export)

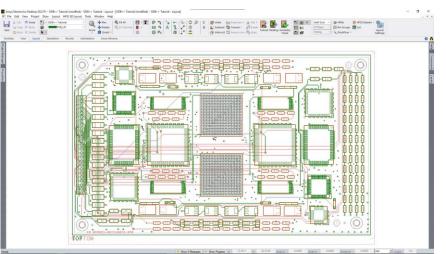
- Users can now export a CCA using the EDB format that is used by Ansys AEDT.
 - Ansys ECAD Database (*.def) file (Commonly referred to as an EDB file).
 - EDB files can then be imported directly in to AEDT.
 - If installed, AEDT can be opened automatically (including the resulting file import).
- Consequently, users can leverage the power of Ansys Sherlock to rapidly generate high-fidelity PCB models for use with Ansys AEDT Icepak.

Supported Features in 2022 R1:

- Stackup Layers
- Board Outline
- Holes
 - Vias
 - Plated Through-Holes
 - Non-Plated Through-Holes
- Traces
- Cutouts
- Components
- Pads (Stored as Pins)
- Material Properties







Ansys AEDT/Icepak



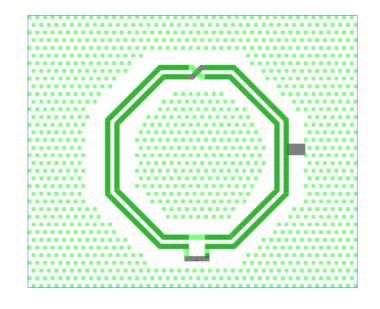
GDSII/EDB Import



New in 2022 R1: GDSII/EDB Import

- Sherlock now provides the ability to import stackups, stackup layers, and board outlines from an Ansys ECAD Database (*.def) file. From the main menu, select Project > Import Sherlock EDB File.
- In Sherlock, you can now import the stackup and stackup layers from a GDSII file. From the main menu, select **Project > Import GDSII File**.
- The ability to import GDSII files facilitates the preparation of Mechanical Models of Chip- and Die-Level, and other electronics structures for Thermal-Mechanical and other studies.

| CCA01 Stac | | | | | | | | | | | | | |
|--|---|--|---------------------------|--|---------------|---|-------------------------------------|---|---|---|--|--|------|
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| ackup Propert | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| The following I | g board pro | operties are based on the currently defined board | d outline and the individ | lual layer properties shown below: | | | | | _ | | | | |
| | | | Board Dimension: | 0.43 x 0.36 mm [0.0169 x 0.014 ii | CTExy: | 17.128 ppm/C | Board Weight: | 9.182e-5 grams | | | | | |
| | | | Board Thickness: | 0.315 mm [12.4 mil] | CTE2 | 69.506 ppm/C | Total Part Weight: | 0 grams | | | | | |
| | | | | 1.9027 g/cc | | 24.655 MPa | Mount Point Weight: | - | | | | | |
| | | | - | 2 | | 1 A A A A A A A A A A A A A A A A A A A | | | | | | | |
| | | | Conductor Layers: | 6 | Ez: | 3,487 MPa | Fixture Weight: | 0 grams | | | | | |
| | | L | | | | | | | | | | | |
| ackup Layers | | | | | | | | | _ | | | | |
| Double-click a | any row to | • edit the properties for that layer or select one or | r more rows and press t | | es for the si | elected layers. Use th | ne <u>Generate Stackup</u> button t | | | | | | |
| Double-click a Layer Type | any row to | Material | r more rows and press t | he <u>Edit</u> button above to edit properti Construction | es for the si | elected layers. Use th | ne <u>Generate Stackup</u> button t | Thickness | Density | CTExy | CTEz | Exy | Ez |
| Double-click a Layer Type 1 SIGNA | any row to N AL C | Material COPPER (26.7%) / COPPER-RESIN | r more rows and press t | Construction | es for the si | elected layers. Use th | ne <u>Generate Stackup</u> button t | Thickness 0.0005 mm | Density 3.6957 | CTExy 41.349 | CTEz 41.349 | Exy 32,736 | |
| Double-click a Layer Type 1 SIGNA 2 Lamin | any row to M AL C nate G | Material COPPER (26.7%) / COPPER-RESIN Seneric FR-4 | r more rows and press t | | es for the si | elected layers. Use th | ne <u>Generate Stackup</u> button t | Thickness 0.0005 mm 1.64 mil | Density 3.6957 1.9000 | CTExy 41.349 17.000 | CTEz 41.349 70.000 | Exy 32,736 24,804 | |
| Double-click a Layer Type 1 SIGNA 2 Lamin 3 SIGNA | any row to AL C nate G AL C | Material COPPER (26.7%) / COPPER-RESIN Generic FR-4 COPPER (3.6%) / COPPER-RESIN | r more rows and press t | Construction DEFAULT (2116) | es for the si | elected layers. Use th | re <u>Generate Stackup</u> button t | Thickness 0.0005 mm 1.64 mil 0.0005 mm | Density 3.6957 1.9000 2.0556 | CTExy 41.349 17.000 48.834 | CTEz 41.349 70.000 48.834 | Exy 32,736 24,804 7,442 | |
| Double-click a Layer Type 1 SIGNA 2 Lamin 3 SIGNA 4 Lamin | any row to AL C nate G AL C nate G | Vaterial COPPER (26.7%) / COPPER-RESIN Seneric FR-4 COPPER (3.6%) / COPPER-RESIN Seneric FR-4 | r more rows and press t | Construction | es for the s | elected layers. Use th | re <u>Generate Stackup</u> button t | Thickness 0.0005 mm 1.64 mil 0.0005 mm 1.64 mil | Density 3.6957 1.9000 2.0556 1.9000 | CTExy 41.349 17.000 48.834 17.000 | CTEz 41.349 70.000 48.834 70.000 | Exy 32,736 24,804 7,442 24,804 | |
| Double-click a Layer Type 1 SIGNA 2 Lamin 3 SIGNA 4 Lamin 5 SIGNA | any row to AL C nate G AL C nate G AL S | Material COPPER (26.7%) / COPPER-RESIN Seneric FR-4 COPPER (3.6%) / COPPER-RESIN Seneric FR-4 SILICON DIOXIDE (51.7%) / COPPER-RESIN | r more rows and press t | Construction DEFAULT (2116) DEFAULT (2116) | es for the se | elected layers. Use th | ne <u>Generate Stackup</u> button t | Thickness 0.0005 mm 1.64 mil 0.0005 mm 1.64 mil 0.0044 mm | Density 3.6957 1.9000 2.0556 1.9000 1.7276 | CTExy 41.349 17.000 48.834 17.000 31.905 | CTEz 41.349 70.000 48.834 70.000 31.905 | Exy 32,736 24,804 7,442 24,804 12,030 | |
| Double-click a Layer Type 1 SIGNA 2 Lamin 3 SIGNA 4 Lamin 5 SIGNA 6 Lamin | any row to AL C nate G AL G AL S nate G AL S nate G | Material COPPER (26:7%) / COPPER-RESIN Seneric FR-4 COPPER (3:6%) / COPPER-RESIN Seneric FR-4 SILICON, DIOXIDE (51:7%) / COPPER-RESIN Seneric FR-4 | r more rows and press t | Construction DEFAULT (2116) | es for the si | elected layers. Use th | ne <u>Generate Stackup</u> button t | Thickness 0.0005 mm 1.64 mil 0.0005 mm 1.64 mil 0.0044 mm 1.64 mil | Density 3.6957 1.9000 2.0556 1.9000 1.7276 1.9000 | CTExy 41.349 17.000 48.834 17.000 31.905 17.000 | CTEz 41.349 70.000 48.834 70.000 31.905 70.000 | Exy 32,736 24,804 7,442 24,804 12,030 24,804 | |
| Double-click a Layer Type 1 SIGNA 2 Lamin 3 SIGNA 4 Lamin 5 SIGNA 6 Lamin 7 SIGNA | any row to AL C nate G AL G AL S nate G AL G AL C | Material COPPER (26,7%) / COPPER-RESIN Service (FR-4 COPPER (26%) / COPPER-RESIN Service (FR-4 SILCON, DIOXIDE (51,7%) / COPPER-RESIN Service (FR-4 COPPER (13,2%) / COPPER-RESIN | r more rows and press to | Construction DEFAULT (2116) DEFAULT (2116) DEFAULT (2116) | es for the si | elected layers. Use th | ne <u>Generate Stackup</u> button t | Thickness 0.0005 mm 1.64 mil 0.0005 mm 1.64 mil 0.0044 mm 1.64 mil 0.0005 mm | Density 3.6957 1.9000 2.0556 1.9000 1.7276 1.9000 2.7372 | CTExy 41.349 17.000 48.834 17.000 31.905 17.000 45.723 | CTEz 41.349 70.000 48.834 70.000 31.905 70.000 45.723 | Exy 32,736 24,804 7,442 24,804 12,030 24,804 17,954 | |
| Double-click a Layer Type 1 SIGNA 2 Lamin 3 SIGNA 4 Lamin 5 SIGNA 6 Lamin | any row to AL C nate G AL C nate G AL S nate G AL C nate si | Material COPPER (26:7%) / COPPER-RESIN Seneric FR-4 COPPER (3:6%) / COPPER-RESIN Seneric FR-4 SILICON, DIOXIDE (51:7%) / COPPER-RESIN Seneric FR-4 | r more rows and press t | Construction DEFAULT (2116) DEFAULT (2116) | es for the s | elected layers. Use th | ne <u>Generate Stackup</u> button t | Thickness 0.0005 mm 1.64 mil 0.0005 mm 1.64 mil 0.0044 mm 1.64 mil | Density 3.6957 1.9000 2.0556 1.9000 1.7276 1.9000 | CTExy 41.349 17.000 48.834 17.000 31.905 17.000 45.723 17.000 | CTEz 41.349 70.000 48.834 70.000 31.905 70.000 | Exy 32,736 24,804 7,442 24,804 12,030 24,804 | |
| Double-click a Layer Type 1 SIGNA 2 Lamin. 3 SIGNA 4 Lamin. 5 SIGNA 6 Lamin. 7 SIGNA 8 Lamin. | any row to AL C nate G AL C AL C AL S nate G AL C nate si AL C | Material COPPER (36.7%) / COPPER-RESIN Semeric FR-4 Semeric FR-4 SILCON (JOXODE (51.7%) / COPPER-RESIN Semeric FR-4 COPPER (13.2%) / COPPER-RESIN Silcon, dioxide | r more rows and press t | Construction DEFAULT (2116) DEFAULT (2116) DEFAULT (2116) | es for the s | elected layers. Use th | ne <u>Generate Stackup</u> button t | Thickness 0.0005 mm 1.64 mil 0.0005 mm 1.64 mil 0.0044 mm 1.64 mil 0.0005 mm 1.64 mil | Density 3.6957 1.9000 2.0556 1.9000 1.7276 1.9000 2.7372 1.9000 | CTExy 41.349 17.000 48.834 17.000 31.905 17.000 45.723 17.000 44.395 | CTEz 41.349 70.000 48.834 70.000 31.905 70.000 45.723 70.000 | Exy 32,736 24,804 7,442 24,804 12,030 24,804 17,954 24,804 | Ez 3 |





Sherlock Automation APIs



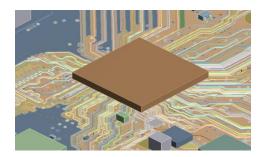
Scripting and Automation – Example Workflows

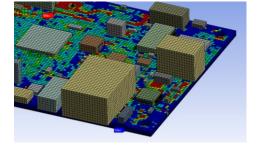
- There are many possibilities for automation in the Electronics Reliability space.
 - From general Sherlock Automation to streamline everyday tasks, to partially- or fully-automated workflows featuring leading Ansys solutions (such as the Reinforcement Element workflow).

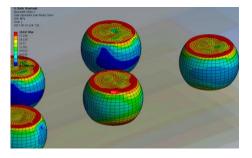
Python Example

import SherlockLifeCycleSer import SherlockLifeCycleSer import grpc

channel = grpc.insecure_cha:







Sherlock General Automation Pre-Processing Automation and Results Extraction End-to-End Workflow Automation

Advanced Applications



Ansys Sherlock Scripting - APIs

- Application Programming Interfaces (APIs) are available for Ansys Sherlock.
 - APIs Flexible framework allows for development in several languages, including Python.
 - Additional APIs that address additional features are being planned for future releases.
- Enables users to:
 - Run Simulations in Batch
 - Automate processes and standardize methods
 - Explore the impact of design and event variations on life prediction and other metrics.
- Automation Feature Examples
 - Open existing projects
 - Import ECAD files
 - Life Cycle and Event Creation
 - Update Parts from Parts Library
 - Query and modify Stackup Properties
 - Run Analyses, such as Solder Fatigue, Natural Frequency, Random Vibration, etc.

| 🦸 Modal | Analysis | | | | | | | | - | - | | \times |
|--|---|--|--------|--------------|--------------------------------------|------------------------------|--|---------|---------|----------|---------------------|-------------------|
| U Enable G Update B Update Lar | Import ECAD pdate Parts List Lead Modeling Get Layer Count loard Thickness minate Material | Imports either ar If project name i Project Name: *ECAD Type: *Browse File | | | a new pro | | | using t | he EC4 | AD filer | iame. | |
| Exp | date Copper % Show Stackup port FEA Model ate PWA Report | | | Im | port ECAE | D | Exit | | | | | |
| | | | Ø Stav | ikup: New Pr | Board Properti CCA: Board Dime | ension: kness: Layers: | ODB++ Tutorial 191 x 115 mm [7.5: 1.700 mm [66.9 mi 2.1969 g/cc 6 17.816 ppm/C 66.506 ppm/C 27,316 MPa 3,728 MPa | | | | - 0 | × |
| | | | Layer | Thickness | Copper % | Materi | ial | Density | СТЕху | CTEz | Exy | Ez |
| | | | 1 | 0.5oz | 17.6 | COPPER | R-RESIN | 3.0496 | 44.2976 | 44.2976 | 22772.0 | 22772.0 |
| | | | 2 | 0.3044mm | 0.0 | Generic | FR-4 Generic FR-4 | 1.9 | 17.0 | 70.0 | 24804.0 | 3450.0 |
| | | | 3 | 1.0oz | 94.2 | | R-RESIN | 8.4882 | 19.4792 | 19.4792 | 106649.0 | 106649. |
| | | | 4 | 0.3044mm | 0.0 | | FR-4 Generic FR-4 | | 17.0 | 70.0 | 24804.0 | 3450.0 |
| | | | 5 | 1.0oz | 2.2 | | R-RESIN | 1.9562 | 49.2872 | 49.2872 | 5909.0 | 5909.0 |
| | | | 6 | 0.3044mm | 0.0 | | FR-4 Generic FR-4 | | 17.0 | 70.0 | 24804.0 | 3450.0 |
| | | | 7 | 1.0oz | 2.1 | | R-RESIN | 1.9491 | 49.3196 | 49.3196 | | 5799.5 |
| | | | 8 | 0.3044mm | 0.0 94.2 | | FR-4 Generic FR-4 | 1.9 | 17.0 | 70.0 | 24804.0 | 3450.0 106649. |
| | | | 10 | 0.3044mm | 94.2 | COPPE | FR-4 Generic FR-4 | | 19.4792 | 70.0 | 106649.0 24804.0 | 3450.0 |
| | | | 11 | 0.507 | 10.9 | | R.RESIN | 2 5730 | | | 15435.5 | |

Custom Toolkit Leveraging Sherlock APIs



Sherlock-WB Connection Leveraging Sherlock APIs

Ansys Sherlock API Examples

Python Example

import SherlockLifeCycleService_pb2
import SherlockLifeCycleService_pb2_grpc
import grpc

channel = grpc.insecure_channel('localhost:9090')

stub = SherlockLifeCycleService_pb2_grpc.SherlockLifeCycleServiceStub(channel)

message = SherlockLifeCycleService_pb2.AddHarmonicEventRequest()

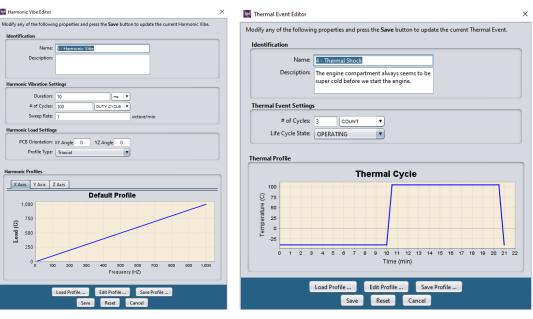
message.project = "Tutorial Project"
message.phaseName = "On The Road"
message.eventName = "Test Harmonic API"
message.description = "Test Description"
message.durationUnits = "ms"
message.durationUnits = "ms"
message.cycleType = "DUTY CYCLE"
message.orgente = 1
message.orientation = "1, 3"
message.profileType = "Uniaxial"
message.loadDirection = "0, 0, -1"

response = stub.addHarmonicEvent(message)

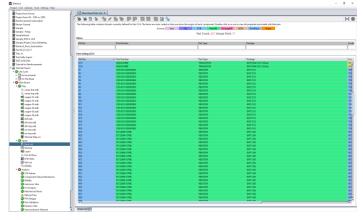
print(str(response))

| t CCA Libraries Tools Settin | | | | | | | | | | | | | | | |
|--|---|--|--|--|--|---------------------|----------------------------|--------------------------------------|-----------------------|---|--|---|--|---|---|
| enrorcements Automatio | | Main Board Stacl | | | | | | | | | | | | | |
| leview Tutorial | <u>je</u> | | | | | | | | | | | | | | |
| iample | 司 | わ 岸 🖥 | 🖥 🗟 💵 🥒 🖆 🔥 🖏 | | | | | | | | | | | | |
| ample - Friday | Tau b | ap Properties | | | | | | | | | | | | | |
| ample Board | | aprospercies. | | | | | | | | | | | | | |
| ample_PCB-4-14v0 | The | following board | properties are based on the currently defined board outline an | nd the individual layer propertie | es shown below: | | | | | | | | | | |
| ample_Project_Trace_Mod herlock_Show_Automation | | | | Barred Dimension | 191 x 115 mm (7.5 x 4.5 in) | <i>(</i> 1) | 17.779 ppm/C | Board Weight: | 47.10 | | | | | | |
| est 05.01.20 V1 | | | | | | | | | | | | | | | |
| lest, ta | | | | | 2.098 mm [82.6 mil] | | 68.514 ppm/C | Total Part Weight: | | | | | | | |
| est. Kelly Import | | | | Density: | 1.9217 g/cc | Exy | 23,800 MPa | Mount Point Weight: | 0 grams | | | | | | |
| EST SON PKG | | | | Conductor Layers: | 6 | Ez | 3.593 MPa | Fixture Weight: | 4.37 grams | | | | | | |
| utorial for Reinforcements | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | |
| utorial Project | Strate | un l'anner | | | | | | | | | | | | | |
| utorial Project Life Cycle | | up Layers | | | | | | | | | | | | | |
| Utorial Project Life Cycle | | | v to edit the properties for that layer or select one or more row | s and press the <u>Edit</u> button abo | we to edit properties for the s | elected layers. Us | the <u>Generate Stac</u> i | long button to replace all lay | ers using a given PCB | thickness and def | ault løyer prop | eties. | | | |
| Life Cycle Life Cycle Christonmental | Dos | | v to edit the properties for that layer or select one or more row | s and press the <u>Edit</u> button abo | ve to edit properties for the s | elected layers. Us | the <u>Generate Stac</u> | ing button to replace all lay | ers using a given PCB | | | | CTE2 | бху | (z |
| Utorial Project Life Cycle C funironmental On The Road Main Board | Dos | ble-click any rov | Material COPPER (14.9%) / COPPER-RESIN | s and press the <u>Edit</u> button abo | Construction | | the <u>Generate Stac</u> l | iog button to replace all lay | ers using a given PCB | Thickness 0.5 oz | Density 2.8579 | CTExy 45.172 | 45.172 | 19,816 | 19,81 |
| Utorial Project Life Cycle Environmental On The Road Main Board Files | Dos | ble-dick any rov er Type | Material COPPER (14.9%) / COPPER-RESIN Generic FR-4 | s and press the <u>Edit</u> button abo | | | the <u>Generate Stac</u> l | iog button to replace all lay | ers using a given PCB | Thickness 0.5 oz 15.4 mil | Density 2.8579 1.9000 | CTEry 45.172 17.000 | 45.172 70.000 | 18,816 | 19,81 3,45 |
| Utorial Project Life Cycle Inviconmental Main Board Main Board Files A comp-bot.odb | Dou Lay 1 2 3 | ble-click any rov er Type SKSNAL Laminate POWER | Material COPPER (14.9%) / COPPER-RESIN General: FR-4 COPPER (4.9%) / COPPER-RESIN | s and press the <u>[dit</u> button abo | Construction DEFAULT (2118 | | the <u>Generate Stac</u> l | log button to replace all lay | ers using a given PCB | Thickness 0.5 oz 15.4 mil 1.0 oz | Density 2.8579 1.9000 2.1479 | CTExy 45.172 17.000 48.412 | 45.172 70.000 48.412 | 18,816 24,804 8,866 | 19,81 3,45 8,86 |
| Utorial Project Life Cycle District Environmental District Read Main Bloard Files A comp-bet.odb Lit. comp-bet.odb | Dou Lay 1 2 3 4 | ble-click any rov er Type SIGNAL Laminate POWER Laminate | Material COPPER (14.9%) / COPPER-RESIN Genetic FR-4 COPPER (4.9%) / COPPER-RESIN Genetic FR-4 | s and press the <u>(dit</u> button abo | Construction | | the <u>Generate Stac</u> l | log button to replace all lay | ers using a given PCB | Thickness 0.5 oz 15.4 mil | Density 2.8579 1.9000 2.1479 1.9000 | CTExy 45.172 17.000 48.412 17.000 | 45.172 70.000 48.412 70.000 | 19,816 24,804 8,866 24,804 | 19,81 3,45 8,86 3,45 |
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| Votorial Project 2 Ke Cycle I Environmental On The Read Mein Board Files A comp-bot.odb A comp-bot.odb A comp-bot.odb A comp-bot.odb A comp-bot.odb A comp-bot.odb | Dos Lay 1 2 3 4 5 | ble-dick any rov or Type SIGNAL Laminate SIGNAL Laminate SIGNAL Laminate | Meterial COPER (14.9%) / COPER-RESN Genetic RF-4 COPER (4/%) / COPER-RESN Genetic RF-4 COPER (1.9%) / COPER-RESN Genetic RF-4 | s and press the <u>Edd</u> button abo | DEFAULT (2116 | 8 | the <u>Generate Stec</u> l | log button to replace all lay | ers using a given PCB | Thickness 0.5 oz 15.4 mil 1.0 oz 15.4 mil 0.5 oz 15.4 mil | Density 2.8579 1.9000 2.1479 1.9000 1.9136 1.9000 | CTExy 45.172 17.000 48.412 17.000 49.482 17.000 | 45.172 70.000 48.412 70.000 49.482 70.000 | 19,816 24,804 8,866 24,804 5,252 24,804 | 19,81 3,45 8,86 3,45 5,25 3,45 |
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Stack-Up Information



Automate Creation and Re-Use of Life Cycles and Events



Update Parts from Libraries

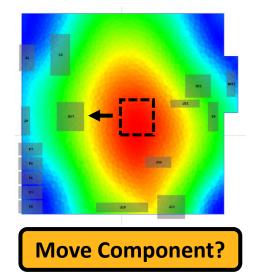


New in 2022 R1: Part Location APIs

Part Location APIs can help users rapidly evaluate the trade-offs associated with moving components on a board subjected to a variety of loading conditions.

New Part Location APIs

- setPartLocation() API to set a part's location properties.
- getPartLocationUnits() API to get a list of valid part location units.
- getBoardSides() API to get a list of valid board side values.
- getPartLocation() API to get a part's location properties.







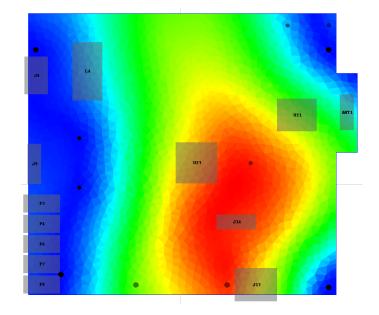


New in 2022 R1: Mount Point APIs

Mount Point APIs can help users rapidly get available Mount Point information programmatically.

New Mount Point APIs

- getMountPointTypes() API to get a valid list of mount point types.
- getMountPointShapeTypes() API to get a valid list of mount point shape types.
- getMountPointSides() API to get a valid list of mount point sides.
- getMountPointUnits() API to get a valid list of mount point units.
- getMountPointBoundaries() API to get a valid list of mount point boundaries.
- getMountPointChassisMaterials() API to get a valid list of mount point chassis materials.



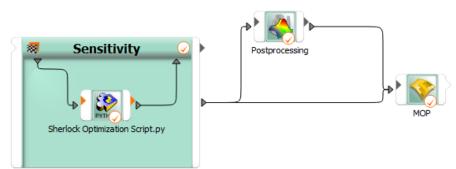


Sherlock-optiSLang Connection



Ansys Sherlock-optiSLang Studies

- Ansys Sherlock APIs allow users to programmatically study the effects of parameterizing key variable, such as:
 - Part Properties, Component Locations, and Stackup Information on key output, such as Time-to-Failure.
- Scripts can be incorporated as a part of Sensitivity Studies and Optimization routines in Ansys optiSLang.
- Examples:
 - Determine the influence of key Part Properties on Cycles-to-Failure for components subjected to Thermal Cycling.
 - Rapidly evaluate the trade-offs associated with moving components on a board subjected to Mechanical Shock, Random Vibration, etc.

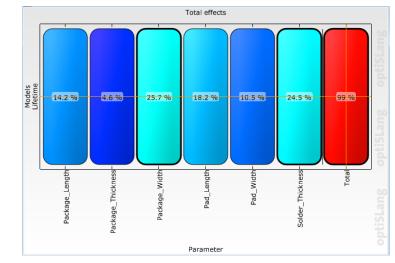


Sample Ansys Sherlock Code Snippet introducing Part Property Parameters Solder_Thickness = 0.0635 Pad_Length = 1.45 Pad_Width = 3.5 Pad_Pitch = 6.40 Package_Length = 6.3 Package_Width = 3.15 Package Thickness = 0.6

newData = []

with open('D:\\Backedup\\ACT\\PartsList.csv','r') as f: reader = csv.reader(f) for l in csv.reader(f, quotechar=''', delimiter=',', quoting=csv.QUOTE_ALL): newData.append(l)

newData[48][125] = Solder_Thickness newData[48][101] = Pad_Length newData[48][104] = Pad_Width newData[48][102] = Pad_Pitch newData[48][95] = Package_Length newData[48][100] = Package_Width newData[48][98] = Package_Thickness



Sample Sensitivity Study Results using Ansys optiSLang



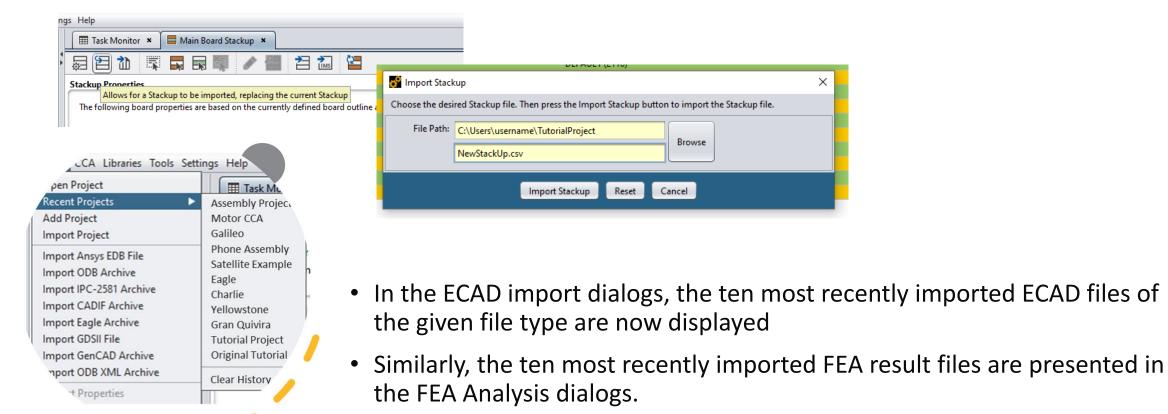
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Sherlock General Enhancements



New in 2022 R1: Workflow Enhancements

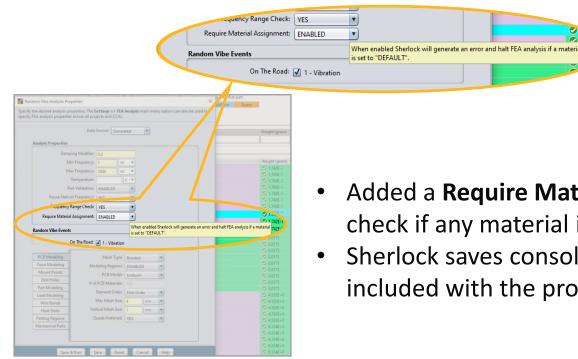
• Added the ability to import a Stackup from CSV and XLS files.





New in 2022 R1: Improved User Experience

- Improved the look and feel of icons and fonts for 4K displays.
- All material selectors in forms are now searchable.



| | | | Material | 0 | OVER | |
|--|--|---|--|--|---|---|
| | | | Material: | 0 | OVERMOLD-BGA | |
| roperties. The choice field to the ource to use another value or ea | a right of each property indicates the data sou lit the property value directly. In that case, the | rce fe | | | OVERMOLD-BGA-JOHNSON OVERMOLD-BGA-SYED OVERMOLD-LEADED | |
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| | | | | | - | |
| | | | | | OVERMOLD-QFN-8 | V |
| Package Length: 🔍 | 3.24 | Us | | | | |
| Package Width: 😣 | 2.8 | ise | | | | |
| Package Thickness: 🤨 | 1.15 | Use | | | | |
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| Laminate Thickness: 9 | 0.965 | G bal | Part DB | | | |
| Model Part: 🔍 | ENABLED | G ess | | | | |
| Corner Shape: 🔍 | SQUARE | Global | Part DB | | | |
| Corner Radius: 🤨 | 0 | Global | Part DB | | | |
| Corner Face: 0 | TOP_BOTTOM | Global | Part DB | | | |
| Material 🔍 | OVER | User | | | | |
| Ove nold Material: 9 | OVERMOLD-BGA | User | | | | |
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| /eight (gram): 9 | | Global | Part DB | | | |
| 5 5 100 | OVERMOLD-LEADED | | | | | |
| | OVERMOLD-QFN-78PPM | | | | | |
| | OVERMOLD-QFN-7PPM | | | | | |
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| | operties. The choice field to the user to use another value or ce d tabs that are not applicable Package Name: 9 Package Varget: 9 Package Nome: 9 Package Length: 9 Package Length: 9 Package Width: 9 Package Width: 9 Package Width: 9 Deckage Thickness: 9 Covernoid Thickness: 9 Covernoid Thickness: 9 Come Radius: 9 Come Radius: 9 Come Radius: 9 Come Radius: 9 Cover Not Material: 9 | uire to us another value or etit the property value directly, in that case, the directly and the property value directly, in that case, the directly and the property value directly is an effective Package Name 0 (C-ERNO-3528-12) Package Name 0 (C-ERNO-19) Nodel Part: 0 (C-ERNO-19) Corren Faker 0 (C-ERNO-19) Name 0 (Re(CV), 0 (C-ERNO-19) VERMOLD-66A) VERMOLD-66A - VORSON (VERNOLD-6A) (VERNOLD-6A) VERMOLD-6A - VERNOLD-6A) (VERNOLD-6A) | Package Name: 0 CERND-528-12 U Corrent Shape: 0 SCEND U Corrent Shape: 0 SCEND Gene Corrent Shap | IMaterial: Set (C/W): The choice field to the right of each property indicates the data source of the property valet directly. The choice field to the right of each property valet directly. The choice field to the right of each property valet directly. Package Name: C Package Type: C Package Type: C Package Name: V Package Name: C Package Name: C Package Name: V Package Name: C Package Name: V Package Name: | apertist. The choice field at the right of acid property indicates the data sources of the property indicates of | Imaterial: OVERMOLD-BGA OVERMOLD-BGA-JOHNSON OVERMOLD-BGA-SYED OVERMOLD-BGA-SYED OVERMOLD-BGA-SYED OVERMOLD-LEADED OVERMOLD-QFN OVERMOLD-QFN OVERMOLD-QFN Package Instruct SMT Overmodil Thickness SSS Overmodil Thickness SSS Overmodil Thickness SSS Overmodil Metaids Overmodil Metaids Ov |

- Added a Require Material Assignment option in an FEA analysis to check if any material is unassigned.
- Sherlock saves console output in a log file for each session and is included with the project export.



Additional Sherlock Enhancements in 2022 R1

- Added option in <u>Advanced Settings</u> to display and use part body weight to update part body's material density in FEA analyses only.
 Refer to <u>Sherlock Part Properties in the Sherlock User's Guide</u>.
- Sherlock now provides the ability to edit the specific heat property of materials in the Materials Library. Some materials have a specific heat property set already. This is useful for exporting to Electronics Desktop so that it can be used for Icepak simulations.
- Improved initial loading time of the Part Viewer and editor dialogs.
- Updated package model forms to hide the package thickness field for BGA packages. BGA packages use the Overmold and Laminate Thickness fields instead.
- Added a **Require Material Assignment** option in an FEA analysis to check if any material is unassigned. If this option is enabled, the FEA analysis will stop as soon as it finds a material that is not assigned. If this option is not enabled and Sherlock finds material that is not assigned, a message appears in the Results Viewer.
- Added information tooltips to the **Stackup Properties** and **Stackup** table.
- Updated the Parts List and Part Editor so they no longer update the pad properties of QFN packages when selecting Update Pad Properties.
- Updated the Part Editor to disable the solder tab if a BGA package is selected.
- Updated the Package Editor so that when a BGA package is added, the package does not have to be saved before adding ball parameters



Additional Sherlock Enhancements in 2022 R1

- In the ECAD import dialogs, the ten most recently imported ECAD files of the given file type are displayed, a helpful shortcut when reimporting a file. In addition, users can now see the ten most recently imported FEA result files in the FEA Analysis dialogs. The displayed files are specific to the combination of the CCA name and the FEA Analysis name.
- The context menu from the Stackup Table allows the associated layers to be opened in the Layer Viewer. The Layer Viewer may also be opened from the Stackup for selected layers by clicking the **View Stackup** icon in the toolbar.
- Added a context menu for copper layers in the Layer Viewer which allows for Trace Modeling options such as Generate Trace
 Model and Export Trace Model. Added a context menu to the Copper Layers folder in the Layer Viewer which allows for Trace Model generation, viewing, and clearing of all copper layers on the circuit card.
- Added Quartz Controlled, Voltage Controlled, Temperature Controlled, and Oven Controlled as sub-types for MISC CRYSTAL in failure class (helpful for the Sherlock-medini workflow).
- Sherlock no longer displays repeated warnings about contact elements during random vibration results input (summary warning provided).
- When performing a Random Vibration analysis where no zero-crossing frequency is found, Sherlock will include this information in the analysis errors to help provide insight into why the analysis was not complete.
- For BGA's, Sherlock uses the ball material defined on the **Ball** tab of the Parts List instead of using the solder material defined on the **Solder** tab when performing Solder Joint Fatigue analysis.
- And more Please refer to the Ansys Sherlock 2022 R1 Release Notes.

Documentation Updates in Ansys Sherlock 2022 R1

- Available Theory Manuals
 - Solder Fatigue Caused by Thermal Cycling
 - BGA Model
 - Quad Flat No-Lead (QFN) Package
 - Thermal Mech
 - In-Circuit Testing (ICT)
 - Random Vibration
 - Mechanical Shock
- User Guide Updates
 - Overhauled 'Ansys Workbench Integration' Chapter to include the latest updates.
 - Improved 'Importing Projects and ECAD Archives' sections.



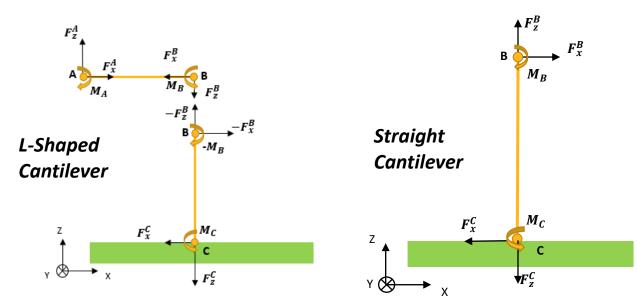
Sherlock Beta Features



New in 2022 R1: Beta Feature –

Analytical Beam Approach for TTF Predictions for Leaded Components

- Feature is in Beta in Ansys 2022 R1
 - Available for ICT and Random Vibe
 - Debug Settings Flag needed (enableLeadNodalForces)
- Updates to minimize the impact of strain singularities on TTF predictions
 - Implemented an analytical beam model from the extracted forces and moment.



| Advanced | FEA Engine Settings | |
|--------------|--------------------------------------|--|
| Color | The following properties control fir | nite element analysis for all projects |
| Data Store | Engine Properties: | |
| Debug | Analysis Engine: | Ansys |
| FEA Analysis | Native RST Reader: | ENABLED |
| Launcher | Mechanical Progress Bar: | ENABLED |
| Meshing | Use Nodal Lead Forces: | ENABLED |
| Part Library | Number of CPUs: | 5 |

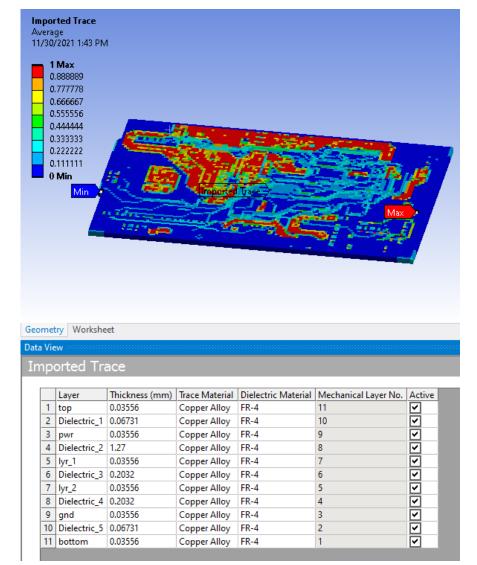


Ansys Mechanical



Support for Solid-Shell Elements in Trace Mapping

- Geometries meshed with Solid-Shell (SOLSH) elements are now supported in the trace mapping workflow.
- The behavior is like that of Shell Trace Mapping, where trace data is controllable on a per-layer basis.
- Dielectric and Trace materials can be defined on a per-layer basis.
- This approach should provide users with the accuracy they are targeting with less computational expense compared to Solid Element Trace Mapping.

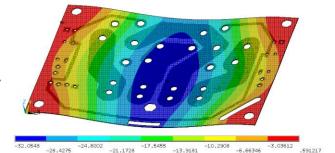




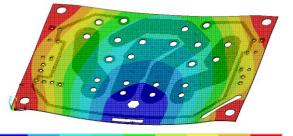
New in 2022 R1: Bending Stiffness for Smeared Reinforcement

- Greatly improves the solution accuracy with 3D smeared reinforcing (REINF) models
- Eliminates the need to use multiple REINF layers to capture the bending stiffness
- Enhances the REINF modeling usability in the new PCP/Chip simulation workflow

Accurate simulation results: REINF with bending vs. full 3D model

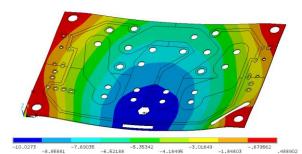


Reinforcing w/o bending stiffness

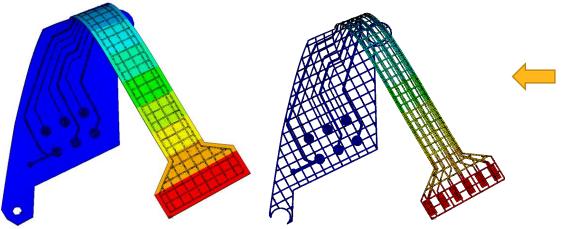


-10.3222 -9.12328 -7.9244 -6.72552 -5.52664 -4.32776 -3.12888 -1.93 -.731125 .467755

Reinforcing with bending stiffness



Full 3D model (trace modeling)

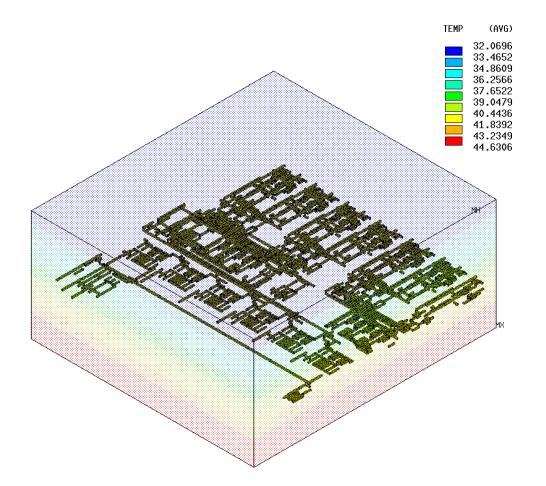


Robust and accurate simulation of flexible PCBs under large deformation



New in 2022 R1: Reinforcing Performance Enhancements

- Motivated by the requirements to account for large models (full PCB and chip models)
- Improved performance in pre-processing
 - Allows large number of reinforcing members in one base element
 - Reduces time needed for load mapping
- Improved solution efficiency
- Improved performance in post-processing
 - Significantly reduced time for querying min/max member results
 - Improved inter-member result smoothing





Ansys LS-DYNA



Ansys LS-DYNA Updates in 2022 R1

Please refer to the Ansys LS-DYNA 2022 R1 Update Presentation for additional details.

• Ansys Mechanical Integration:

- Imported Displacement
- Localization (multiple language support)
- Cyclic Symmetry Support
- Fluent to LS-DYNA Thermal Transfer(1 way)
- Restart Improvements Displacements and Remote Displacement can now be modified in a small restart calculation. In addition, initial velocities can be modified for parts in small restarts and full restarts.
- Foam Material Support New Material Models have been added in support of foam applications
- Support for Additional Contact Scoping Options
- Additional Properties for Interference Contact
- New Solver Version

• Meshing for Explicit

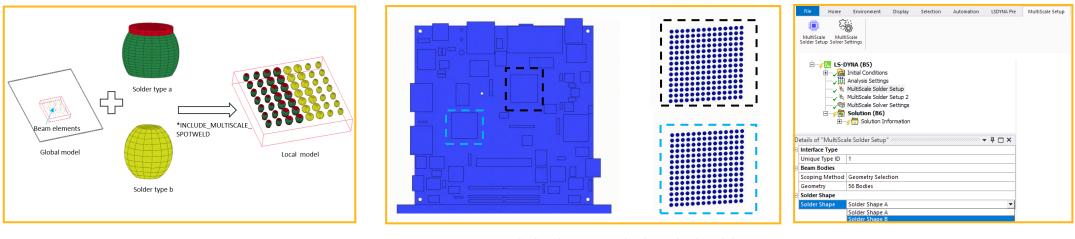
• LS-DYNA Solver R13:

- Iso-geometric Analysis (IGA)
- Materials and Element Enhancements
- Element Free Galerkin Enhancements
- Smoothed Particle Galerkin (SPG) Features
- Smooth Particle Hydrodynamics Enhancements
- XFEM, Peridynamics
- Multi-scale Modeling
- Contact
- Stamping
- Acoustics
- Fatigue
- Thermal
- ALE
- Electro-magnetics (EM)
- Incompressible Computational Fluid Dynamics (ICFD)
- Miscellaneous enhancements



Two-scale Co-simulation Approach in Electronics Applications

- New keywords: *INCLUDE_MULTISCALE, *DEFINE_MULTISCALE
 - The two-scale co-simulation couples the mesoscale model and the macroscale model using the nonmatching discretization to co-simulate the structural response.
 - The beam element can be replaced by solid elements for the solder ball modeling.
 - This solder joint model will be modularized, duplicable, and numerically immersed in a meso-scale chip model automatically.
- ACT on Ansys Workbench (work with LST ACE team)



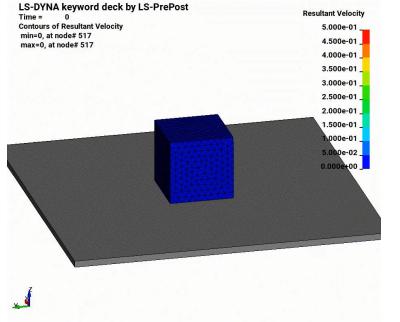
Automated process of replication solder joint Trace mapped shell PCB with detailed solder joints model in drop test

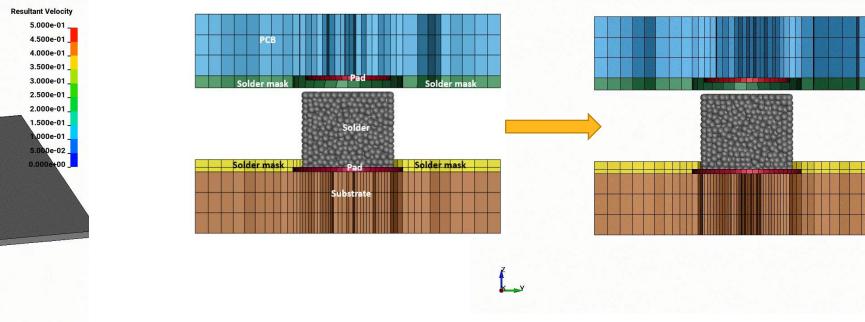
ACT on Ansys Workbench



Fully Implicit Incompressible SPG (ISPG) Formulation

- Fully implicit ISPG formulation
 - A new Lagrangian Navier-Stoke solver
 - Can handle the surface tension and wall adhesion accurately and efficiently
 - Can simulate the solder reflow with complex models with the solder mask defined (SMD) pad and NSMD





LS-DYNA keyword deck by LS-PrePost

Single solder interacts with PCB

Time =

Large deformation of droplet

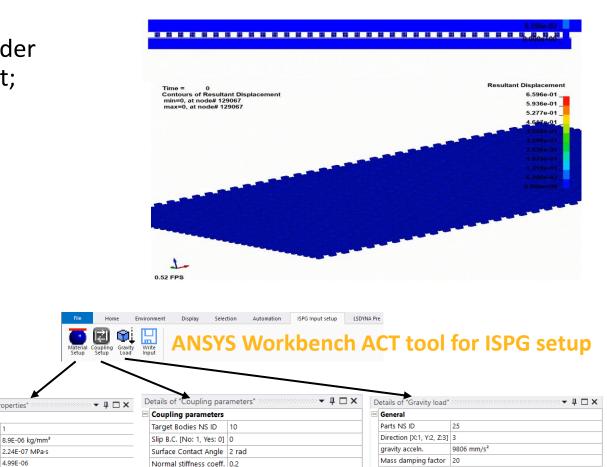


Fully Implicit ISPG Formulation

- Coupled with implicit thermal and structure solvers
 - for large scale thermal-mechanical PCB and solder reflow analysis (considering PCB warpage effect; SMP&MPP)

- ACT on Ansys Workbench available
 - Capable to define all necessary keywords

1225 solders (1.02M nodes) on PCB solved with MPP solver on 64 CPU cores (Run time – 7.5hrs)





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4.99E-06

Details of "Material Properties"

Solder Properties

Surface Tension

Density

Viscosity

Named Selection ID

Ansys Icepak



Ansys Icepak 2022 R1 Highlight Summary

Please refer to the Ansys Icepak 2022 R1 Update Presentation for additional details:

- Reduced Order Modeling (ROM)
 - Redhawk CTM 2-Way Co-Simulation
 - Delphi Network Creation

Advanced Modeling

- Blower Model

ECAD Import

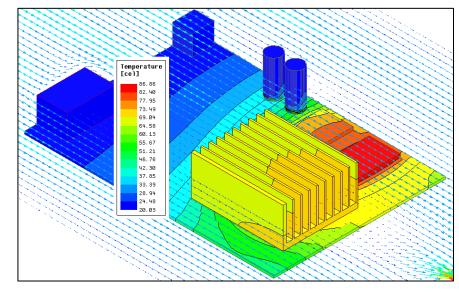
- Wirebond import
- IDX Import
- Maxwell 2D Icepak EM Loss Coupling

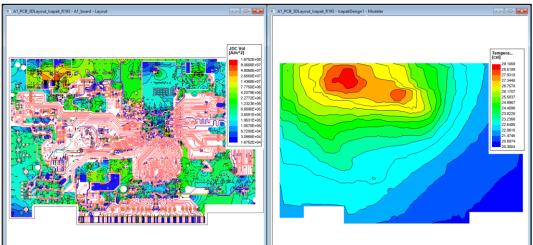
• Mesher Enhancements

- 2.5D Meshing improvements

• User Experience

- Streamlines
- Validation Enhancements
- Migration
 - Improve speed of TZR conversion
 - Network Schematic enhancements
 - Toolkit enhancements
 - PCB, Package parameterization





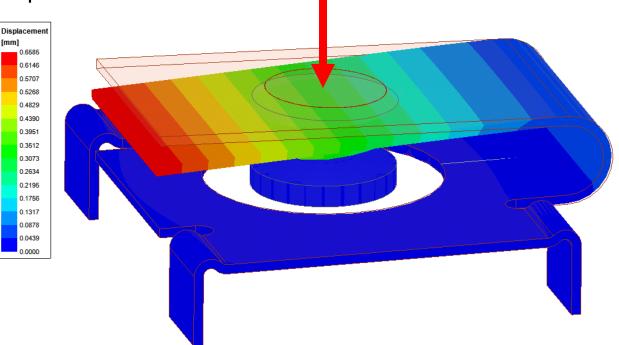


Ansys AEDT Mechanical



AEDT Mechanical 2022 R1 Highlights

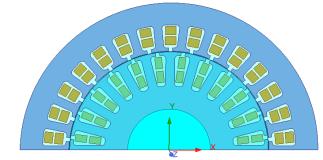
- Coupling
 - Maxwell 2D Thermal EM Loss Coupling
- Materials
 - General expression support for temperature-dependence
- Structural Beta
 - Boundaries
 - Displacement
 - Pressure/Force
 - Coupling
 - Mechanical Thermal-Structural Link
 - EM Force Structural Coupling
- Meshing Beta
 - Thermal Slider bar Meshing
- Reporting
 - Fields Summary



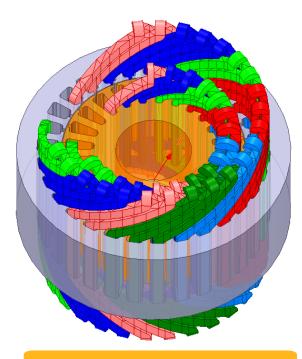


Coupling: Maxwell 2D – Thermal EM Loss Coupling

- Support EM Loss Import from Maxwell 2D
 - Extruded geometries of 2D representations
 - Support both +ve and -ve extrusions in XY
 - Can be partial geometries
 - Coupling projects 3D mesh points onto 2D geometry
 - Limitations
 - Extrusions need to be along Z axis
 - Losses not conservative
 - 2-way coupling not supported



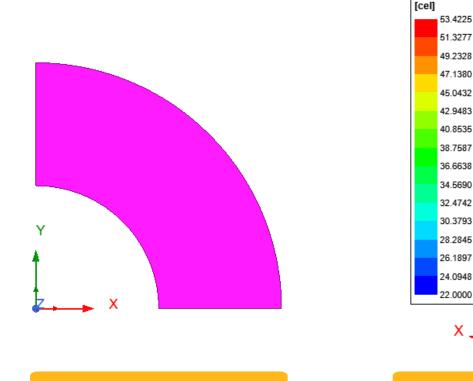
Maxwell 2D Geometry



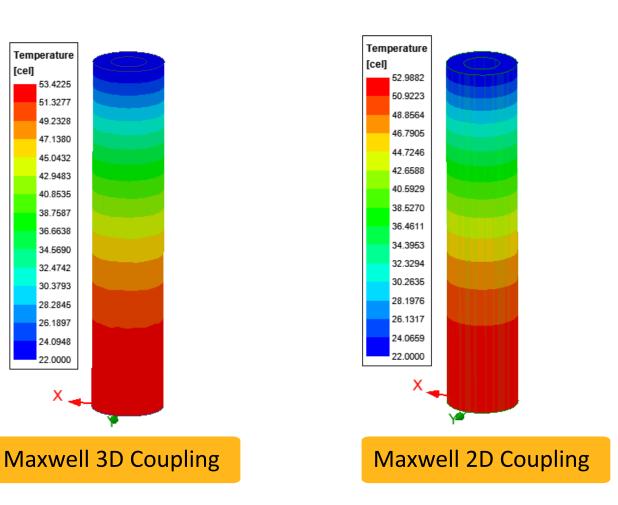
Thermal 3D Geometry



Coupling: Maxwell 2D – Thermal EM Loss Coupling



Maxwell 2D Geometry





Materials: Temperature-Dependent Materials

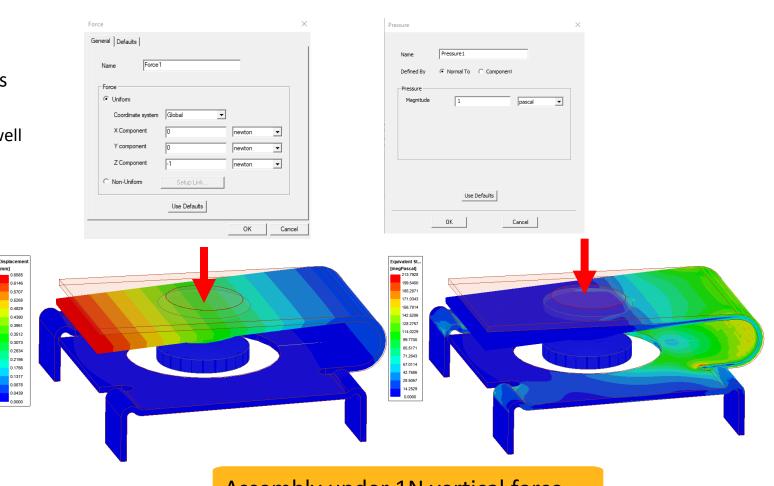
• Temperature Dependent Materials

- General expression support
- Quadratic expressions
 - Advanced coefficient support
- Converted to datasets for solver
- Thermal & Structural

| dit Thermal Modifier | \times | Edit | Thermal Modi | fier | × |
|--|----------|--------|--------------------|---------------------|---|
| Expression C Quadratic | | C E | xpression | Quadratic | |
| Expression | | Bas | sic Coefficient Se | Advanced Coe | fficient Set |
| Temperature-Dependent Themal Conductivity: P(Temp) = Pref [Modifier] Reference Themal Conductivity: Pref = 205 Parameters Modifier: ff(Temp > 2200cel, 14.95100476, fr(Temp < 0cel, 0.97475676, 1 + 0.0012 * (Temp - (22cel)) + 2.39e-06 * pow ((Temp - (22cel)), 2))) Use temperature dependent dataset | | | P(Temp) = | hermal Conductivity | - TempRef) + C2(Temp - TempRef) ^ 2] |
| | | | | | Edit Thermal Modifier C Expression C Quadratic |
| TEMP, 1,0 TEMP, 2,20 TEMP, 3,40 TEMP, 3,40 TEMP, 4,60 TEMP, 4,60 TEMP, 5,10 TEMP, 7,120 TEMP, 1,120 TEMP, 1,200 TEMP, 1,1200 TEMP, 1,1200 TEMP, 1,300 TEMP, 1,300 TEMP, 1,300 TEMP, 1,500 TEMP, 1,500 TEMP, 1,800 TEMP, 1,800 TEMP, 1,9100 DATA, KXX, 1, ,233.8134798,240.8500638,248.2786078,256.0991118,260 DATA, KXX, 1, ,367.9940158,434.537358,510.8724558,597.0101758,692 DATA, KXX, 1, ,914.2173358, ! W m^-1 C^-1 TEMP, | 4.311575 | 58,311 | .2532958, | | Basic Coefficient Set Advanced Coefficient Set Temperature Limits TL and TU are the lower and upper temperature limits where the quadratic formula is valid. TL: 0 cel TU: 2200 cel Value Limits cel ✓ TML and TMU are the constant themal modifier values outside the interval[TL, TU]. ✓ ✓ Auto calculate TML, TMU TML: 0.97475676 TMU: 14.95100476 |

Structural: Pressure/Force Excitations

- Force Excitation
 - Face and Object assignment
 - Uniform and Non-uniform Force options
 - Uniform (face): X, Y, Z components
 - Non-uniform via Setup Link to HFSS/Maxwell
- Pressure Excitation
 - Face assignment
 - Normal To or Component options
 - Normal To: Magnitude
 - Component: X, Y, Z components
 - Support curved faces

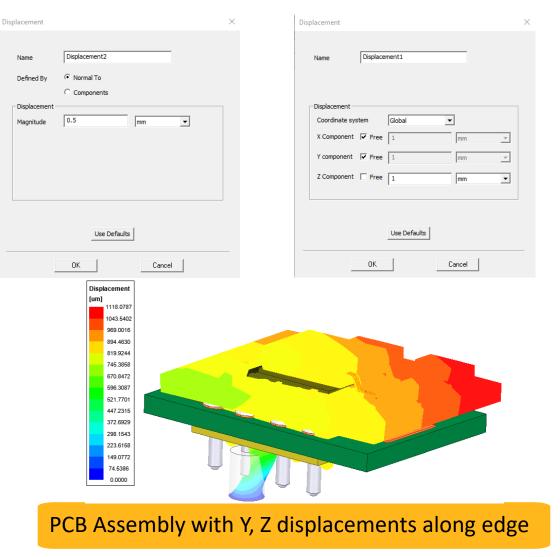


Assembly under 1N vertical force



Structural: Displacement Excitation

- Displacement Excitation
 - Assignment: Faces and Edges ٠
 - Normal To (faces) ٠
 - Magnitude
 - Components (faces and edges) ٠
 - X, Y, Z components
 - Each component can be fixed magnitude or free

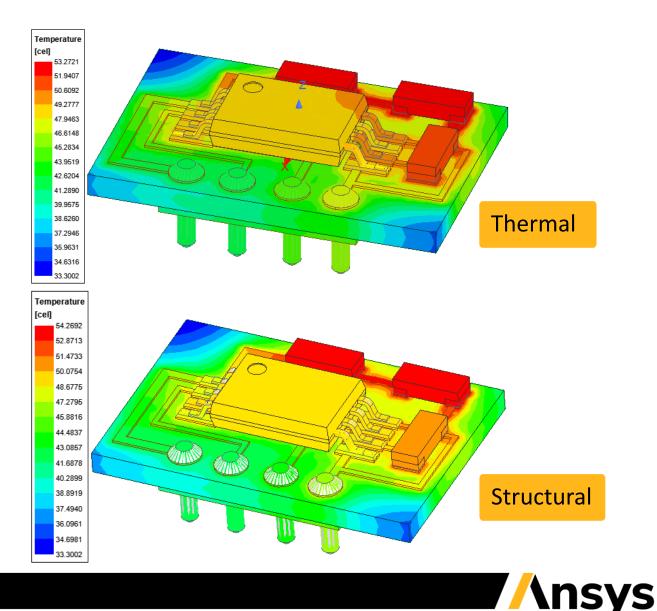




Name

Thermal Stress Analysis: Link to Mechanical Thermal

- Coupled Thermal Stress Analysis
 - Linked to Thermal design
 - Thermal condition excitation
 - Temperatures imported for objects
 - System Coupling mapper
 - Radial Basis Functions (RBF) Algorithm
 - Temperature field plots





EM – Structural Coupling: EM Force

Force1

Coordinate system Global

Us

OK

C Uniform

Z Compone

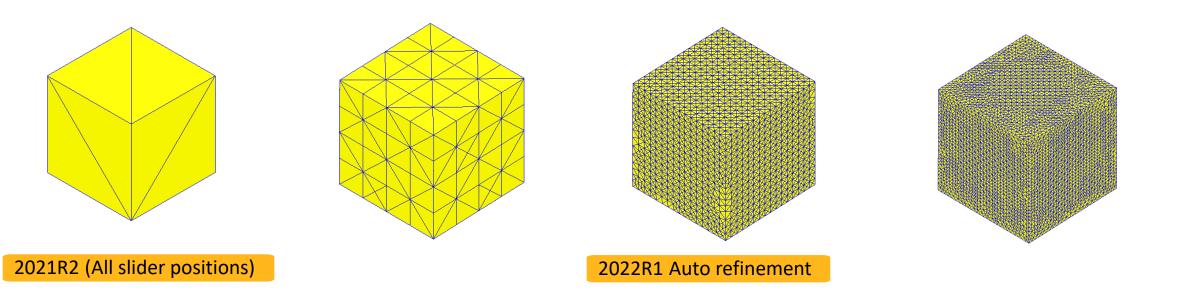
- Coupled EM Force Structural Analysis
 - Linked to HFSS
 - Surface assignment
 - Linked to Maxwell 3D
 - Surface and Volume assignment
 - Assignment: Faces and Objects
 - 1-way coupling support

| × rewton rewton rewton rewton rewton x x x x x x x x x x x x x | Displacement Interes 0 0,5 1 (mm) |
|---|--|
| General Variable Mapping Product: ElectronicsDesktop Source Project: ✓ Source Project: ✓ Use This Project Sever source path relative to: C The project directory of selected product This Project This Project Source Design: Maxwell3DDesign1 Source Solution: Setup1 : LastAdaptive | B: Static Structural Total Deformation Unit: m Min Ansys Time: 1 s 9/12/2021 10:13 AM 2022 R1 7.9431e-5 Max 7.0606e-5 6.178e-5 5.2954e-5 4.4128e-5 3.5303e-5 2.6477e-5 2.6477e-5 1.7651e-5 |
| Simulate source design as needed Preserve source design solution Note: In extractor mode, source project will be saved upon exit. | B8257e-6 Max Workbench |
| OK Cancel | 0C.0006 (m) |

nsys

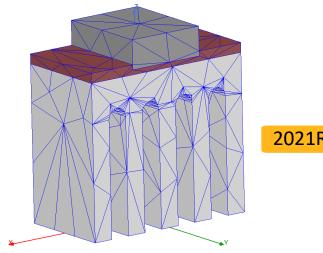
Thermal Slider Meshing: Automated Refinement (Beta)

- Automated refinement based on slider position
 - Length-based refinement inside and on surfaces of all objects
 - Refinement tailored to curvilinear and rectilinear geometries
- Restrict the need for user-defined mesh operations
- Improved solution accuracy

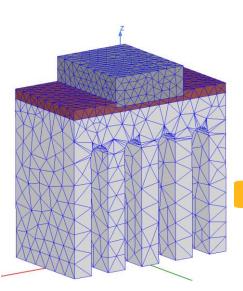




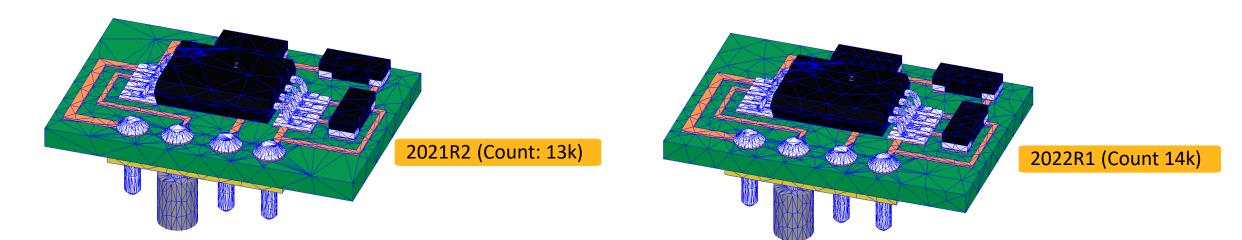
Thermal Slider Meshing: Comparison



2021R2 (Count: 2k)



2022R1 (Count 11k)





Reporting: Fields Summary

- Fields Summary: User-friendly report calculation capability
 - Supports all Fields Calculator variables
 - Boundary and Object selection
 - Surface and Volume calculations
 - Min, Max, Mean, Standard Deviation, Total
 - Multi-select and multiple calculations
 - Export to CSV format
 - Heat Flow Rate not available yet

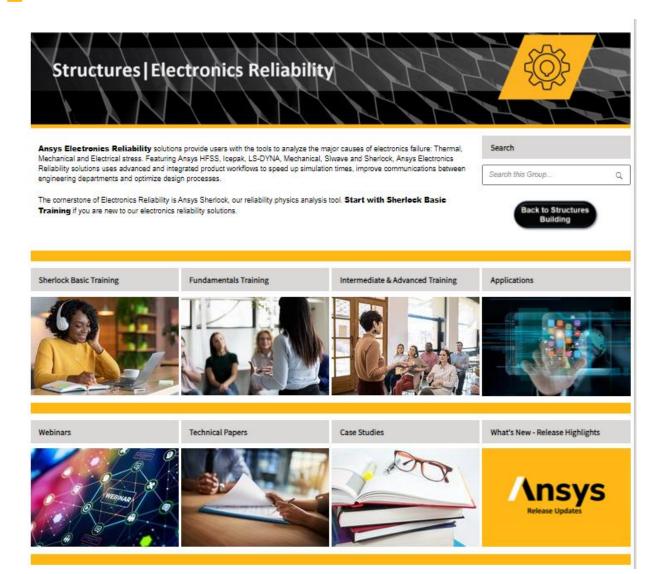
| | Setup1 : Solu | Setup1 : Solution | | | | | | | | | | | |
|---------------|------------------|-------------------|---------------------|---------|--------|---------|---------|---------|----------|---------|------------------------------|--|--|
| Design Vari | iation: Nominal | Nominal | | | | | | | | | | | |
| Calculations: | | | | | | | | | | | | | |
| Entity Ty | pe Geometry Type | Entity | Quantity | Side | Normal | Min | Max | Mean | Stdev | Area | Setup | | |
| Boundary | Surface | Convection1 | Temperature[C] | Default | | 87.2397 | 91.2407 | 88.6246 | 0.974567 | 0.0117: | | | |
| Object | Surface | Box1 | Temperature[C] | Default | | 87.2397 | 91.2664 | 88.8164 | 1.12229 | 0.0128! | Delete | | |
| Object | Volume | Box1,Box2,Box3 | | Default | | | 92.0858 | | 1.38128 | 3.4966 | Clear All | | |
| Object | Surface | Box1 | Mag_HeatFlux[W/m^2] | Default | | 2065.29 | 48196 | 18972 | 9898.65 | 0.0128! | | | |
| | | | | | | | | | | | Setup Calculation | | |
| | | | | | | | | | | | Entity Type: 6 | Boundary C Object | |
| | | | | | | | | | | | Geometry Type: 6 | Surface C Volum | |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | -1 | |
| | | | | | | | | | | | Entity: | X Quantity: Temperature | |
| < | | | | | | | | | | > | HeatFlux1 HeatGeneration1 | Mag_HeatFlux Surface Loss Densit | |
| | | | | - | | | 1 | | | - | Treatareneration | Volume Loss Density Linked Heat Transfe | |
| | | | Apply and Export | | | OK | | Ca | ncel | | | | |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |



Additional Resources



Ansys Learning Hub (ALH) Electronics Reliability Learning Room



- New and improved user experience
- 3-pronged learning paths including Basic,
 Fundamentals, Intermediate & Advanced
 Training
- Video Walk-throughs, on-demand webinars, technical papers, and more
- Ask questions directly to Ansys experts

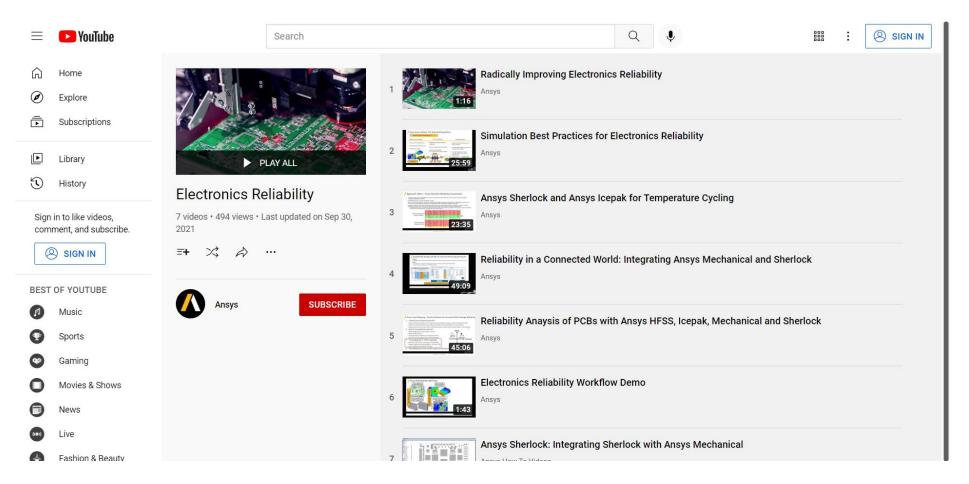
Login here: https://catalog.ansys.com/ALH.cshtml

Direct Link (ALH Access Required):

https://jam8.sapjam.com/groups/QxhZIS5hvjR1 EWlg4pCOD2/overview_page/owCBFHDqvFQ01 u7FsvRRcx



Ansys Electronics Reliability YouTube Page



https://www.youtube.com/playlist?list=PLQMtm0_chcLzeB8zCeGmvBkFpT3oG7kFN



