Release 2023 R1 Highlights Thermal Integrity in AEDT

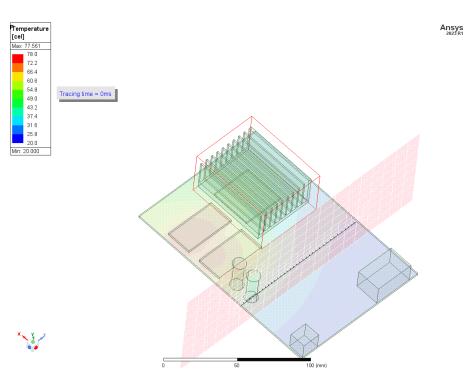


AEDT Icepak 2023R1 Update



Icepak 2023R1 Highlights

- Automatic Export of Icepak or Mechanical Thermal Project from HFSS/Maxwell/Q3D
 - Commercial
- Icepak-Sherlock data transfer support for multiple PCBs
- CTM V2 support
 - 2-way co-simulation with Redhawk SC-ET
- Meshing Enhancements
 - Stair-Step Meshing for 2D MLM
 - Automatic 2D MLM in Slider Meshing
- ECXML export
 - BC's, Native components, Mesh regions and monitor points supported
- Post Processing
 - Hybrid mesh support for post processing (Beta)
 - Streamline creation from a plane
- ROM
 - Delphi network support for BGA (Beta)
- Migration
 - Imports PCB with via information



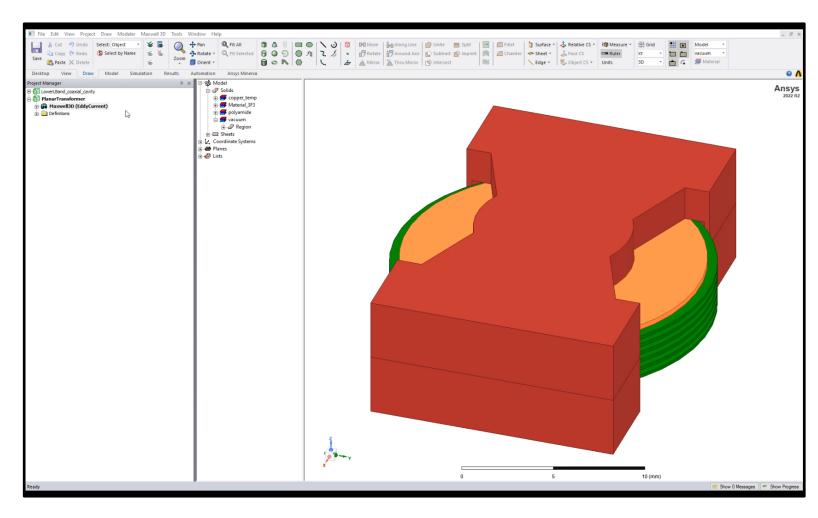
Credit: Babu/Narendra



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Workflow Enhancements: Thermal Design Creation

- Automated creation of linked thermal design from a source EM design
 - Icepak/Mechanical target designs created
 - Source Designs can be HFSS/Maxwell/Q3D
- Boundary conditions and excitations created automatically
 - Forced convection & Natural convection domains (Icepak)
 - Conduction setup (Mechanical)
 - Solution setup created in ready-to-run design

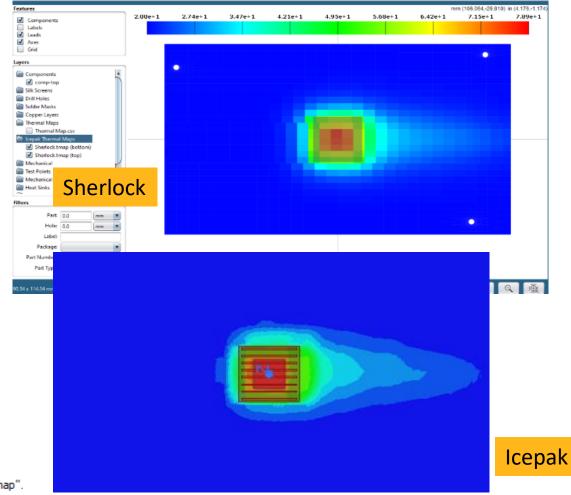




Icepak-Sherlock Data Transfer

- Enable 1-way data transfer between Icepak and Sherlock for cosimulation
- Solder Fatigue Analysis for *multiple* PCB supported
- PCB transformations supported
 - Temp data is written at the location of PCB in EDB file

Icepak Design Settings	×
Ambient Conditions Gravity Validations Export Settings Mesh	
- Export Monitor data	
Export monitor data after completing simulation	
D:/Hardening/610578/pbglarge.aedtexport/	
(Default to project path)	
☐ Save as default	
Export data for Sherlock	
 Export temperature data for Sherlock co-simulation 	
Solder Fatigue	
OK Cancel	



Wrote Sherlock co-simulation data at

 "E:/Projects/Development/Sherlock/BGA_wthout_SolderBall_UpdatedModel.aedtexport/IcepakDesign1/Setup1/Sherlock.tmap". (7:52:16 AM Mar 23, 2022)

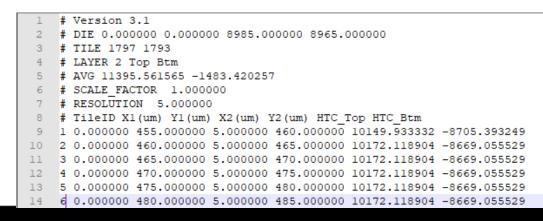


Icepak Integration - BGA_wthout_SolderBall

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HTC Back-annotation to RHSC-ET

- Icepak:
 - Thermal modeling of a physical die using CTMv2 (encrypted component)
 - Export this die's top & bottom surface HTC to a binary file
- RHSC-ET:
 - Back-annotate this HTC as boundary condition of physical die
 - Executes detailed CTM modeling and displays chip thermal profile results
- Support Face-up or Face-down die configurations
- One-to-One mapping to the CTM coordinate system

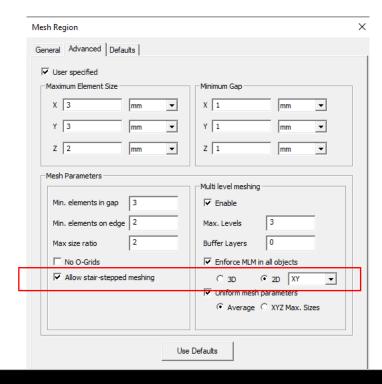


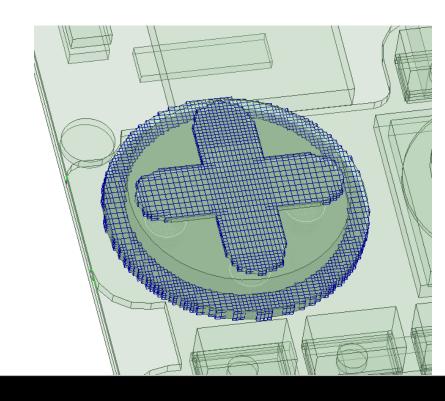


HDM: Stair-Step Meshing for 2D MLM

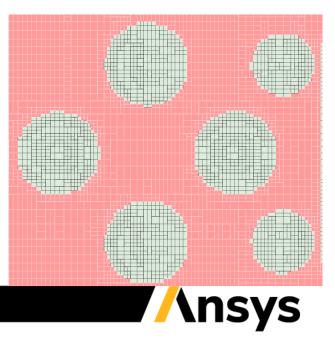
Enabling stair-step meshing method for 2DMLM

- Stair-step meshing is frequently used as a fail-proof option if meshing for complex models are prone to failure.
- Select both "Allow stair-stepped meshing" and "2D MLM" to use.
- Improve meshing efficiency.





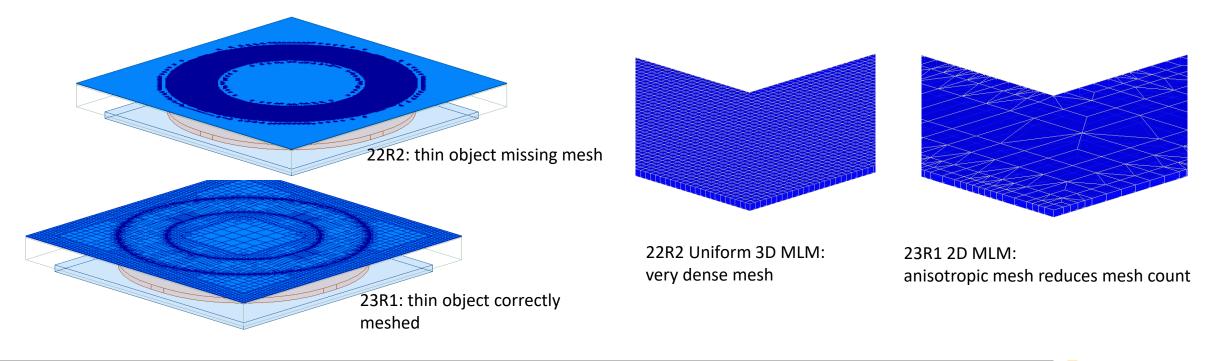
Stair-step: 1035966 cells ~ 92 s Regular: 2386436 cells ~ 152 s



HDM: Automatic 2DMLM in Slider Meshing

Detect 2.5D geometries in model automatically and apply 2D MLM in proper directions

- Slider-bar meshing medium or higher levels used 3D MLM, which did not necessarily work well for 2.5D layered thin geometries.
- In 2023R1, slider-bar meshing will automatically detect 2.5D geometries and calculate a suitable direction to apply 2D MLM, if applicable.
- Helpful for meshing thin objects in model.



ECXML Export

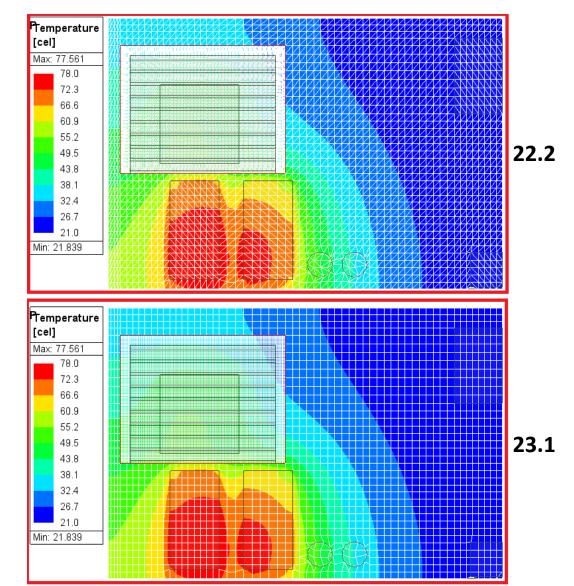
- Support common-format ECXML export of Icepak Designs
- Supported BCs
 - Solution Domain
 - Block (solid 3d block, solid 2d block, cylinder block)
 - Source (2d source, 3d source)
 - Plate
 - Wall
 - Grille (2d grille, opening b.c. without velocity)
 - 2-resistor model networks
 - Flow resistance (3d flow resistance)
- Native Components
 - Fan (rectangle 2d fan and axial 3d fan)
 - Heatsink
 - PCB (no solder ball, no via)
- Others
 - Mesh Regions
 - Point monitor

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		Ex	port RO	м	>	



Hybrid Mesh Post Processing (Beta)

- Support for Quad and Hex elements
- No splitting into tets!
- Greatly reduces number of elements for postprocessing
- Increased speed of plotting, summary reports and field calculator operations
- New post processing paradigm for AEDT and especially created for Icepak as it uses a hex-dominant mesh
- ~2x-3x speed up for some models





ROM: Delphi Network Creation for BGAs (Beta)

🗆 🍯 IcepakDesign1 (SteadyState)

- 🛃 3D Components - 🚯 Model - 🗗 Thermal Bottom_inner Bottom_outer --- A PBGA1 die attach BGA1_die_source PBGA1_trace1 PBGA1_trace4 PBGA1_wire_bond Sides_X_0 Sides_X_1 Sides_Y_0 Sides_Y_1 Top_inne Top_oute Monitor 🗄 💷 🚺 Mesh 🗄 🔊 Analysis Optimetrics Results

Field Overlays

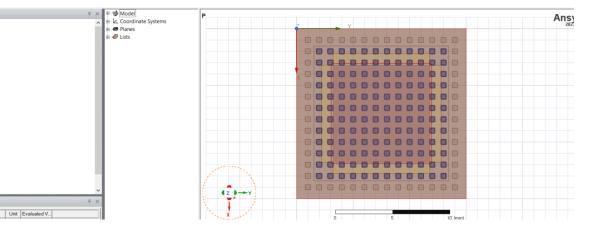
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t Manager

PBGA_finaltest*

🕷 Extract Delphi Network	_		×
Select package type			
BGA			
QFP			
QFN/LCC			
C Exposed die BGA			
Setup Control			
Tasks: 4			
Enable two level			
Distributed solutions at first level: 4			
			_
Status:			
Create Network Cancel		Read me	

Create BC's, parametric setup.



Run Parametric setup

Value

• Extract data from Parametric solve and Run

Manager	म × ा≣∵ช≱ Model	P	
PBGA_1	🖲 🗠 Coordinate Systems		
🅉 IcepakDesign1 (SteadyState)	🗉 🛲 Planes		
🍯 IcepakDesign2 (SteadyState)	🖻 🤣 Lists		
and a second sec			
🛞 Model			
E d Thermal			
R Network1			
Monitor			7
🕀 📲 Mesh			till the second se
🖉 Analysis			
Optimetrics			
- 23 Results			
Field Overlays			
Definitions			
Definicions			*
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• Final network created after optimization.

Enhancements

- Introduced 2D profile interpolation method
 - Constant
 - Inverse Weighted
 - Least Squares
- Introduced Altitude Effects

Icepak Design Settings	
Ambient Conditions Gravity Validations Export Settings Mesh Advanced	
Altitude effects	
I Altitude 16000 meter ▼	
✓ Update fan and blower curves	

	Under	-relaxat	tion Discretiz	zation Scheme	
Pressure	0.3		Standar	rd 💌	
Momentum	0.7		First	•	
Temperature	1		First	•	Secondary Gradien
Turbulent Kinetic Energy	0.8		First	-	
Turbulent Dissipation Rate	0.8		First	~	
Specific Dissipation Rate	0.8		First	~	
Discrete Ordinates			First	v	
Joule Heating	1				
Pressure	V	•	0.1	0.1	None
Managehow			0.1		
Momentum	flex	•	0.1	0.1	
Momentum Temperature	flex F	• •	0.1	0.1	None
					None
Temperature	F	•	0.1	0.1	None 💽
Temperature Turbulent Kinetic Energy	F	•	0.1	0.1	None
Temperature Turbulent Kinetic Energy Turbulent Dissipation Rate	F flex flex	•	0.1	0.1 0.1 0.1	None
Temperature Turbulent Kinetic Energy Turbulent Dissipation Rate Specific Dissipation Rate Joule Heating	F flex flex flex	• •	0.1 0.1 0.1	0.1 0.1 0.1 0.1	
Temperature Turbulent Kinetic Energy Turbulent Dissipation Rate Specific Dissipation Rate	F flex flex flex F		0.1 0.1 0.1	0.1 0.1 0.1 0.1 1e-09	



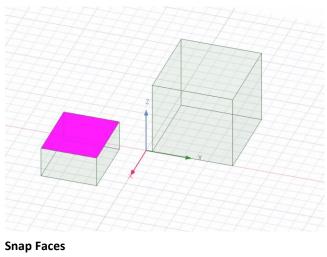
Classic Icepak Migration: TZR Import Enhancements

- Import Face Centered Based Contour Plots.
- Imports PCB with via information.
- Imports particle streamline attributes from Classic Icepak Post Object.

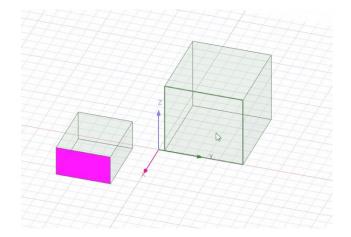
Toolkit Development

Snapping Toolkit:

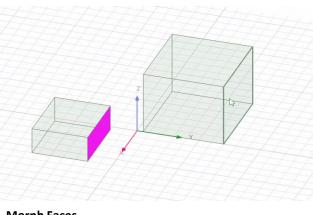
蘮 SnappingGUI	_		\times
Snap Faces	Face 1	Face 2	✓
Align Face Centers	Face 1	Face 2	✓
Morph Faces	Face 1	Face 2	✓
Align Object Centers	Object 1	Object 2	✓
Align and Morph vertices	Vertex 1	Vertex 2	✓
Align and Morph Edges	Edge 1	Edge 2	✓
		Done	



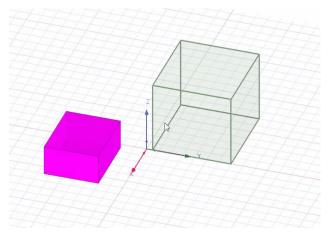




Align face centers





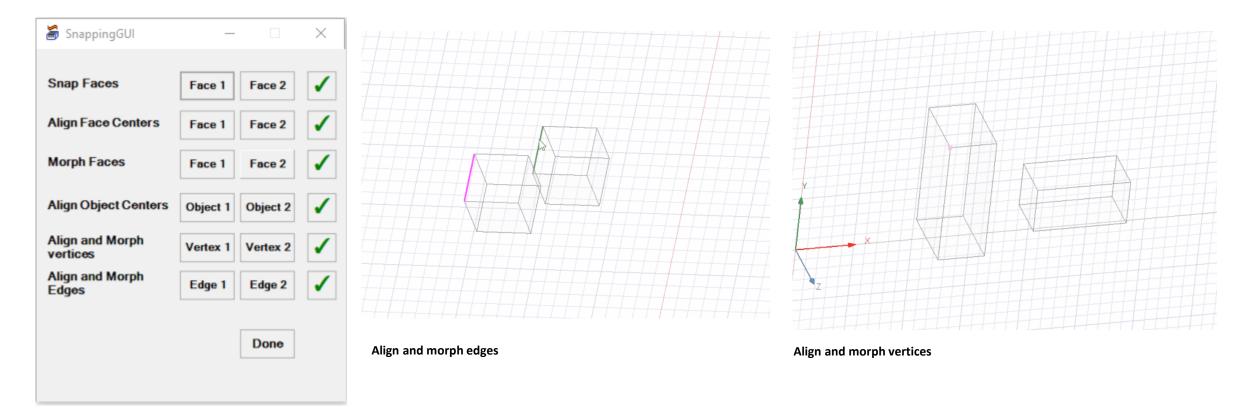


Align object centers



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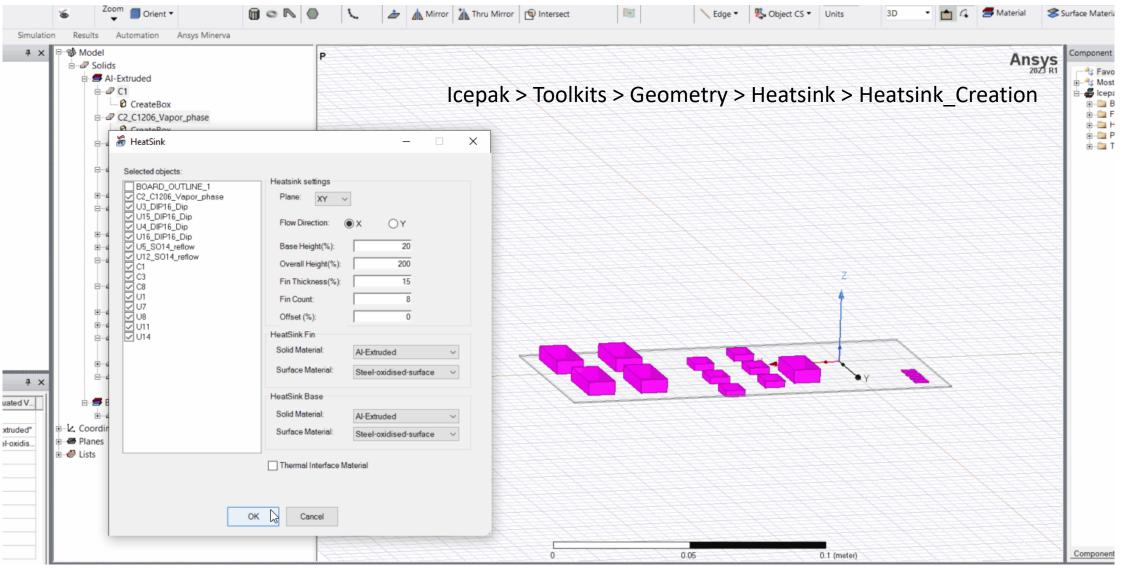
Toolkits: Snapping Toolkit (2)



Icepak > Toolkits > Productivity > Snapping



Toolkits: Heatsink Automation Toolkit (3)



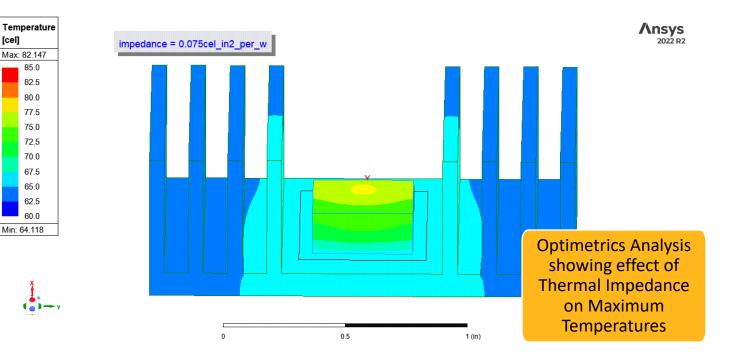


AEDT Mechanical 2023R1 Update



Mechanical 2023R1 Highlights

- Thermal
 - Automatic Export of **Icepak or Mechanical Thermal Project from HFSS/Maxwell/Q3D**
 - Contacts Commercial
 - Smart Slider Mesh Enhancements
 - Transient Thermal Solution Type Alpha
- Structural Beta
 - Object Reference Temperature
 - Edges supported for Fixed Support BC

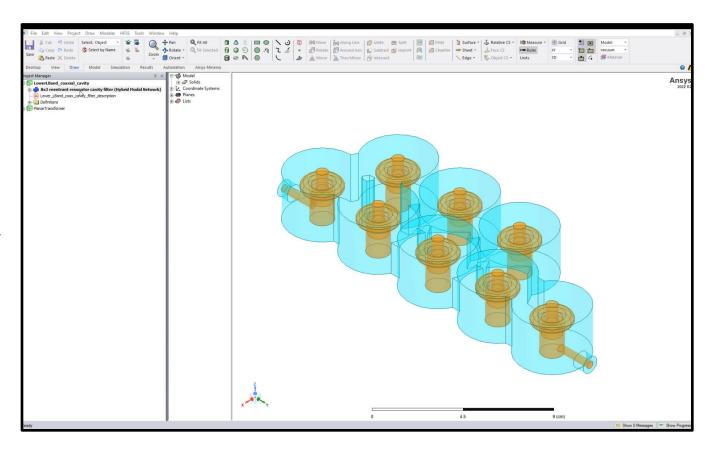




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Workflow Enhancements: Thermal Design Creation

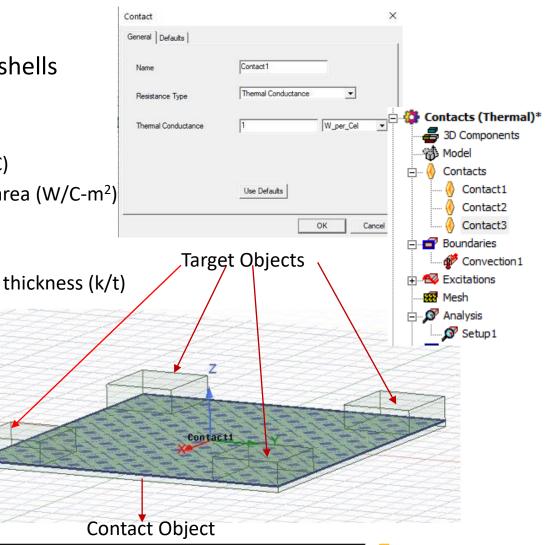
- Automated creation of linked thermal design from a source EM design
 - Icepak/Mechanical target designs created
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- Boundary conditions and excitations created automatically
 - Forced convection & Natural convection domains (Icepak)
 - Conduction setup (Mechanical)
 - Solution setup created in ready-torun design





Thermal Contacts

- Support for Thermal Contacts [Commercial]
 - Assignment on Faces or Shells in contact with other objects/shells
 - Select faces/shells for contacts, target faces automatically determined
 - Resistance types:
 - Thermal Conductance Total conductance for contact surface area (W/C)
 - Thermal Conductance per unit area Distributed conductance per unit area (W/C-m²)
 - Thermal Resistance Total resistance for the contact surface area (C/W)
 - Thermal Impedance Total resistance times area (C-m²/W)
 - Thickness and Material Conductance calculated based on material and thickness (k/t)
 - Multi-Region mesh created when contacts created
 - Non-conformal mesh created only at contact surfaces
 - No zero contact resistances defined at other surfaces
 - Improved and faster mesh handling!



Thermal Contacts : Improved Mesh Handling

Simulation: Setup1 Design Variation: Profile Mesh Statistics Task Real Time CPU Time Memory Information Solution Process	Solutions: CDCSliderC	Qorvo_22.2 - [01QM7708001	_AE_SB=9	_ ×
Task Real Time CPU Time Memory Information Solution Process Start Time: 09/19/2022 11:04:18, Host: CDCEBUDEVw18, Processor: 32, OS: NT 10.0, Product Solution Process Executing from C:/Program Files/AnsysEM\v222\Win64\MECHANICALCOMENGINE.exe HPC: Enabled Design Validation Elapsed time: 00:00:59 , MechanicalComengine.exe ComEngine Memory : 219 M Mesh Phi 00:01:32 0.11:04 1.5 G Tetrahedra: 239038 Mesh Post 00:18:04 00:18:04 1.5 G Tetrahedra: 636901 Mesh (volume, seed) 00:28:01 0.28:02 1.42 G Tetrahedra: 636901 Mesh (translation) 00:26:46 0.01 G Tetrahedra: 636901	Simulation: Setup1		-]	
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Image: Conversion Operation Perform full validations Mesh Phi 00:01:32 00:01:32 1.11 G Tetrahedra: 239038 Mesh Post 00:18:04 00:18:04 1.5 G Tetrahedra: 291567, (PMR1) Mesh (volume, seed) 00:28:01 00:28:02 1.42 G Tetrahedra: 636901, (PMR1) Mesh (translation) 00:26:46 00:26:46 1.01 G Tetrahedra: 636901 Mesh (conversion) 00:00:00 0 K K K	Design Validation				
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Mesh (translation) 00:26:46 00:26:46 1.01 G Tetrahedra: 636901 Mesh (conversion) 00:00:35 00:00:00 0 K	Mesh Post	00:18:04	00:18:04	1.5 G	Tetrahedra: 291567, (PMR1)
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	Mesh (translation)	00:26:46	00:26:46	1.01 G	Tetrahedra: 636901
Populate Solver Input 00:06:00 00:00:00 0 K.	Mesh (conversion)	00:00:35	00:00:00	0 K	
	Populate Solver Input	00:06:00	00:00:00	0 K	
Stop Time: 09/19/2022 21:14:19, Status: Normal Completion					Stop Time: 09/19/2022 21:14:19, Status: Normal Completion
Solution Process 01:20:58 01:14:24 Elapsed Time: 10:10:01, ComEngine Memory: 230 M	Solution Process	01:20:58	01:14:24		Elapsed Time: 10:10:01, ComEngine Memory: 230 M
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Close					Close
2022R2				2	022R2

Solution Time: 10 hr 10 min

n Variation:				
le Mesh Statistics				
Task	Real Time	CPU Time	Memory	
Solution Process				Start Time: 09/19/2022 07:28:42, Host: CDCEBUDEVW38
				Executing From: C:\Program Files\AnsysEM\v231\Win64\
HPC				Type: Manual, Distribution Types: Variations
Machine				Name: cdcebudevw38.win.ansys.com, Tasks: 1, Cores: 8
				Validation warning: Skipped intersection checks.
Design Validation				Level: Perform full validations, Elapsed Time: 00:00:41, Mei
Meshing Process				Time: 09/19/2022 07:29:24
Mesh	00:02:40	00:02:40	1.12 G	Type: Phi, Tetrahedra: 239266
Post	00:00:23	00:00:23	1.38 G	Tetrahedra: 290152, Cores: 1
Initial Refine	00:01:48	00:01:48	1.02e+03 M	Tetrahedra: 626503
Convert	00:00:28	00:00:00		
Meshing Process	00:05:19	00:04:51		Elapsed Time: 00:05:24
Populate Solver Input	00:00:06	00:00:00	0 K	
Solve	00:01:34	00:03:30	5.31 G	Type: Program Controlled, Core: 8
Solution Process	00:06:59	00:08:21		Elapsed Time: 00:08:15, 0 omEngine Memory: 220 M
				Stop Time: 03/13/2022 07:36:57, Status: Normal Completic
<				>

2023R1 Solution Time: 8 min 15 sec



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Thermal Contacts - Limitations

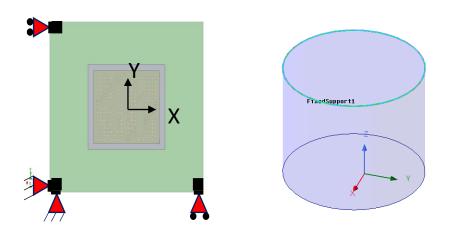
- Thermal cannot be used as source design for mesh links
 - Thermal-Thermal mesh links supported
 - 'Apply mesh operations in target design' not supported for the mesh link
- Convection boundary cannot be defined on a contact surface

Setup Link
General Variable Mapping Additional mesh refinements
Mesh operations
Apply mesh operations in target design on the imported mesh
C Ignore mesh operations in target design



Structural Solution Enhancements

- Structural Solution type [Beta]
 - Reference Temperature Specification for Objects
 - Stress-free temperature for individual objects
 - Environment temperature default
 - Edge Support
 - Enable edges to be defined as Fixed Support boundaries



Name	Value	Unit	Evaluated Value	Attribu	le
Name	Rod				
Material	"steel_1008"		"steel_1008"		Nan Mat
Solve Inside	~				Solv
Reference Temperature	EnvTemp		20cel		Ref
Orientation	Global				Mod
Model	~				Gro
Group	Model				Disp Mat
Display Wireframe	Г				Cold
Material Appearance	, ,			l l	Tra
Color					
Transparent	0				
<			>		

	Name	Value	Unit	Evaluated Value	Description	Read-only
	Name	Substrate				
	Material	"FR4_epoxy"		"FR4_epoxy"		
	Solve Inside	~				
	Reference Temperature	EnvTemp		20cel		
	Orientation	Global				
	Model	~				
	Group	Model				
	Display Wireframe					
[Material Appearance	~				
[Color					4
	Transparent	0				V





