



## **Ansys + Rockwell Automation**

“Virtual prototyping in Ansys Maxwell software coupled with Ansys Mechanical software makes it easy for us to understand the very complex dynamics inside the arc chamber and to change the design and tolerances inside the arc chamber of our low-voltage circuit breaker to meet the UL 60947-4-1 requirements and minimize the number of physical prototypes, ultimately reducing the time to market. The simulation software also enabled us to get the perfect guidance for the plastic components used in the arc chamber design, which helped us to reduce device cost and improve life cycle and short-circuit performance.”

— **Sadashiv Devidasrao Pimple, M.Sc.**  
Project Engineer / Rockwell Automation

## / Low-voltage Circuit Breaker Analysis and Design Using Transient-transient Co-simulation With Electromagnetic and Structural Simulation Software

Circuit breakers (CBs) are crucial devices in many electrical systems, ranging from standard domestic low-voltage systems to high-voltage transmission ones. CBs are vital devices for an electrical system's safety and reliability. The purpose of every CB is to open the circuit when sending a fault current. In the case of short-circuit currents, the CB must clear the fault in the minimum possible time, thus avoiding any damage to the downstream devices. Therefore, improving their performance (by reducing fault clearance time) is a never-ending process at the research level.

Rockwell Automation has implemented Ansys engineering simulation software to assist in the design process of a low-voltage CB architecture. Guided using a complete multiphysics coupling between transient electromagnetic and transient mechanical analysis, the design process uses 3D simulation to provide valuable insights related to the CB design. This enables Rockwell engineers to better understand the high-speed dynamic of the device and therefore identify necessary modifications to improve performances.

### / Challenges

To continue the evolution of the safety and reliability of CBs in electrical systems, performance improvements were explored using a novel low-voltage CB architecture designed by Rockwell Automation. Ansys Maxwell® advanced electromagnetic field solver and Ansys Mechanical™ structural finite element analysis software were leveraged for analyzing the performances of a new generation of low-voltage circuit breakers.

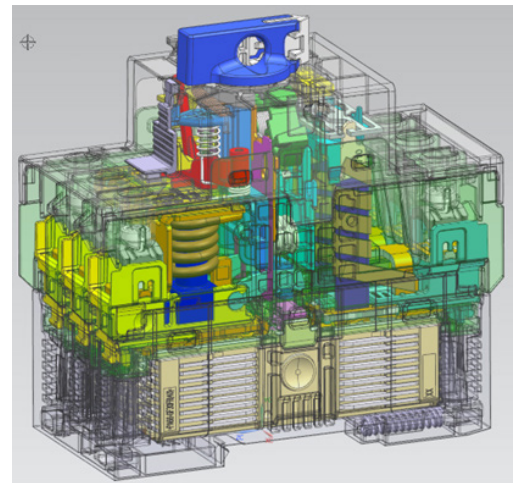
### / Technology Used

- Ansys Maxwell® advanced electromagnetic field solver
- Ansys Mechanical™ structural finite element analysis software
- Ansys Workbench™ simulation integration platform

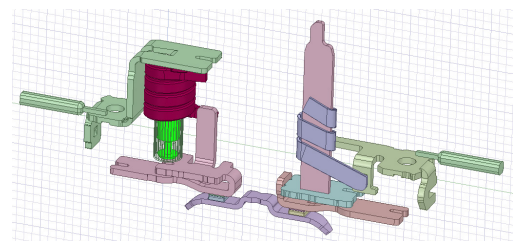
### / Engineering Solutions

Engineers at Rockwell Automation used a combination of Ansys products to observe and determine the reliability of three-phase CB functions. By using the coupled transient Maxwell solver to transient Mechanical simulation, relevant dynamics within the arc chamber were observed. Ansys Workbench simulation integration platform was used to couple Maxwell 3D transient solver with the transient Mechanical solver.

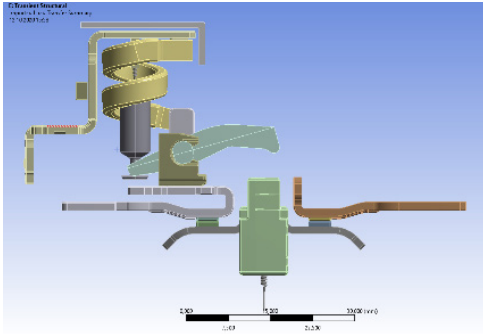
The ability to simulate engineering changes within a CB makes the software incredibly efficient in both cost and time savings. The transient dynamics analysis can determine the time-varying displacement, strain, stress, and force response of the structure under a random combination of the steady load, transient load, and simple harmonic load. Moving metal and plastic parts were considered to understand the dynamics inside the arc chamber as well as the magnetic unit.



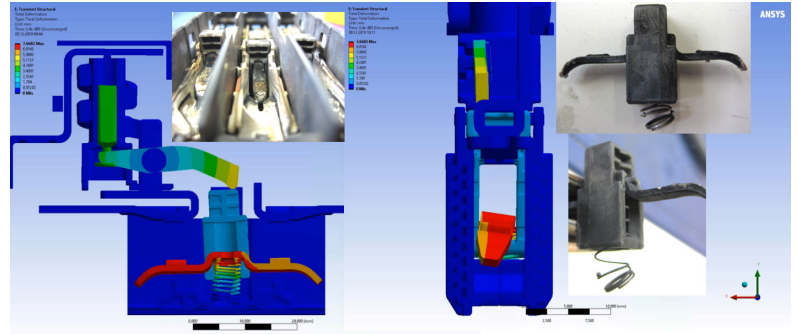
Mechanical software 3D view of device under analysis



Electromechanical device implemented within Maxwell 3D software



Transient mechanical software simulation setup



Transient mechanical simulation results and actual prototype under test

## / Benefits

- Simulations have shown critical aspects in the device dynamic behavior, enabling Rockwell engineers to implement significant changes in the arc chamber design (namely, more guidance for the spring inside the spanner holder and additional ribs to support spanner holder inside H parts). This resulted in a final relevant increment of device performances.
- For further simulation iterations, Ansys spring elements were used to reduce the computational time and achieve faster convergence.
- Simulation results were used to optimize the geometry of the spanner and spanner holder within the CB to prevent blockage during short-circuit and device-tripping tests.
- The winding feature within Maxwell software proved to be very convenient, since the software provides winding inductances, flux linkages, and induced voltages as default outputs for postprocessing purposes.

Ansys Maxwell and Ansys Mechanical coupled simulation reduced the total design time by 20% and made possible the implementation of a new design.

## / Company Description

Rockwell Automation, Inc. is a global leader in industrial automation and digital transformation. Rockwell Automation connects the imaginations of people with the potential of technology to expand what is humanly possible, making the world more productive and more sustainable. Headquartered in Milwaukee, Wisconsin, Rockwell Automation employs approximately 29,000 problem solvers dedicated to our customers in more than 100 countries. To learn more about how Rockwell Automation is bringing the Connected Enterprise to life across industrial enterprises, visit [www.rockwellautomation.com](http://www.rockwellautomation.com).

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Final product present on the market

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When visionary companies need to know how their world-changing ideas will perform, they close the gap between design and reality with Ansys simulation. For more than 50 years, Ansys software has enabled innovators across industries to push boundaries by using the predictive power of simulation. From sustainable transportation to advanced semiconductors, from satellite systems to life-saving medical devices, the next great leaps in human advancement will be powered by Ansys.

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