

Carrier Corporation

Reciprocating Chiller Designed with Embed



"Due to its power, flexibility, ease-of-use, and low cost, [Embed SE] has been Carrier's choice for system modeling, simulation, data acquisition, and rapid prototyping for each of the past five years."

Dr. Fred Cogswell
Senior Scientist
Carrier Corporation

Carrier Corporation, a division of United Technologies Corporation, is one of the largest manufacturers and distributors of heating, ventilation, and air conditioning (HVAC) equipment worldwide. Carrier is committed to using Embed SE (formerly called VisSim) to model, simulate and validate product designs, ranging in scope from single-zone air conditioners to hundred-ton chillers used in hospitals, university campuses, and office complexes.

Dr. Fred Cogswell, senior scientist, explained, "Due to its power, flexibility, ease of use, and low cost, [Embed SE] has been Carrier's choice for system modeling and simulation, data acquisition, and rapid prototyping for each of the past five years. Carrier uses [Embed SE] to develop and test all of its electronic controls, and depends on the resulting shortened development times to continually merge new technology into its products. Products that would have taken three years to develop are now routinely completed using [Embed SE] in less than one year."

Embed SE's power is extended to cover both scalar and vector block diagrams, including such features as matrix operations, matrix output displays, expression blocks, and a model tree. These features enable complex real-world systems to be rapidly modeled, simulated, and debugged. Modeling of essential matrix-based control elements, such as



INDUSTRY

HVAC/Commercial Refrigeration

CHALLENGE

Design a reciprocating chiller for simulating faults

SOLUTION

Use Embed SE's extensive block libraries to model the two refrigerant circuits consisting of multiple compressors, condensers, stepper- motor-controlled expansion valve, and evaporator

BENEFITS

- Model-Based Design environment significantly decreases design time
- Block diagram interface makes it easy to develop and test all chiller components
- Dynamic simulation of the chiller system conveniently tracks migration of refrigerant between components

state-space controllers, observers, and Kalman filters becomes particularly easy with matrix operations.

Reciprocating Chiller Design

An Embed SE modeling effort conducted by Dr. Cogswell focused on the development of a reciprocating chiller model for simulating faults. The reciprocating chiller consisted of two refrigerant circuits, each with the following components:

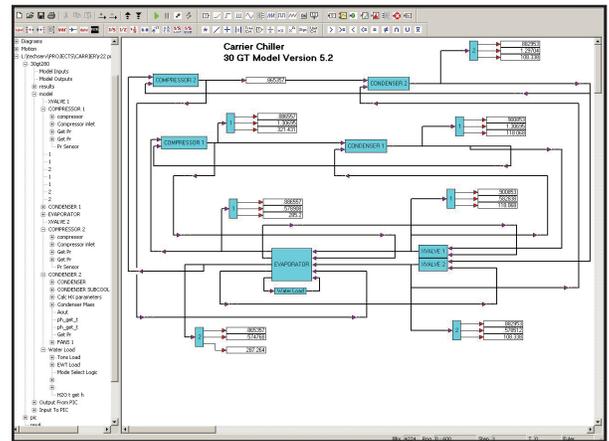
- One to four reciprocating compressors in parallel to compress the refrigerant vapor
- A water-cooled or air-cooled condenser to remove heat from the high pressure refrigerant and condense it to liquid
- A stepper motor controlled expansion valve to meter the refrigerant flow as it goes from high to low pressure
- An evaporator to transfer heat from the chilled water to the refrigerant, thus boiling the refrigerant to vapor while providing cooling

Dynamic Simulation

The Embed SE model, which consisted of approximately 6,000 blocks, performed a dynamic simulation of the chiller system, tracking the migration of refrigerant between components, as well as the control interactions.

The model ran at an update time of one second in order to maintain stability between the components; however, on a Pentium computer, it is capable of running many times faster in real time.

The reciprocating chiller model represents one of the many ways Carrier uses Embed SE to significantly decrease design time in their product line.



High-level diagram of Carrier Chiller GT 30 model.

The VisSim™ product line has been renamed to Embed™ and Embed SE™



For more information

Authorized Distributors



**EMBEDDED SYSTEMS
SOLUTIONS**
www.embeddedindia.com

#S 606, World Trade Center, Bangalore
altairsales@embeddedindia.com
080-6764 8888/36, +91 98450 83528
www.embeddedindia.com/contact.html