

### Description

- Software Tool for Vehicle Energy- & Thermal Management Optimization 用于车辆能量及热管理优化
- Used by numerous OEMs and Suppliers worldwide 在全球范围被众多主机厂和零部件供应商使用

### Features/Specifications

- Windows<sup>®</sup> desktop software 桌面Windows<sup>®</sup>应用软件
- Comprehensive simulation of engine cooling and air conditioning systems 发动机冷却和空调系统的综合仿真
- High flexibility allows fast and simple variation of different concepts 高度的灵活性允许快速简单地改变不同的概念设计
- Quick analysis of component interaction 快速分析零部件之间相互影响
- Steady state as well as driving simulation 稳态以及行驶模拟
- Easy to learn and comfortable handling 易于学习，操作舒适
- Reduction of expensive prototype building and time-consuming tests 减少昂贵的样件制造和费时的测试
- For passenger cars, trucks, trains, construction and farm machines, but not restricted to mobile applications 适用于乘用车、卡车、火车、建筑和农用机械，但不限于移动应用

### Innovation Pillars



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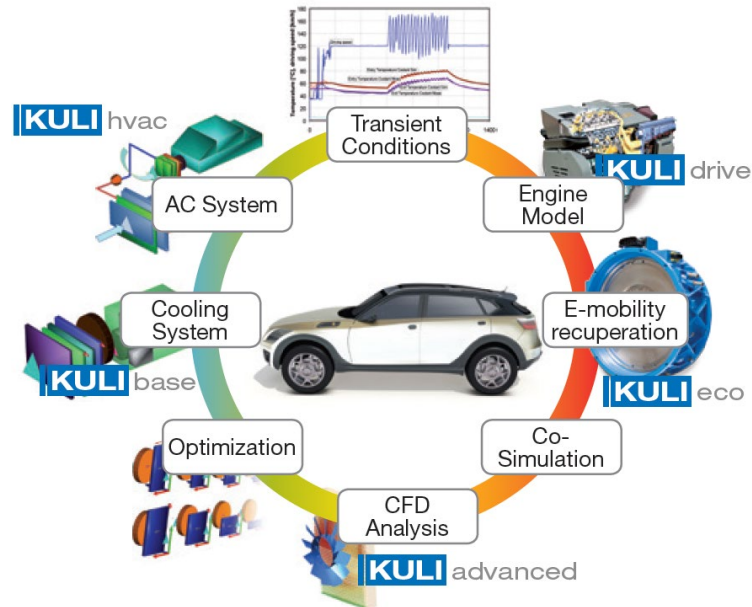


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# KULI base – Powertrain Cooling 动力总成冷却



## Description

- CAE-Software for the thermal management optimization of powertrain cooling systems CAE软件用于动力总成冷却系统的热管理优化
- Simulation of the various heat balances based on experimental component data 基于试验数据的各种热平衡仿真

## Features/Specifications

- Steady state thermal management analysis 稳态热管理分析
- Consideration of all thermodynamic key values (temperatures, pressure mass- and heat-flows,...) 考虑所有热力学关键值 (温度、压力、质量和热流,...)
- 1-dimensional Fluid Network Analysis allowing arbitrary level of detail 一维流体管网分析, 允许任意详细程度
- Quasi 1-dimensional Air Flow Network Analysis 准一维空气流网分析
- Automatic consideration of component overlapping 自动考虑零部件相互重叠
- Extendable media library 可扩展的媒体库
- Sensors and actuators for manipulation of input data via controllers 传感器和执行器, 用于通过控制器操作输入数据
- Sub-systems for "black-box" treatment and better system overview 用于“黑匣子”处理的子系统和更好的系统概览
- Interactive output display and post processor including automated reporting 交互式输出显示和后处理器, 包括自动报告
- Upgradeable function range via further KULI modules 通过更多 KULI 模块可升级功能范围

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**Component & Function Toolbars**

**Project Organization**

**Analysis Progress Info**

**2D Fluid Network View**

**3D Air Network View**

**KULI base**  
ENERGY MANAGEMENT OPTIMIZATION

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# KULI hvac – Air Conditioning 空调系统

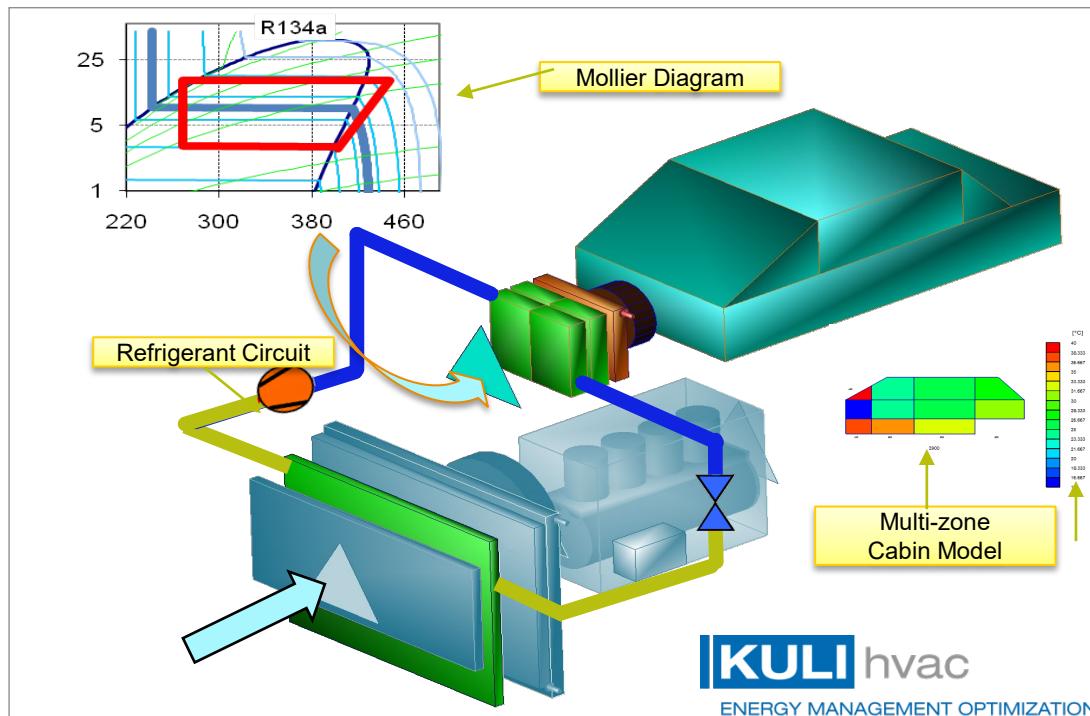


## Description

- CAE-Software for the thermal management optimization of HVAC systems CAE软件用于暖通空调系统的热管理优化
- Simulation of refrigerant circuits and passenger cabin for comfort estimation 模拟制冷剂回路和客舱以评估舒适度

## Features/Specifications

- Can be used as standalone program or as an add-on to KULI base 可以作为独立程序使用，也可以作为 KULI base 的附加组件使用
- Output like COP, evaporator dehumidification, refrigerant charge or subcooling value 输出，如 COP、蒸发器除湿、制冷剂充注或过冷值
- Simulate interaction between engine cooling and HVAC system (add-on version only) 模拟发动机冷却和 HVAC 系统之间的交互（仅限附加版本）
- Evaluate passenger cabin heat-up/ cool-down requirements 评估客舱加热/冷却要求
- Extendable refrigerant media library 可扩展制冷剂介质库
- Geometry based heat exchanger models 基于几何形状的热交换器模型
- Various compressor control strategies 各种压缩机控制策略
- Multi-zone passenger cabin model 多区域客舱模型
- “Chiller” component for electric vehicle battery cooling systems 用于电动汽车电池冷却系统的“冷却器”组件
- Graphical output like Mollier diagram or evaporator surface temperature plot 图形输出，如莫里尔图或蒸发器表面温度图



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# KULI advanced – Interfaces & Optimization 接口和优化



## Description

Add-on module to KULI base or KULI hvac / KULI base或hvac附加模块

- Integration of 3D-effects from CFD analysis  
集成 CFD 分析的三维效果
- Open Interface to other programs  
连接其他程序的开放接口
- Toolbox for automatic variations and optimization  
用于自动化计算和最优化的工具箱

## Features/Specifications

### cfid

- Input details of a given 3D velocity distribution  
输入给定三维速度分布的详细信息
- Outputs local heat transfer rates and air temperatures  
输出局部传热率和空气温度
- Reduces the computation time of underhood flow projects dramatically  
大大减少冷却流场项目的计算时间

### com

- Built-in set of COM-commands to control KULI from other programs (e.g. Excel®, Matlab®, ...)  
内置的COM命令集, 用于从其他软件 (例如Excel®, Matlab®等) 控制KULI
- Integration in complete vehicle simulation tools or in-house applications  
集成到整车仿真工具或内部应用中

### optimize

- Vary any number of parameters in one simulation  
在一次仿真中改变任意数量的参数
- Optimize specified parameters according to defined targets  
根据设定的目标优化指定参数

Private Sub CommandButton1\_Click()  
Dim calcOK As Boolean

```
'set a new KULI-controller
Set KULI = New KuliAnalysis
'Definition of coolingsystem
KULI.KuliFileName = "C:\Cool"
'initialize the cooling sys
calcOK = KULI.Initialize()
...

```

Engine RPM	Mean oil pressure bar	Driving speed km/h	Entry Temp IM °C	Quantity of heat kW	Mass flow rate of cooling air m³/s	
8	1500	6	0	93.823	19.742	0.370
9	2650	6	40	100.109	35.317	0.597
10	3300	6	60	108.285	47.387	0.724
11	3400	9	100	114.637	61.838	0.905
12	3500	9	130	103.376	64.925	1.126
13	3600	9	180	89.087	67.960	1.557
14	3600	9	190	89.087	67.960	1.557
15	2400	6	50	91.743	31.551	0.610
16	1700	6	20	92.038	22.127	0.429
17	1000	6	10	114.273	19.743	0.304

**KULI advanced**  
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# KULI drive – Transient Analysis 瞬态仿真



## Description

Add-on module to KULI base or KULI hvac / KULI base或hvac附加模块

- Only transient simulation of reference driving cycles allows using the full potential of CAE regarding component sizing & packaging and implementation of warm-up and cool-down strategies.  
只有对参考驾驶周期进行瞬态仿真，才能充分发挥CAE软件在零部件尺寸和封装方面的潜力，以及采暖和降温策略的实施。

## Features/Specifications

- No over sizing of components due to steady state operating points 零部件尺寸不会因为仅在稳态工作点设计而过大
- Reduced fuel consumption due to faster engine warm-up 发动机预热速度更快，油耗降低
- Improved passenger comfort due to faster cabin warm-up (or cool-down)  
由于乘员舱预热（或冷却）更快而提高乘客的舒适度
- More realistic temperature profiles due to consideration of thermal capacities (e.g. engine model, thermal network)  
由于考虑了热容量（例如：发动机模型、热管网），因此温度曲线更真实
- Possibility for fast concept studies regarding comfort and fuel economy 可以进行舒适性和燃油经济性的快速概念研究
- Optimization of control strategies 优化控制策略
- Consideration of auxiliaries and drivetrain cooling 考虑附件和传动系统冷却

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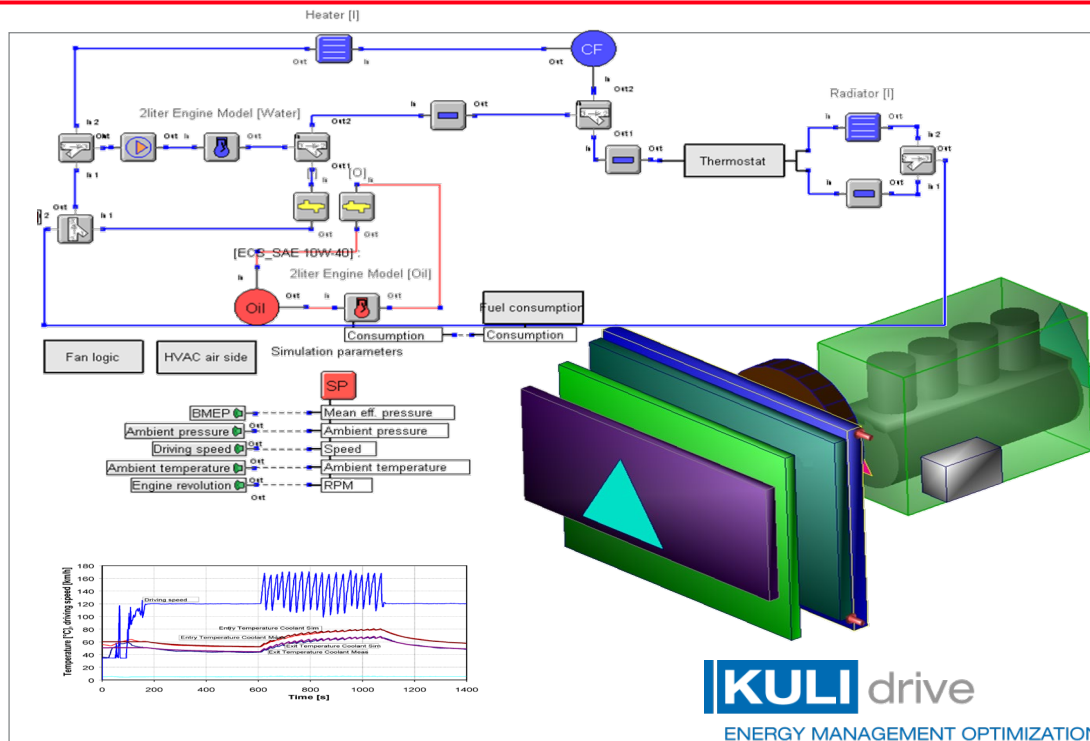


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ENERGY MANAGEMENT OPTIMIZATION

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## Description

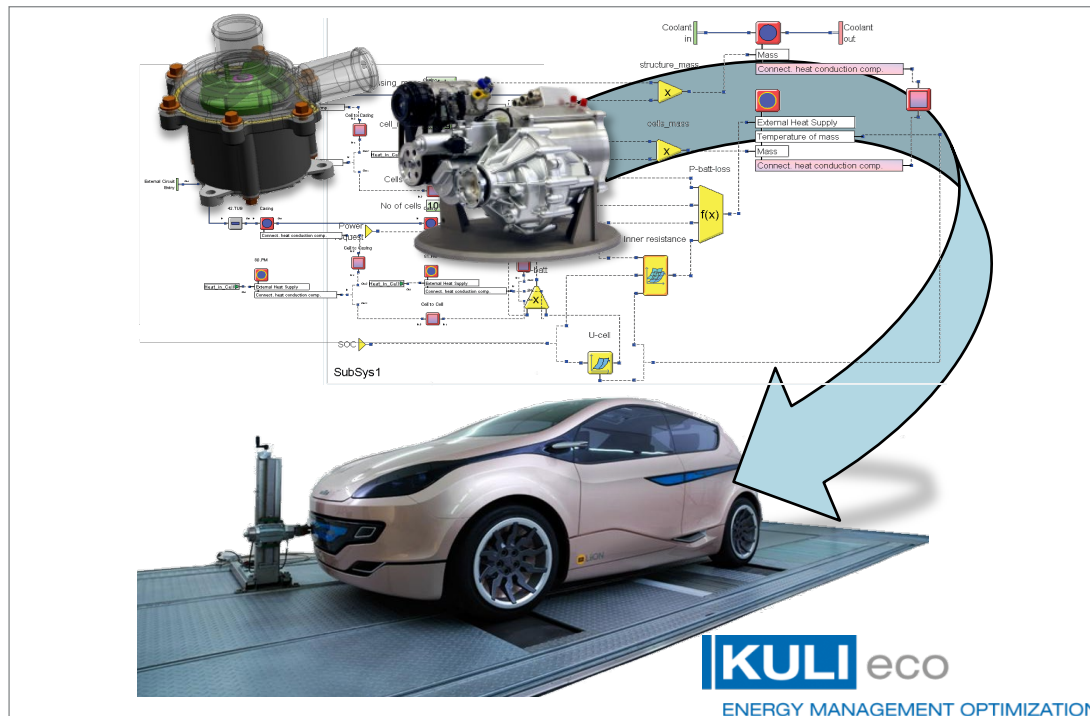
Add-on module to KULI drive. / KULI drive 模块的附加模块

- KULI gives you the opportunity to efficiently investigate in different EV/HEV concepts. Transient simulation makes it possible to consider overall power consumption.

KULI 让您有机会有效地研究不同的 EV/HEV 概念设计。通过瞬态仿真来考虑总体功耗。

## Features/Specifications

- Dedicated component models for:
  - 专用零部件模型
  - Battery 电池
  - Electric motor / generator 电机/发电机
  - Heavy duty electronic components 重型电子零部件
  - Electric auxiliaries (pump, fan, compressor) 电动辅助设备 (泵、风扇、压缩机)
  - Rankine cycle for heat recuperation conceptions 朗肯循环用于热回收概念
- Flexible simulation parameter concept 灵活的仿真参数概念设计
- Transient simulation for overall vehicle efficiency investigations on driving cycles 瞬态仿真用于对车辆行驶循环整体效率进行分析
- Efficient analysis of various hybrid cooling concepts (air, coolant, refrigerant) 高效分析各种混合冷却概念 (空气、冷却剂、制冷剂)
- Investigation of heating up conceptions (e.g. battery) 加热系统概念分析 (例如电池) 的研究
- Development of an optimized control-strategy for improved vehicle efficiency 开发优化的控制策略以提高车辆效率



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# KULI components – Virtual Test Bench 虚拟测试台架



## Description

- Software for the processing of thermal management component data 用于处理热管理零部件数据
- Import, organization and generation of heat exchanger and fan data 热交换器和风机数据的导入、组织和生成

## Features/Specifications

- Can be used as standalone program or as an add-on to KULI base 可以作为独立程序使用，也可以作为 KULI base 的附加组件使用
- Active interface for the automatic creation of KULI component files 用于自动创建 KULI 组件文件的活动接口
- File handling 文件处理
- Component search according to various search criteria 根据各种搜索条件进行组件搜索
- Extrapolation of measured data 测量数据的外推
- Regression of measured data 测量数据的回归
- Scaling of components 零部件缩放
- Comparison of the performance of different components 不同零部件之间的性能比较
- Comparison of the performance with different media 不同介质之间的性能比较



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# KULI mediaX – Media Database 媒介数据库

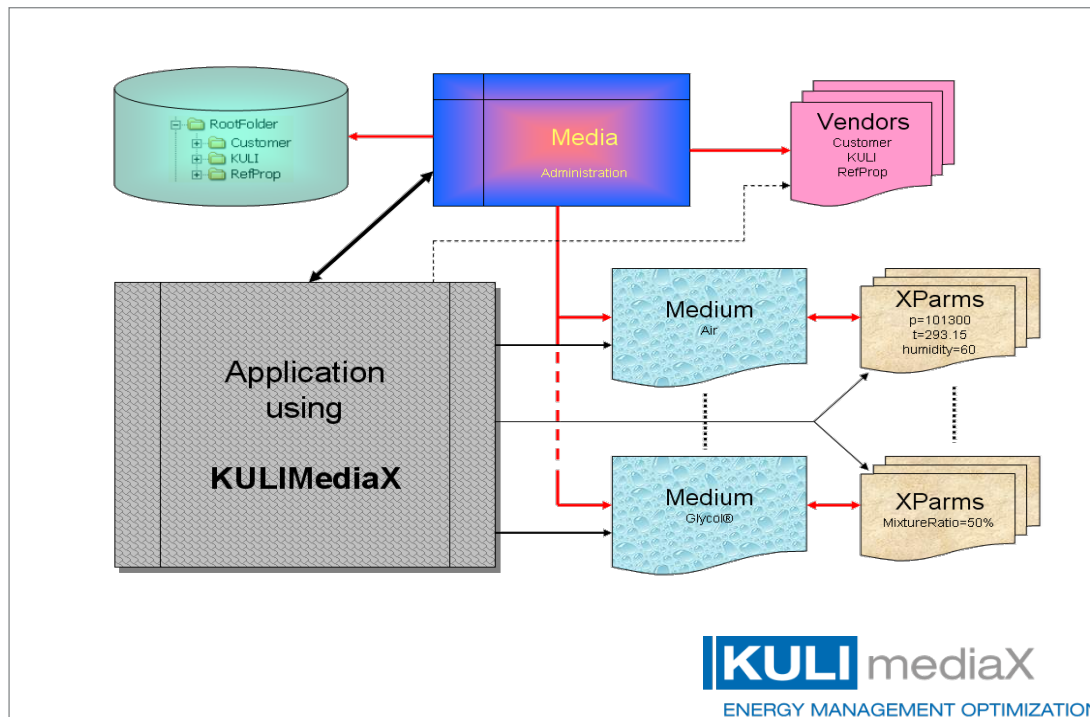


## Description

- KULI mediaX is an ActiveX DLL.  
KULI mediaX是一个动态链接库。
- Routine library with a multitude of functions to describe the material properties of KULI media  
具有多种功能的常规库，用于描述 KULI 介质的材料属性

## Features/Specifications

- Routine library which can be used for own program code  
可用于个人程序代码的库文件
- For applications that support COM-interfaces like Excel<sup>®</sup>, Matlab<sup>®</sup>, etc.  
适用于支持COM接口的应用程序，如Excel<sup>®</sup>、Matlab<sup>®</sup>等。
- Multitude of routines to describe the media properties (e.g. density, viscosity,...)  
描述介质特性（例如密度、粘度,...）的多种方式
- For air, coolant, oil, and refrigerant.  
用于空气、冷却剂、机油和制冷剂。
- Media database of KULI base included.  
包括KULI base的媒介数据库。
- Interface to other media databases (e.g. Refprop<sup>®</sup>)  
与其他媒体数据库的接口（例如Refprop<sup>®</sup>）
- Examples for usage  
使用案例



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# KULI FMU pro – Securely encrypted interface 安全加密接口



## Description

- The new KULI fmu pro feature will allow you to provide your customers with virtual models of your components and modules  
新的 KULI fmu pro 功能将允许您为客户提供组件和模块的虚拟模型

## Features/Specifications

- Securely encrypted, so your customers will see how well your components perform, but not how you do it.  
安全加密, 因此您的客户将看到您的组件性能如何, 但看不到您是如何做到的。
- Easy to use in any simulation tool which supports the FMI standard.  
易于在任何支持FMI标准的仿真工具中使用。
- License free for your customers, so they can be directly used without any additional costs or setup-efforts.  
您的客户无需获得许可证, 因此可以直接使用它们, 而无需任何额外费用或设置工作。
- Easily transferred to your customers as single-file worry-free packages.  
以单文件无忧包的形式轻松传输给您的客户。
- Easily created by you with our tried and tested KULI FMU generator.  
您可以使用我们久经考验的 KULI FMU 创建器轻松创建。

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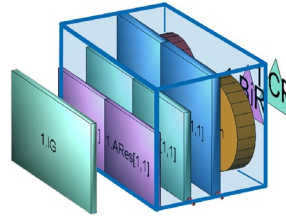


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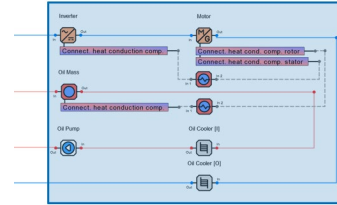
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A KULI FMU pro can be...

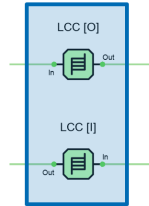
a cooling pack...



an e-drive assembly...



a single heat-exchanger...



... or even your new ground-breaking mystery component



The workflow is always the same:



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