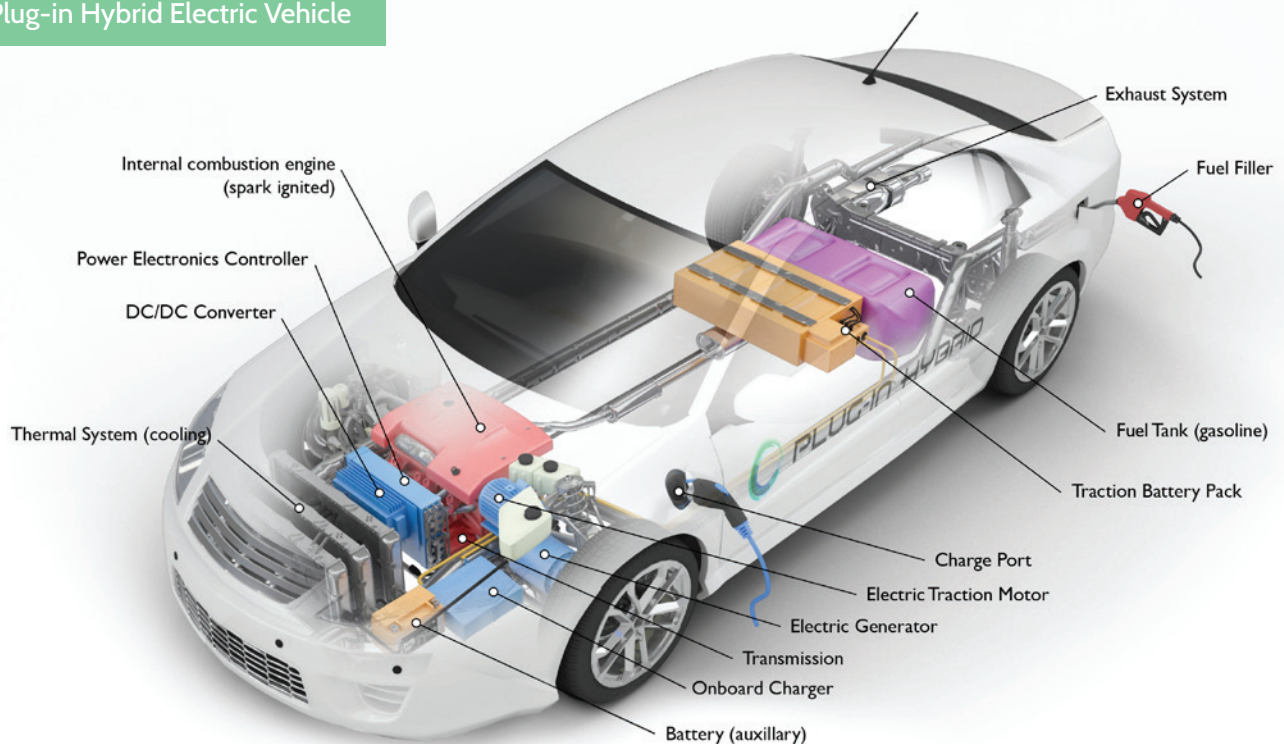


# HYBRID AND ELECTRIC POWERTRAINS

Alpha is extremely well positioned for the growing trend towards increased electrification of the automotive powertrain, enabling the highest efficiency power electronics, while achieving a reduced form factor, lower cost and an unprecedented increase in reliability.

## Plug-in Hybrid Electric Vehicle

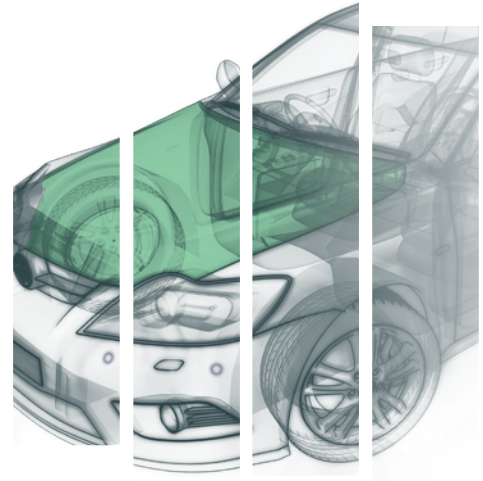


Credit: U.S. Department of Energy's Alternative Fuels Data Center ([afdc.energy.gov](http://afdc.energy.gov))



## ALPHA® Argomax® Silver Sinter Technology

ALPHA® Argomax® sintered silver provides high thermal conductivity enabling individual die to handle more current, reducing the total number of die required.



## HIGH RELIABILITY SILVER SINTER TECHNOLOGY

ALPHA® Argomax® sintered silver technology for die attach, package attach and substrate-heat spreader attach significantly improves the efficiency and reliability of power electronics, such as traction inverters and other high voltage conversion applications, including on board chargers and DC/DC converters. As vehicles transition from micro and mild hybrids to full hybrids, plug in hybrids and battery vehicles, powertrain kilowatt requirements increase dramatically. These applications demand optimized efficiency to achieve increased vehicle range for a given battery size.

Argomax® Material Types & Assembly Options	Paste - Printing
	Paste - Dispensing
	Film - Wafer Level Processing
	Film - Individual Die Transfer
	Film - Large Area Attachment
	Preform - Pick and Place
Sintering Temperature	200 - 300°C
Surface Finish Compatibility	Silver, Gold, Copper
Substrate Types	DBC - Direct Bond Copper
	DBA - Direct Bond Aluminium
	Copper Substrates, Others
Thermal Conductivity	200 - 300W/m-K

**Alpha's wide range of product types, coupled with solutions from Ag, Au and Cu surface finishes, provide unparalleled flexibility to achieve highest performance, throughput and yield.**



ALPHA® Argomax® sintered silver provides an order of magnitude improvement in die attach reliability, which is important when considering costs for a typical 100,000 mile, eight-year power train warranty.



ALPHA® Argomax® implementation results in the lowest \$/kW (dollars per kilowatt) supporting both silicon as well as wide bandgap devices with high voltages, and higher operating temperatures.

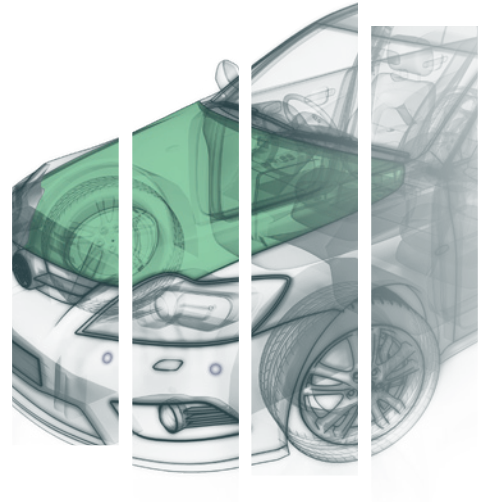
# HYBRID AND ELECTRIC POWERTRAINS

## THE ALPHA® ECOSYSTEM – TOTAL PROCESS SOLUTIONS

Tier 1 and OEMs can transition to a sintered solution with confidence knowing that Alpha partners are with them every step of the way. Our customer applications labs provide design assistance for both package and module level implementations, as well as sample build assistance and power cycle verification testing. This deep engagement results in drastically reduced development cycle time and a measurable time to market advantage.



ALPHA® Argomax® sintered silver enables a significant reduction in time-to-market.



## HIGH RELIABILITY ALLOY PREFORMS FOR DIE ATTACH

### ALPHA® PowerBond® Solder Alloys

ALPHA® PowerBond® Solder Alloys are a family of lead-free, high-reliability alloys with Antimony (Sb) content ranging from 5-10%. The use of Sb in Pb-free solder applications is increasing due to its improved strength and thermal fatigue resistance. The Powerbond® family can be customized with ALPHA® TrueHeight® Preform Technology (for bond-line thickness and tilt control) and pre-coated with ALPHA® AccuFlux™ series for difficult to solder surfaces.

### ALPHA® PowerBond® 2110

ALPHA® PowerBond® 2110 Preforms balance high creep resistance of Sn90Sb10 system with high thermal conductivity required for the power semiconductor devices operating at high junction temperatures (150-175°C). The alloy composition has been particularly tailored to enable easy wetting and low voiding.

### ALPHA® PowerBond® 2050

ALPHA® PowerBond® 2050 Preforms expands upon industry standard Sn95Sb5 alloy to provide improved wetting characteristics. The superior soldering characteristics combined with good thermal conductivity make it a viable option for heat sink applications.

PHYSICAL PROPERTIES	UNITS	POWERBOND® 2110	POWERBOND® 2050
Alloy Composition	%	Sn/10Sb/3Ag/1Cu +X	Sn/5Sb + X
Melting Temperature Range (30°C/min)	°C	222/266	235/240
Thermal Conductivity	W/mk	52.1	46.1
Specific Heat	J/gK	0.3	0.22
Density	g/cm3	7.3	7.25
Tensile Strength (150°C)	Mpa	19.2	13.2
Yield Strength (150°C)	Mpa	8.8	6
Elongation (150°C)	%	57.9	67.1

