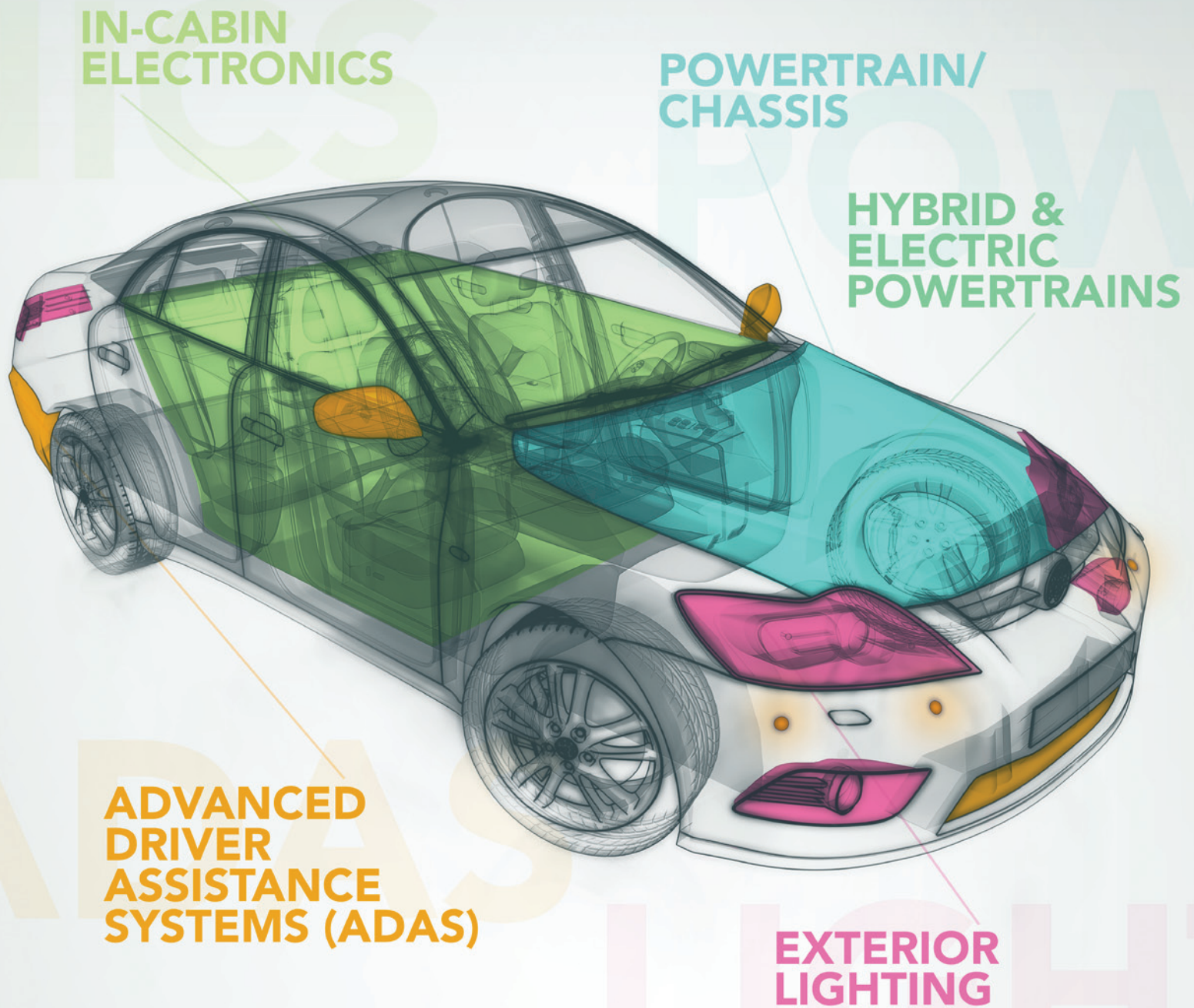
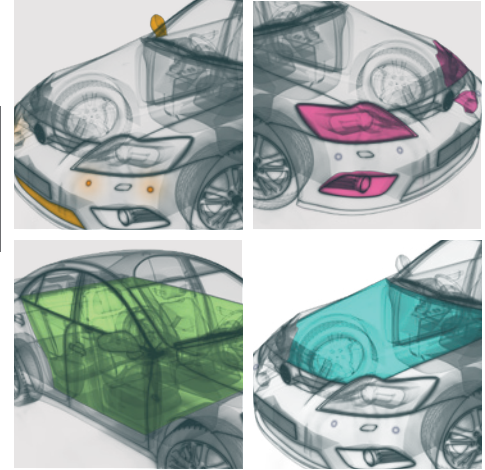




DRIVING ASSEMBLY MATERIALS INNOVATION

THE GLOBAL LEADER IN AUTOMOTIVE ASSEMBLY MATERIALS





Alpha is focused on addressing the needs of the automotive industry with proven solutions targeting reduced emissions, electrification, safety, reliability and performance.

Tier 1 suppliers and OEMs are leveraging Alpha's focused research and development and as part of MacDermid Performance Solutions, a world leader in the development, manufacture and supply of surface coating and joining materials, we are uniquely qualified to offer a full range of materials technology solutions for the Automotive market.

Alpha's Innot alloy supports higher operating temperature environments as well as superior vibration resistance. Our low temperature, high reliability solder alloy provides a cost of ownership advantage for in cabin electronics.

For high voltage hybrid and electric power train electronics, ALPHA® Argomax® sintered silver enables smaller form factors, higher performance, and an order of magnitude reliability improvement compared to first generation systems.

Alpha's global customer applications laboratories focus on accelerating time to market for Tier 1 and OEM automotive customers. Our customer technical support staff provide onsite assistance to ensure your processes remain optimized to realize the full capability of Alpha products.

To support the unprecedented introduction of new systems, Alpha has evolved our internal quality standard in compliance with ITAF 16949.

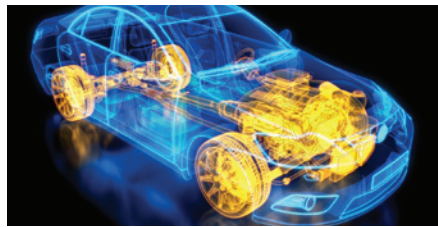
POWERTRAIN/CHASSIS ELECTRONICS

Assembly technology enablers for enhanced reliability

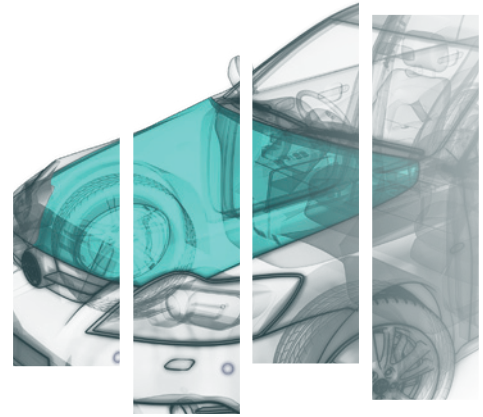
Electronics are increasingly being located in parts of the vehicle which expose them to extreme environmental stress. One of the most significant effects has been the requirement for electronics to operate reliably at higher operating temperatures in addition to meeting more stringent warranty requirements.

Alpha's advanced range of solder pastes that contain the InnoLot alloy are designed to withstand the most demanding of operational environments (temperature and vibration) that require reliability beyond the capabilities of traditional SAC alloys.

Alpha has a range of products that can reduce the cost of producing assemblies through process elimination, energy reduction and reduced reliance on precious metals whilst ensuring best-in-class reliability.



PRODUCT TYPE	PRODUCT NAME	PERFORMANCE IMPACT
Alloy	InnoLot, SAC305 and SACX Plus 0807	Enhanced product reliability through increased solder joint life under harsh environmental conditions
Solder Paste	OM-358 SAC305, InnoLot	Ultra Low Voiding increases process stability, thermal and electrical performance
	OM-353 SAC305, InnoLot	Excellent printability at fine features and high electrochemical reliability reduces rework and increases operational throughput while enhancing reliability
	CVP-390 SAC305, InnoLot	
Liquid Flux	EF-6000	Pin testable low solid content flux with exceptional electrical reliability
	EF-2210	Thermally stable VOC-free flux to help meet air quality regulation
	EF-6808HF	Wide process window halogen free flux with robust soldering performance
	EF-8800HF	Halogen free flux for complicated board and difficult-to-solder process
Cored Wire	Telecore® HF-850 SAC305, InnoLot	Faster wetting and low spatter increase production throughput and yield



HIGH RELIABILITY SOLDER TECHNOLOGY

InnoLot Alloy

The InnoLot alloy is a SAC based alloy developed with the Automotive industry for use in environments exposed to high temperature and vibration. The creep resistance properties of the InnoLot alloy offer significant improvements in reliability over standard SAC alloys.

ALPHA® OM-358

ALPHA® OM-358 is the next generation high-reliability InnoLot solder paste designed to provide ultra-low voiding performance on all component types including bottom termination components. ALPHA® OM-358 achieves IPC7095 Class III voiding on BGA components and less than 10% voiding on bottom termination components. ALPHA® OM-358 offers increased process stability and improved electrical and thermal performance through the reduction in average void levels and distribution of voids.

ALPHA® CVP-390

ALPHA® CVP-390 is a broad latitude paste applicable with multiple alloys and powder types. The CVP-390 chemistry offers excellent fine feature printability and world class electrochemical reliability down to 0.100mm.

ALPHA® OM-353

ALPHA® OM-353 offers flexibility of multiple powder types and alloys to offer excellent fine feature printability and best in class reliability. The ability to contain solder flux residue enhances electrochemical reliability and reduces issues generated from solder wicking on leads.

PRODUCT TYPE	ALPHA® OM-358	ALPHA® CVP-390	ALPHA® OM-353
Alloy	InnoLot SAC305	InnoLot SAC305	InnoLot SAC305
Benefits	Ultra-low voiding High Electrochemical Reliability	World class electrochemical reliability Fine feature printability	Solder Residue Containment Fine Feature Printability Excellent Processability
Performance	Enhancements in process stability, thermal performance, and electrochemical reliability improve the performance		

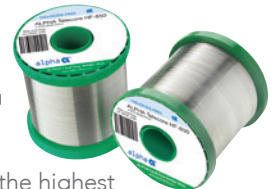


CORED WIRE FOR AUTOMOTIVE ELECTRONICS

ALPHA® Telecore® HF-850

ALPHA® Telecore® HF-850 is a high performance, lead-free alloy solder wire. Its halogen-free formulation meets the highest levels of electrochemical reliability, making it suitable for the harsh environment encountered in the Powertrain/Chassis area.

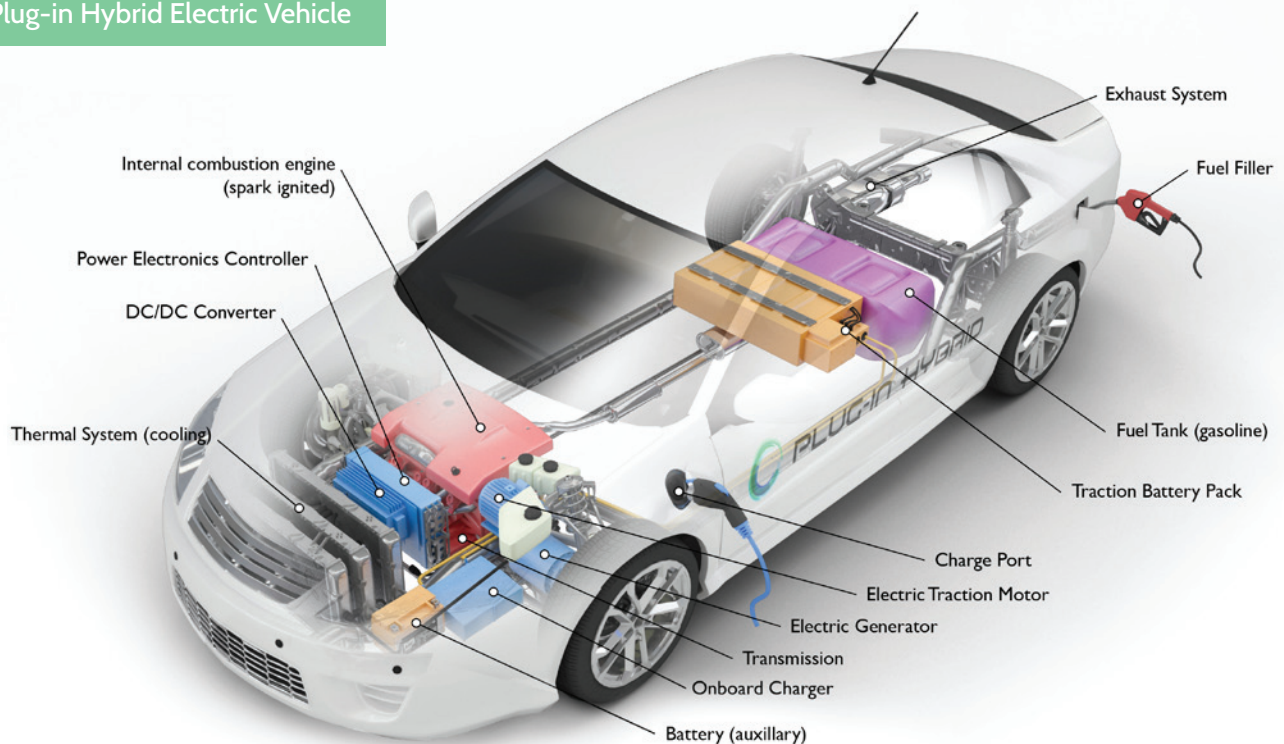
PRODUCT TYPE	TELECORE® HF-850
Alloy	InnoLot, SAC 305 and SACX® Plus
Properties	Halogen and Halide Free
Key Benefits	Very fast wetting, Very low flux spatter, Good spread characteristics and excellent first pass solder joints
Performance	Increased throughput and improved product life



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

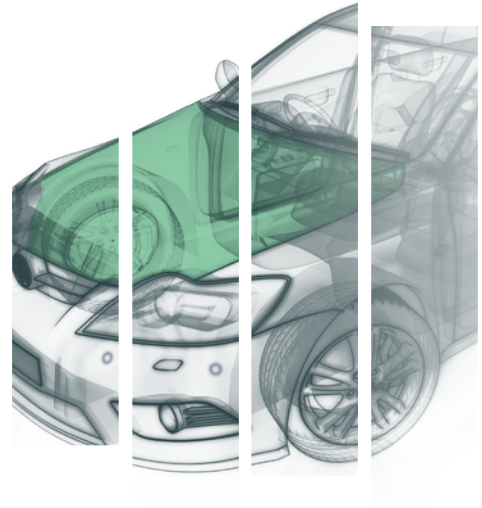


Credit: U.S. Department of Energy's Alternative Fuels Data Center (afdc.energy.gov)



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.

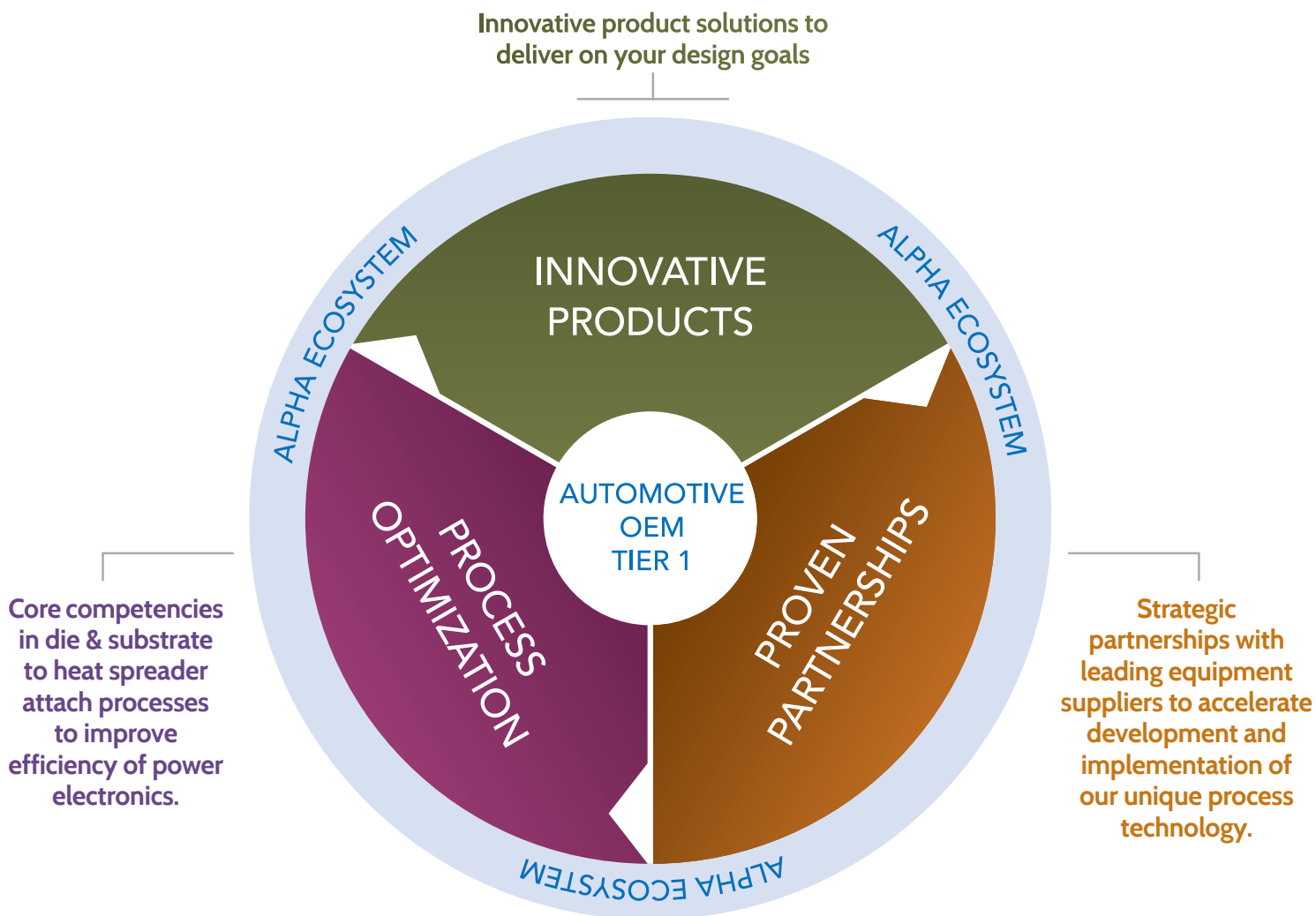


ALPHA® Argomax® implementation results in the lowest \$/kW (dollars per kilowatt) supporting both silicon as well as wide bandgap devices with high voltages, and higher operating temperatures.

HYBRID AND ELECTRIC POWERTRAINS

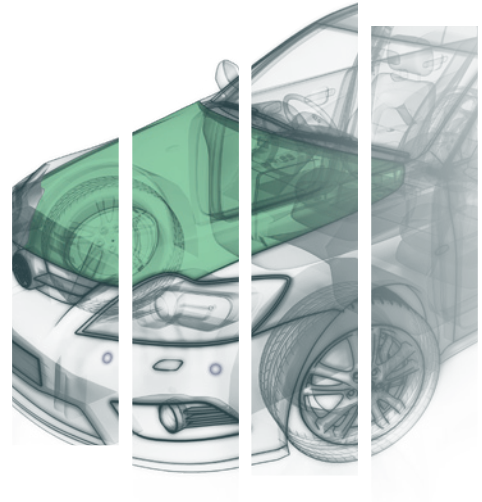
THE ALPHA® ECOSYSTEM – TOTAL PROCESS SOLUTIONS

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.



50%
REDUCTION IN
development
T I M E

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.

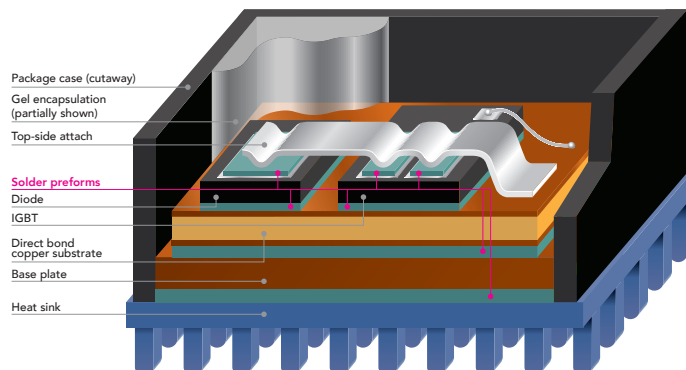
ALPHA® PowerBond® 2110

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



IN-CABIN ELECTRONICS

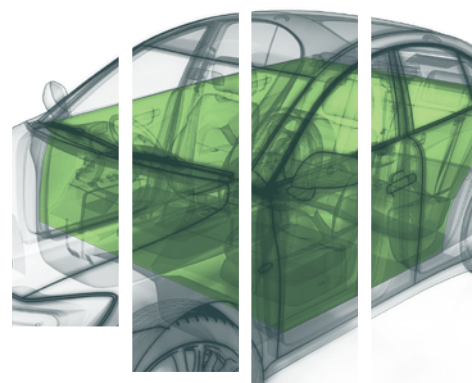
Assembly Technology Enablers for Lowest Total Cost of Ownership

Electronics are increasingly used in all passenger and commercial vehicles. What is considered as a luxury one year is expected as standard the next. This desire to include more electronics into the vehicle cabin has started to drive miniaturization which had not been a priority in the past. Automotive Electronics companies are under continual pressure to reduce the cost of their systems, against a back-drop of increasing raw material and energy prices.

Alpha has a range of products that can reduce the cost of producing assemblies through process elimination, energy reduction and reduced reliance on precious metals whilst ensuring reliability.



PRODUCT TYPE	PRODUCT NAME	PERFORMANCE IMPACT
Solder Paste	ALPHA® OM-550 HRL1 ALPHA® CVP-390 SAC305 and ALPHA® SACX® Plus	Reduced defects/rework and increased throughput Same chemistry with alloys optimised for electronics environment within vehicle
Liquid Flux	EF-6000	Pin testable low solid content flux with exceptional electrical reliability
	EF-2210	Thermally stable VOC-free flux to help meet air quality regulation
	EF-6808HF	Wide process window halogen free flux with robust soldering performance
Cored Wire	ALPHA® Telecore® HF-850	Increased throughput Improved product life
Bar Solder	ALPHA® SAC305 ALPHA® SACX® Plus 0807 ALPHA® SACX® Plus 0307	Optimise alloy choice/cost for application Reduce process defects and cost of waste



REVOLUTIONARY LOW TEMPERATURE SOLDER PASTES

ALPHA® OM-550

ALPHA® OM-550 HRL1 solder paste is a revolutionary advancement in low temperature solder pastes. The HRL1 alloy reduces board warpage and stress on device components by lowering soldering temperature 50°C below SAC alloys. This results in a highly reliable and energy efficient soldering process which is of most importance to the In-Cabin area of motor vehicles, where emphasis is placed on cost and energy reduction.

PRODUCT TYPE		ALPHA® OM-550
Alloys		HRL1
Applications		Excellent mechanical and thermal reliability Soldering temperature 50°C below SAC alloys
Performance		Reduction in board warpage and component stress Reliability comparable to SAC305 against in-cabin performance requirements Reduction in warpage induced defects such as Non-Wet Opens and Head-in-Pillow Reduces power consumption and carbon emissions



HIGH PERFORMANCE FLUXES

ALPHA® EF-6000

ALPHA® EF-6000 has been specifically developed to deliver high reliability and excellent soldering performance combined with outstanding board cosmetics and pin testability.

ALPHA® EF-6808HF

ALPHA® EF-6808HF is an alcohol based flux designed to optimize solderability and reliability. It is designed to have low bridging on bottom side QFPs, as well as provide superior performance in pin testing, hole-fill and solderballing.

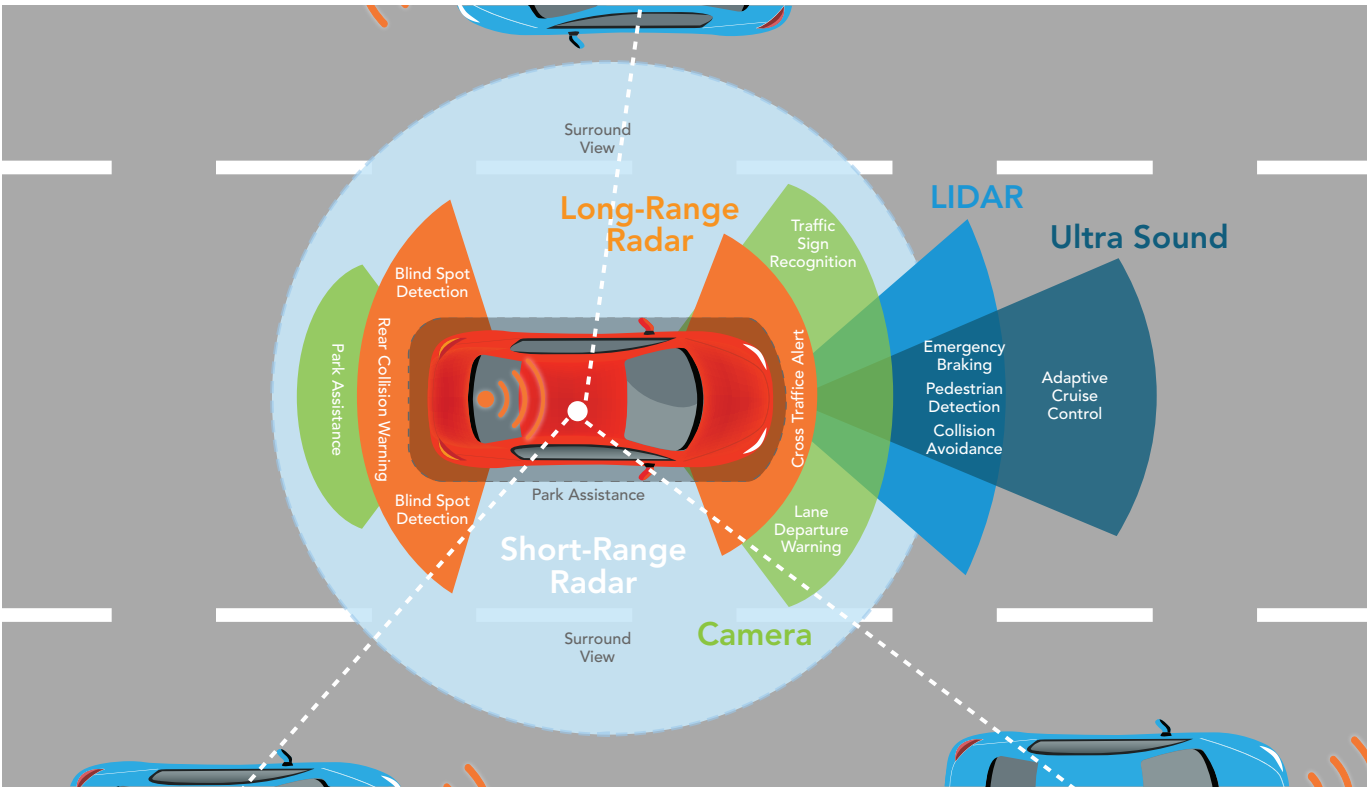
PRODUCT TYPE		ALPHA® EF-6000	ALPHA® EF-6808HF
Properties		Low-Solids, No-Clean	Low solids, alcohol based
		IPC-J-STD-004 SIR, Bellcore SIR, Bellcore ECM, JIS ECM & JIS SIR	Can be used in Lead-Free or SnPB processes
		IPC-J-STD-004 SIR Classification-ORL0	IPC-J-STD-004 SIR Classification-ROL0
Key Benefits		Thermally stable activator for excellent solderability Outstanding board cosmetics and pin testability	Wide process window and high throughput Excellent post-soldering cosmetics on PCB and pin testable Low bridging performance and high hole-fill
Performance		High electrical reliability & able to meet tougher SIR/EM tests Proven performance with common conformal coat chemistries	

ADVANCED DRIVER ASSISTANCE SYSTEMS (ADAS)

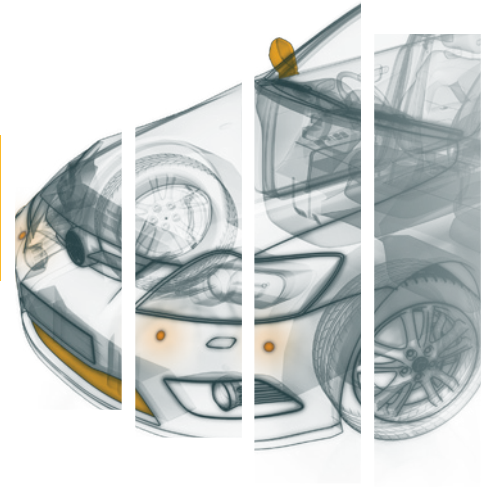
Materials Technologies Providing the Highest Levels of In-Service Reliability for Advanced Vision and Detection Technology

Advanced vision and detection systems are developed to play more critical roles within the vehicle. These Advanced Driver Assistance Systems (ADAS) include; Lane Departure Warning Systems (LDWS), Lighting, Detection and Ranging (LIDAR), Active Cruise Control and Front/Rear View Cameras to assist and automate parking.

The integration of these systems has driven a new level of miniaturization and an even greater emphasis on long-term reliability. Alpha is at the forefront of developing solutions which give the ultimate process performance through superior print and reflow yield for the finest pitch components. Fine pitch materials provide the highest levels of in-service reliability for cameras and sensors.



PRODUCT TYPE	PRODUCT NAME	PERFORMANCE IMPACT
Solder Paste	ALPHA® CVP-390 SAC305, InnoLot	Excellent printability and electrochemical reliability on fine pitch components
	ALPHA® OM-353 SAC305, InnoLot	Increased process stability
	ALPHA® OM-358 SAC305, InnoLot	Enhanced thermal and electrical performance
Preforms	ALPHA® Exactalloy® Tape and Reel Preforms	Provide reliable joints on SMT connectors with a purely SMT reflow process
	ALPHA® AccuFlux™ Preforms	Optimum solder volume with high density interconnects Maximize void reduction



HIGH PERFORMANCE SOLDER PASTES

ALPHA® solder paste technology has been developed to provide a wide processing window whilst providing industry leading electrochemical reliability performance. It is designed for use in Automotive environments where operating temperatures do not exceed 120°C.

PRODUCT TYPE	SOLDER PASTE
CVP-390	Zero Halogen, no-clean solder paste flux system Excellent pin testing properties Electrochemical reliability down to 0.100mm on the most challenging automotive SIR profiles Consistent fine pitch printing capability down to 180um circle printed with 100um thickness
OM-353	Zero-Halogen, no-clean solder paste flux system Excellent residue containment Electrochemical reliability down to 0.200mm on the most challenging automotive SIR profiles Consistent fine pitch printing capability down to 160um circle printed with 100um thickness
OM-358	Zero-Halogen, no-clean solder paste flux system <10% voiding on bottom termination components Electrochemical reliability down to 0.200mm on the most challenging automotive SIR profiles

SOLDER PREFORMS FOR THE ULTIMATE PROCESS OPTIMIZATION

ALPHA® Exactalloy® Preforms and AccuFlux™ Technology

ALPHA® Exactalloy® Preforms precisely increase solder volume in paste applications, achieving 100% hole fill with a wide variety of pin and hole ratios, even for thick PCBs. These preforms complement the printed solder paste to provide adequate and predictable solder volume for reliable through-hole connector attach in Automotive Electronics. AccuFlux™ technology is also available for ALPHA® Preforms to maximize void reduction. The preforms are coated with a precise amount of micro-flux to reduce residue and voids.

PRODUCT TYPE	SOLDER PREFORMS
Exactalloy® Tape & Reel Preforms	Tape & Reel packaging allows drop in replacement with any existing SMT line Maximize solder volume for ideal joint integrity Available in a range of shapes and sizes for flexibility in design
AccuFlux™ Preforms	Precision microflux coating ensures effective solderability with minimal residue Achieve <10% voiding under troublesome bottom termination components Maximize flux to solder ratio to eliminate flux spattering and mid-chip solder balls

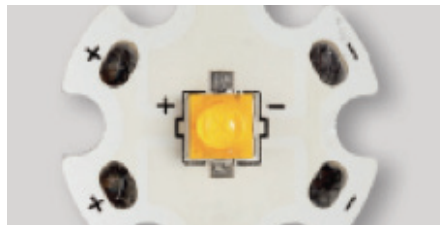


EXTERIOR LIGHTING

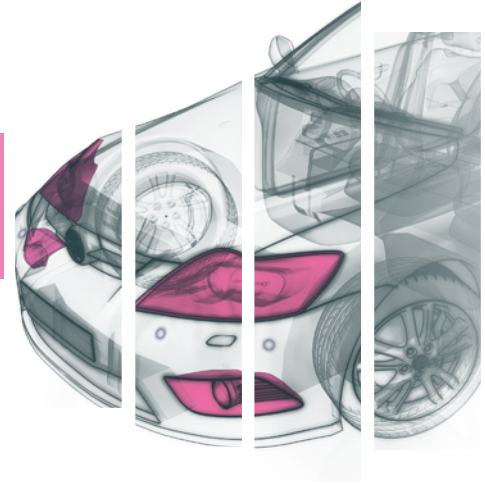
Enabling Technologies for the Latest Generation of LED Lighting

The use of LED lighting for front and rear car lights is accelerating. One of the challenges in LED Assembly is the use of assembly processes and materials which deliver high performance and reliability along with minimal long-term light output degradation.

Alpha is at the forefront of developing solutions which enable automotive lighting companies to meet their assembly, performance and reliability requirements.



PRODUCT TYPE	PRODUCT NAME	PERFORMANCE IMPACT
High Reliability Alloy	ALPHA® Maxrel™ Alloy	Creep-resistant alloy designed for high reliability requirements. Intended for exterior lighting applications where wide temperature swings, high-thermal cycling loads, longer lifetime, vibration and creep resistance are required.
Improved Tin-Bismuth Zero Silver Alloy	ALPHA® SBX02	Enhanced drop shock and thermal cycling performance with low temperature processing. Intended for enabling PET flex circuits for in-cabin lighting applications
Ultra Low Voiding Solder Pastes	ALPHA® OM-358	Designed to provide ultra low voiding and low flux residue with both SAC305 & high reliability alloys.



LED SOLDER PASTES

High Reliability Solder Paste - ALPHA® MAXREL™ Alloy

ALPHA® MAXREL™ Alloys are a high temperature creep resistant family of solder alloys. They are designed for high reliability requirements where wide temperature swings, high thermal cycling loads, longer lifetime, vibration and creep resistance are required.

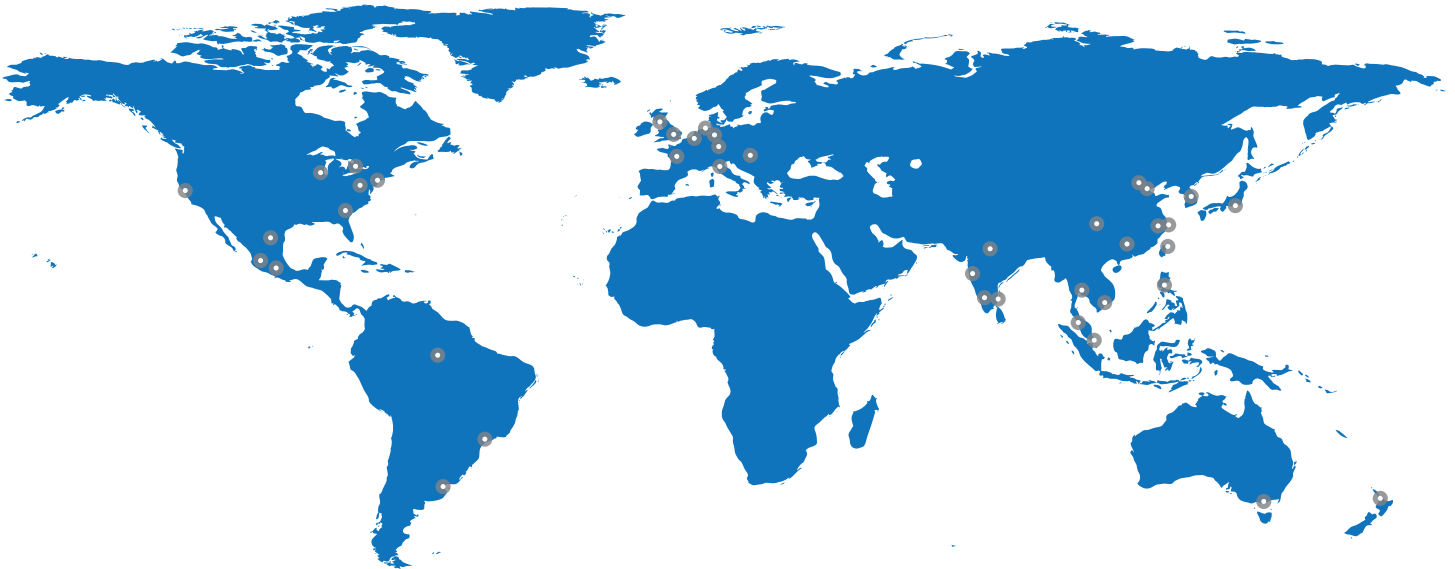
SOLDER PASTES FOR FLIP CHIP WAFER BUMPING, FLIP CHIP DIE ATTACH AND CHIP-ON-BOARD (CoB)

ALPHA® Lumet® FC is designed for ultra-fine feature applications offered in Type 6 & 7 alloy particle sizes.

ALPHA® Lumet P23 is the industry standard Type 6 solder paste for flip-chip die attach by Pin-Transfer / Stamping.

ALPHA® JP510 is a proven low cost of ownership jet printable solder paste delivering ultra-high throughput for CSP LED attach.

PRODUCT TYPE	OM-358	LUMET P39	LUMET FC39	LUMET P23	LUMET JP510	LUMET P53
Alloy	SAC305 InnoLot	SAC305 Maxrel	SAC305	SAC305 SnCu0.7	SAC305	Low Temperature SBX02
Application Method	Printing	Printing	Printing	Stamping/ Pin-Transfer & Dispense	Jet Printing	Printing
Features	Ultra Low Voiding Solder Paste	Industry Standard Solder Paste	Fine Feature Printable Paste	Fine Feature Pin-Transferable Paste	Ultra-High Throughput High Precision Volume Control	Improved Reliability Compared to SnBiAg Zero Silver Alloy
Suitable Application	High Stress, High Operating Temperature Exterior Lighting (Automotive Headlamps)	General Automotive Signal and Brake Lamp	Flip Chip Wafer Bumping and Die Attach Chip Scale Package to Board Attach	Flip-Chip LED Die Attach	Chip Scale Package Attach for Board (Back Light Unit, BLU)	Flexible Circuit Assembly on PET and Polyimide Pin-in-Paste (Elimination of Wave Soldering Process) for Through Hole Driver and Controls Assembly



**For more information on Alpha's
Automotive Technologies, please contact
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