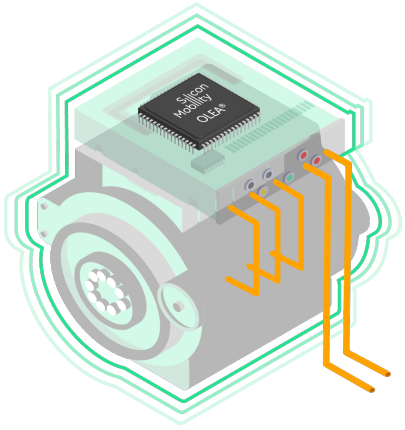
OLEA® APP INVERTER High Efficiency



Application for the control of inverter/e-Motor delivering the highest energy efficiency

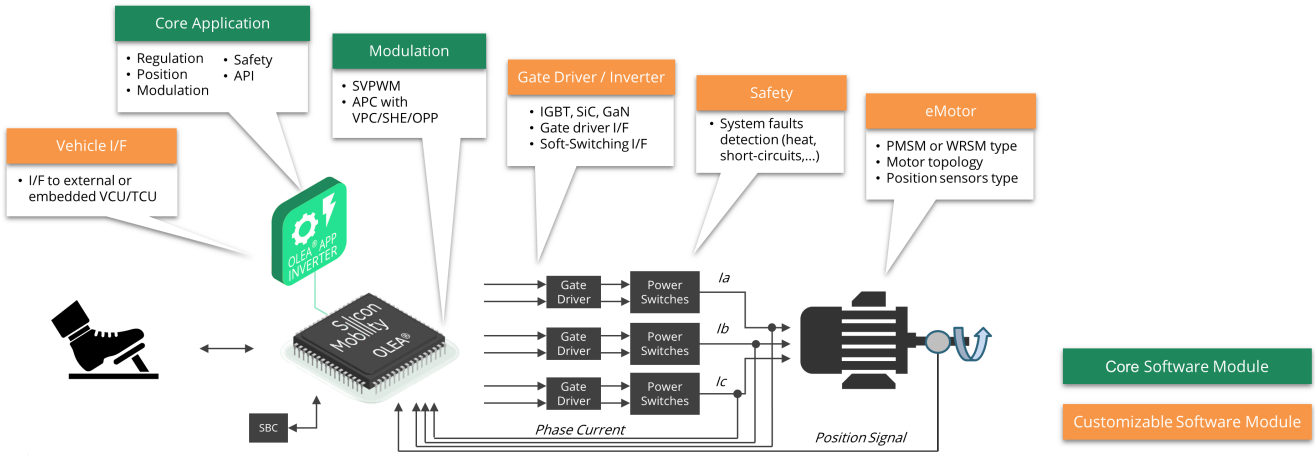
- Up to +20% energy gain*
- Up to +30% e-motor torque/speed range increase*
- Single chip solution delivering +50% BoM reduction
- Integrated safety and ASIL-D ISO 26262 ready

The most advanced control algorithms

OLEA® APP INVERTER HE is a turnkey software application for the control of inverter and electric motor delivering the highest level of energy efficiency and optimized for the OLEA® FPCU.

OLEA® APP INVERTER HE integrates all the necessary functions of a safe torque or speed regulation or electric motor control. The software's architecture is based around a core application that includes unique adaptive algorithms which applies the most suitable control strategy upon requested power, motor angle and speed. OLEA® APP INVERTER HE cuts energy losses into the power switches and into the electric motor while extending the operating range of the e-motor. Simulations on a WLTP** cycle demonstrate an energy gain of up to 20% when compared to inverter/e-Motor controlled by incumbent multi-core microcontroller-based applications.

OLEA® APP INVERTER HE has several customizable modules to interface any system configuration such as power transistors, gate drivers type, e-motor topology, position sensor and faults managment. The software interface is compatiant to AUTOSAR 4.3.



Advanced Algorithms

- Field Oriented Control (FoC)
- Adaptive PWM Control (APC)
- Space Vector Modulation (SVPWM)
- Optimized Pulse Pattern (OPP)
- Overmodulation with Noise Reduction (ONR)
- Selective Harmonic Elimination (SHE)
- Voltage Phase Compensation (VPC)
- Soft-switching of power switches.

Inverter/e-motor Topologies

OLEA® APP INVERTER HE can be customized to control any e-Powertrain system:

- Compatible with all power transistor technologies (MOSFET, IGBT, SiC and GaN)
- Support any e-Motor voltages (<60V and > 60V) .
- Support all types of e-Motor (PMSM, WRSM and more)
- Support all number of pair poles (1, 2, 4, 8 and more)
- Support 3 or 6 phases current acquisition
- Compatible with all types of position sensor (Resolver, Hall-effect)
- Can be interface with external or embedded VCU/TCU

** Compared to WLTP** simulation of state-of -the art FoC, SVPWM and Full Wave algorithms executed on conventional MCU*
*** Worldwide harmonized Light vehicles Test Procedures*

Adaptive PWM Control

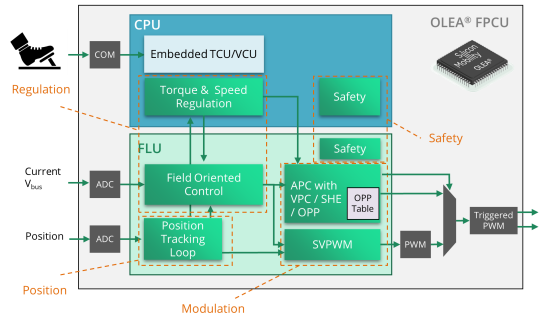
The APC reduces energy losses of both the inverter and the e-motor power stages, while mitigating Noise, Vibration and Harshness effects.
Based on the electrical angle position and the requested power (Torque x Speed), APC orchestrates several advanced algorithms to suppress useless switching events on the inverter and to improve the e-Motor Torque/Speed operating points. These advanced algorithms are:

- Optimized Pulse Pattern (OPP) – Offline and online calculated switching patterns reducing inverter losses including SHE.
- Selective Harmonic Elimination (SHE) – Eliminate harmonics to reduce iron losses and NVH effects.
- Overmodulation with Noise Reduction (ONR) – Increases the speed range and reduces the copper losses in the "constant torque" area. Harmonics noise generated are suppressed with APC.
- Voltage Phase Compensation (VPC) – Better correct the magnetic angle of the e-Motor to extend its operating range and to better reduce iron and copper losses.

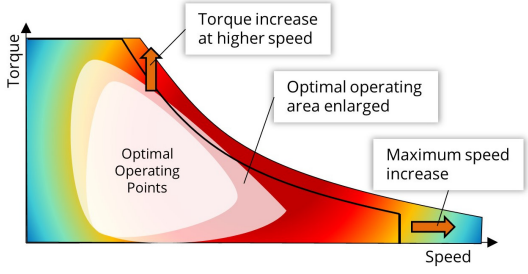
Impact of algorithms per type of losses:

Losses Type		Algorithms	Impact
Inverter	Switching	APC + OPP + Soft-Switching	Reduction of the losses > 70%
	Conduction and others		
e-Motor	Iron	APC + SHE + VPC	Reduction of the losses > 80%
	Copper	APC + ONR + VPC	Reduction of the losses > 30%

OLEA® APP INVERTER HE implemantion



Efficiency Map with OLEA® APP INVERTER HE

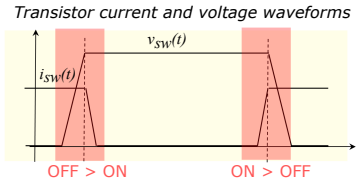


Soft-Switching - Real-Time Control

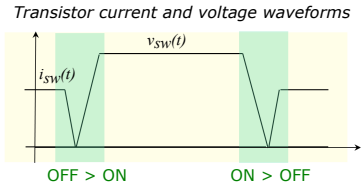
OLEA® APP INVERTER HE implements soft-switching to prevent power transistor's voltage and current signals to overlap. This real-time control of soft-switching reduces switching losses, transistor heating and conduction losses and delivers wide-bandgap performances regardless of the power technology in use.

Soft-switching algorithms enables a x5 switching frequency increase to extend the electric motor operating range while cancelling power transistor's losses. It also enables doubling of current rating to reduce transistor size and cost by a factor of 2.

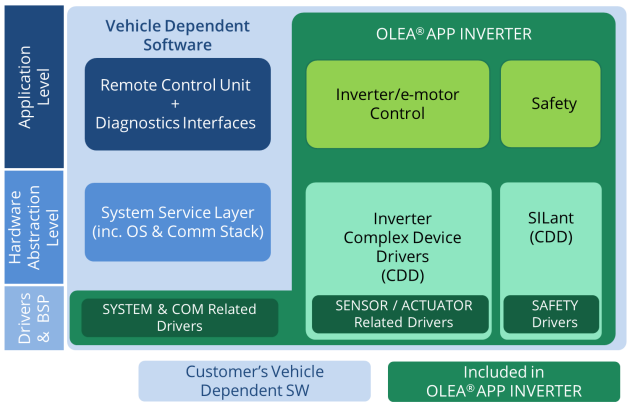
Hard switching - Fixed switching time



Soft-switching - Real-time control



Key Deliverables



Complete package including:

- MATLAB Simulink Target Model
- Application level functions for high level control of the eMotor, API and Safety functions
- Complex Device Driver for fine control of the e-motor/ Inverter and Safety mechanisms
- Low-level drivers of FPCU hardware resources
- User's guide including detailed API functions description for fast integration into vehicle dependent software.
- Safety work products
- Consultation with our in-house experts

Software interface is compliant with AUTOSAR 4.3 requirements

Silicon Mobility

www.silicon-mobility.com
sales@silicon-mobility.com
535 Route des Lucioles
Les Aqueducs – Bâtiment 2
06560 Sophia Antipolis
France