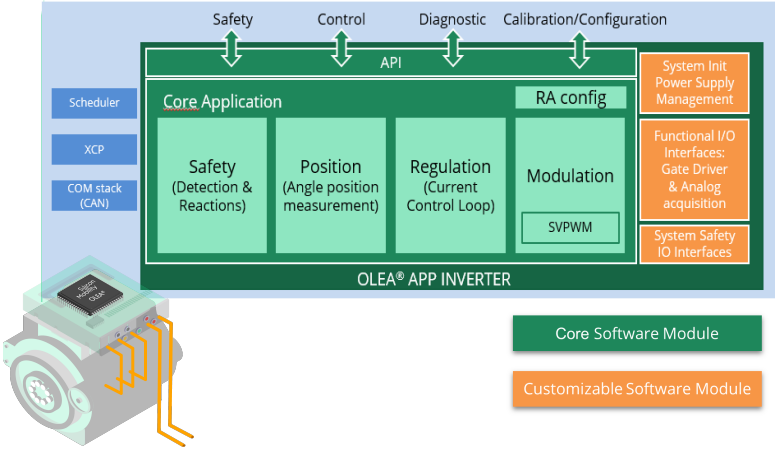
OLEA® APP - T222 INVERTER

Silicon Mobility

Application software for OLEA® FPCU enabling best in class control of electrified powertrains



- **Application software** for OLEA® FPCU
- Software **flexibility** and **modularity** enabling development of **platform**
- **Adaptable** for further differentiation
- State of the art **performance** and **efficiency**
- Compliant with **automotive standards**
- Short **time to market**

Ready to satisfy current and next generations e-powertrains

OLEA APP - T222 INVERTER is based on the OLEA T222 FPCU parallel architecture, which allows extremely high-performance, real-time and safe control of advanced power electronics and electric motors.

The application provides efficient and safe torque, speed, current or rotor control using Field Oriented Control (FoC) and variable Space Vector Pulse Width Modulation (SVPWM) algorithms. The modular software is flexible and can be adapted to a large variety of customer applications, whether Low or High-Voltage systems with PMSM or WRSM. The high controller performance supports not only MOSFET and IGBT power transistors – it is particularly suited for the latest technology SiC or GaN based inverters.

By exploiting the programmable and parallel hardware of the OLEA T222 FPCU chip, it allows real-time control loops and switching frequencies up to 100 kHz. The application has two independent stacks - one for control and one for the functional safety - designed as AUTOSAR Complex Device Drivers including APIs to interface with the RTE bus.

To support customers' developments, the OLEA APP - T222 INVERTER platform enables a fully integrated model-based design flow along the development cycle, from Model-in-the-Loop through Hardware-in-the-Loop simulations down to calibration and validation thanks to its ASAM standard as the native format.

Key metrics

Current Control Loop	2-100 kHz
D Current Reponse time Q Current Reponse time	30 ms 80 ms
Current Ripple	2.5%
Fault rate Reaction Time (FRT) Fault Handling Time Interval	100 ns 300 ns
Max CPU Load	10%

Adaptable to any e-powertrain system

Supports **48V to 800V** for HEVs and BEV

Automotive Qualified, ASIL-C/D design ready and AUTOSAR compliant

Any **MOSEFT, IGBT, SiC or GaN** based inverters

Support most advanced **measurement and calibration tooling**

Support wide variety of **PMSM** and **WRSM** motors

Model based design accessible as **Reference** and **Target Models**

Fully Featured

Type of E-motor
- PMSM (Permanent Magnet Synchronous Motor)
- WRSM (Wound Rotor Synchronous Motor)
- Configurable number of pole pairs
- Uniform air gap (Non-salient pole machine):
  - When D/Q inductances are the same (Ld=Lq)
- Non uniform air gap (Salient pole machine):
  - When D/Q inductances are different (Ld≠Lq)
- AFM (Axial Flux Machine)
- RFM (Radial Flux Machine)
- 3 Phase motor with star connection
- 6 Phase motor controlled as two-3 phases star connection motors

Modulation:
- SVPWM (Space Vector Pulse Width Modulation)
- Variable switching frequency based on the electrical speed
- Dead-time compensation

Motor Sensor Signal Processing:
- Position tracking loop algorithm for SIN/COS signals with a configurable number of e-motor/ resolver configurable pole pairs number
- Position sensor phase auto calibration at boot
- Position delta phase LUT calibration update at high speed
- Position gain and offset auto adjustment of SIN/COS ADC

VCU Interface:
- E-motor control FSM supporting the VCU operating states
- Fully features set of APIs (control, diagnostics, safety, calibration/configuration) allowing integration with a VCU

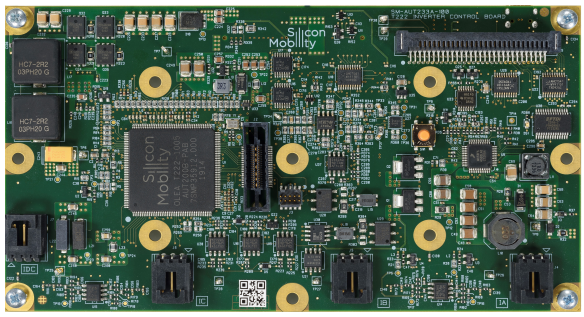
E-motor Control
- Flux weakening management
- Active discharge
- FOC (Field Oriented Control) incl.
  - Clarke/Park and Inverse Clarke/park transforms
  - D/Q currents filtering using a MAF (Moving Average Filter)
  - PID coefficient computing with lambda and bandwidth LUT
  - D/Q voltages decoupling
  - D/Q voltages saturation
- D/Q inductances LUT:
  - Fct. of D/Q currents for PMSM
  - Fct. of D/Q currents & rotor excitation current for WRSM
- Torque derating LUT based on Speed/DC-Link and T°
- Slew rate limitation: D/Q currents, switching frequency and rotor DC excitation current (WRSM)
- Filtering of DC voltage, motor speed, measured T° and rotor DC excitation current (WRSM)
- T° monitoring: filtered and interpolated using 8 post-build configurable LUT
- Torque control:
  - LUT of D/Q Currents based on speed and torque (PMSM)
  - LUT of D/Q Currents and LUT of rotor excitation current based on speed and torque (WRSM)
- Current control
- Speed control
- Rotor control:
  - Enabled automatically for WRSM
  - Rotor current regulator parameters computing
- Clockwise/anti-clockwise direction support

Safety & Diagnostics:
- ISO 26262 ASIL-C Ready Design
- Safety Finite State Machine (FSM) managing the faults containment
- Configurable safety faults detections
- Warning detections: over/under temperature warning

Key Deliverables

- Licensable as object or source code
- Fully featured API for an efficient integration with custom software
- Fast configuration and calibration with OLEA® COMPOSER - T222 e-motor GUI
- OLEA® T222 FPCU Technical Reference Manual, OLEA® COMPOSER – T222 SDK and User's Guides

Starter Kit for rapid prototyping



OLEA® COMPOSER – T222 HVIC Starter Kit is based on a reference design board for inverter/electric motor control to enable OLEA® technology evaluation, proof of concept and rapid prototyping. The Starter Kit includes:
- OLEA® COMPOSER HVIC Control Board with OLEA® T222 FPCU
- OLEA® APP INVERTER + Functional vehicle dependent software example
- Schematics and BoM
- User manuals

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