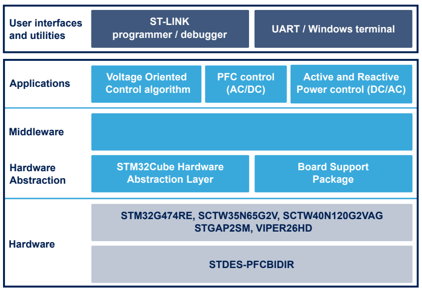
STSW-PFCBIDIR

Data brief

Firmware for Active Front End (AFE) bidirectional converter for industrial and electric vehicle DC fast charging applications



Product summary	
firmware for 15 kW, 3-lvl, 3-ph, bidirectional converter	STSW-PFCBIDIR
15 kW, 3-level, 3-phase bidirectional converter	STDES-PFCBIDIR
Firmware runs on:	STM32G474RE
Firmware download method:	ST-LINK/V2 ST-LINK/V3
Firmware development environments:	IAR Embedded Workbench
Applications	PFC Converter - Three Phase Input DC Fast Charging Station

Features

- Voltage Oriented Control (VOC) algorithm
- Based on STM32G474 platform:
  - Digital solution with advanced analog peripherals (comparators, op-amps, ADCs and DACs)
  - High-resolution timer (HRTIM)
  - Hardware Math Accelerator (Cordic)
- AC to DC (rectifier) mode:
  - Power Factor Control (PFC)
  - DC Bus Regulation
  - Soft Start-up and burst mode operation at light load
- DC to AC (inverter) mode:
  - Active and reactive power control
  - Standalone inverter (UPS)
  - Integrated grid connection solution
- Overcurrent and overvoltage protections
- On-line configurable multilevel topology (2-level and 3-level topologies)

Description

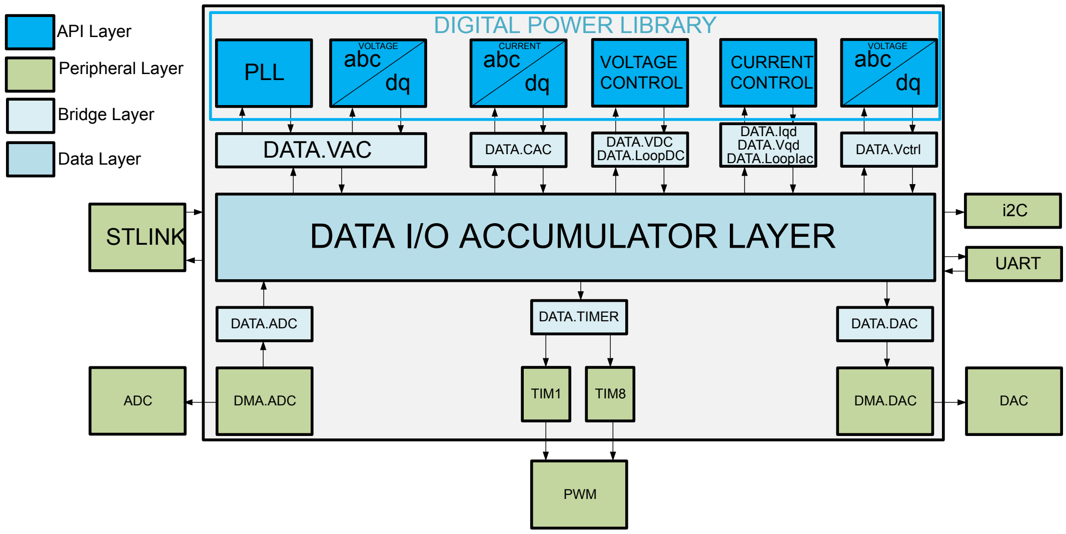
The firmware provides comprehensive three-phase, three-level and two-level AC/DC and DC/AC power conversion control on the STM32G474 mixed-signal MCU optimized for Digital Power. The firmware includes a sophisticated voltage oriented control (VOC) algorithm to control either the Power Factor in AC/DC conversion or the AC output power (active and reactive) in DC/AC conversion.

1 Voltage oriented control implementation

The voltage oriented control (VOC) algorithm implements vector control based on synchronous reference frames for current decoupling strategy.

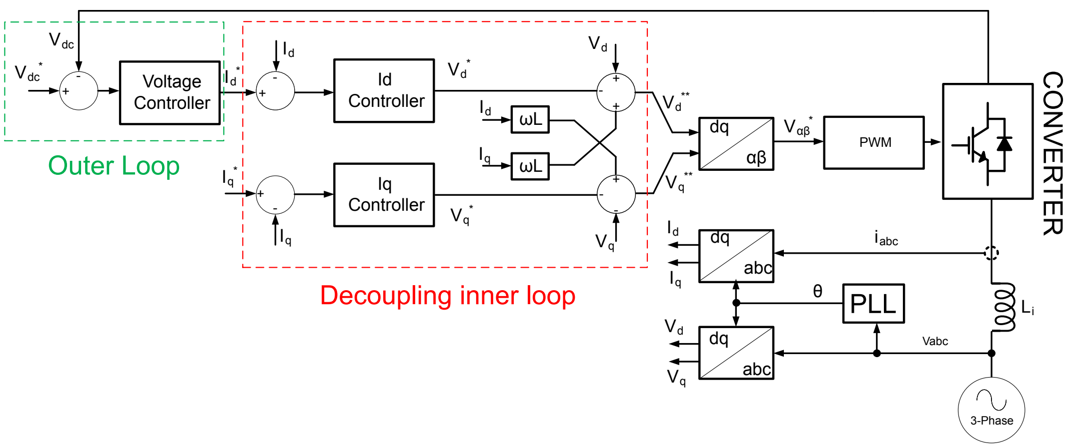
In order to deliver the highest possible power quality, the algorithm requires a high performance microcontroller such as the STM32G474 mixed signal integrated control platform, featuring high-resolution Timers and a large number of PWM outputs, and a Math Accelerator, which boosts calculation rates for higher output signal definition and accuracy.

Figure 1. Block diagram of the library architecture



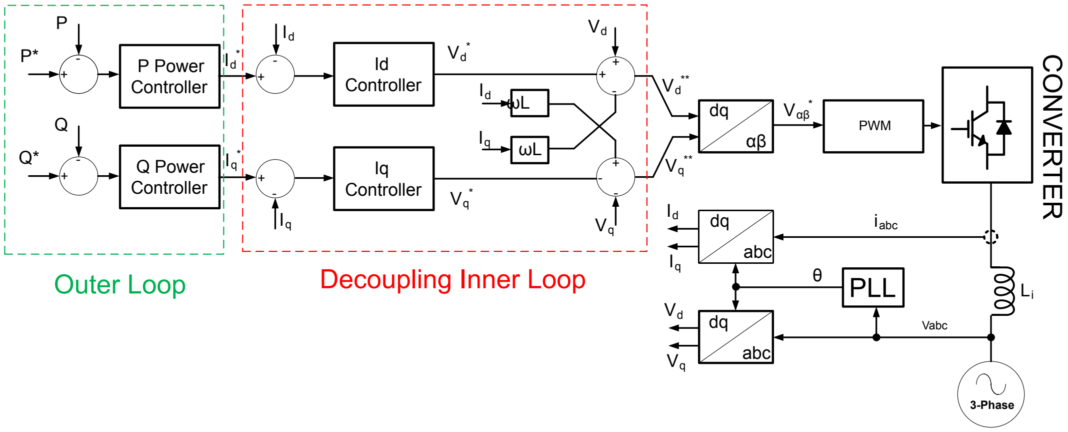
In rectifier mode (AC/DC), for unity power factor operation, the input current is controlled through the regulation of the direct (d-axis) component according to the output power demand, while setting the quadrature (q-axis) component to zero in order to achieve null reactive power.

Figure 2. Block diagram of the VOC: AC/DC conversion



In inverter mode (DC/AC), the direct (d-axis) component of the current is directly related to the active power (P) while the quadrature (q-axis) component is directly related to the reactive power (Q).

Figure 3. **Block diagram of the VOC: DC/AC conversion**



Revision history

Table 1. **Document revision history**

Date	Version	Changes
20-Nov-2019	1	Initial release.
16-Mar-2020	2	Minor text edits.