

# PSOC™ Control C3 (PSC3P2xx, PSC3M3xx, PSC3P5xx, PSC3M5xx) – application use cases

## Customer training workshop (CTW)

January 2026

public

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# Industrial and consumer market applications

## Smart home



- Power/gardening tools
- Lawn mower robots
- Home robots

## Home appliances



- Residential AC ODU
- Large and medium home appliances drives

## Renewables



- LEV
- PV inverters
- EV charging

## SMPS



- Telecom PSUs
- Server PSUs
- Workstation PSUs
- LED lighting

## Industrial



- General-purpose drives
- Servo drives
- Commercial ACs

## Markets

Motor control

Power conversion

Communication

SiC

GaN

Wide-bandgap (WBG) ready

System solution offering with other Infineon products

**PSOC™ Control C3**


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# Dual-motor control (lawn mower)

### Why choose PSOC™ Control C3?

- High processing power for smooth software execution and efficient multitasking
- Extensive peripheral, pin-count enabling simultaneous multi-motor control and replacing multiple controllers
- Cost and size-efficiency through high integration

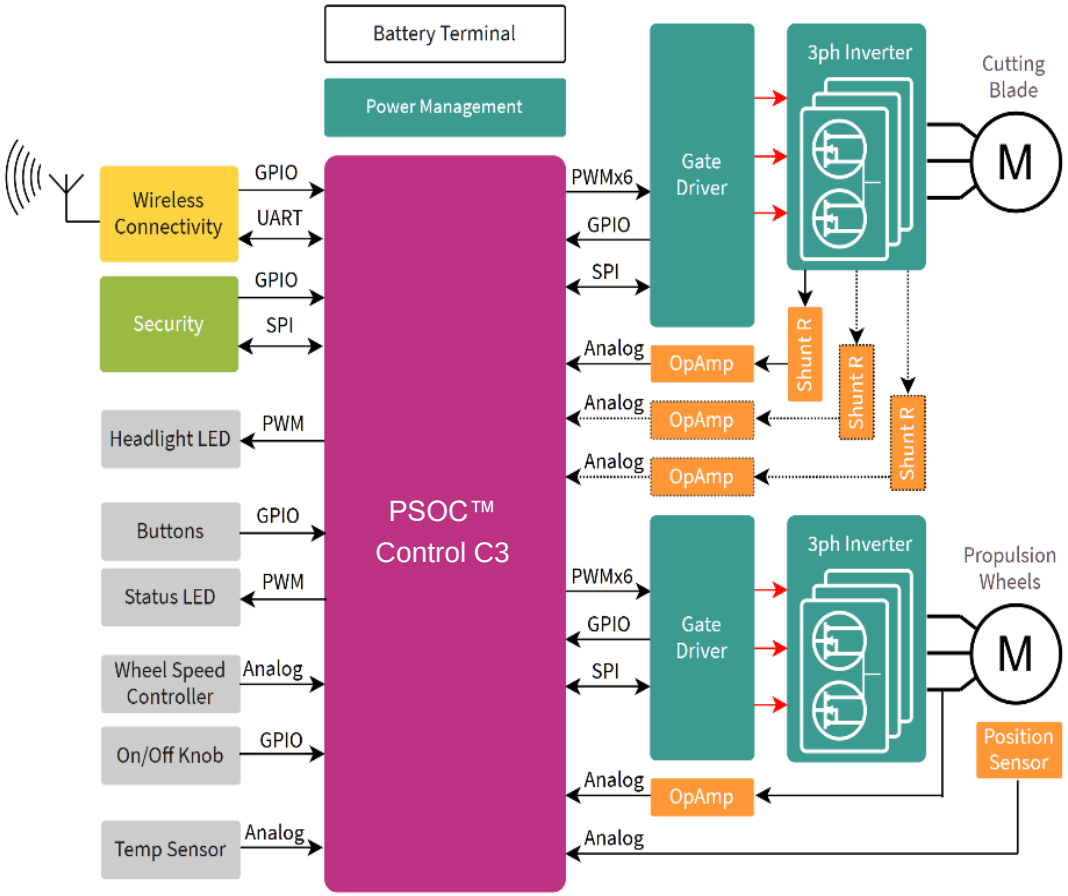
### Key features

- Advanced MCU core with FPU and CORDIC accelerator
- High-speed ADC with 16 parallel sample-and-hold registers
- Highly versatile TCPWM motor control timers
- Fully configurable interconnects with <1 ns latency
- Robust security and safety features
- Low-power standby

### Additional applications

- Cordless concrete saw
- Battery-powered chainsaw
- Cordless blower/trimmer
- Self-propelled lawn-mower

## Functional block diagram (self-propelled lawn mower)





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# Dual-motor control and PFC (residential AC ODU, heat pump)

## Why PSOC™ Control C3?

- Optimized design for high switch frequency boost PFC (80 kHz) and dual-motor control (compressor and fan)
- Integrated safety and security features to protect customer software IP and communication (secure boot, secure OTA, and secure communication)
- Dedicated motor control peripherals for simplified development (CORDIC accelerator, DSP/FPU, TCPWM, 12 MSPS ADC)

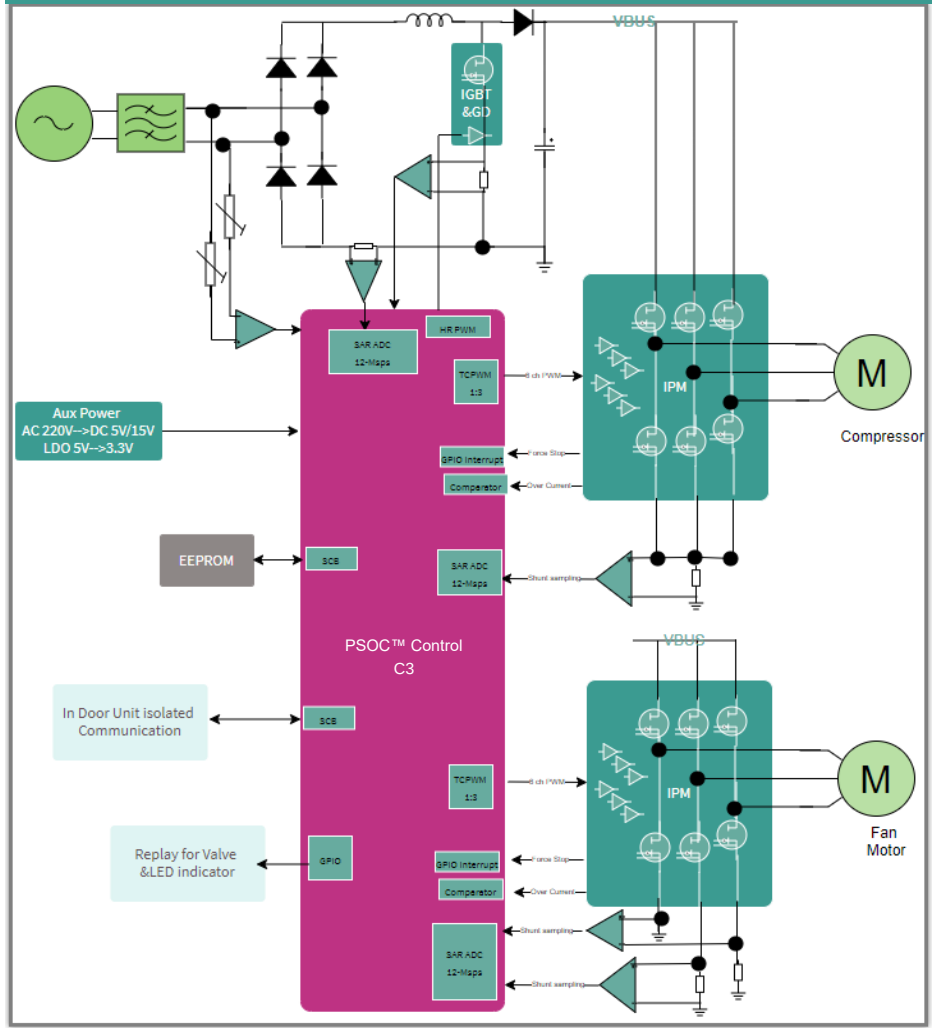
## Key features

- CORDIC hardware accelerator
- Internal oscillator with ±1% accuracy across full range (reduced external oscillator)
- Up to 16×16-bit, 4×32-bit TCPWM, HRPWM with <100 ps resolution
- Up to 12 MSPS idle sampling ADC, 16 synchronous sample-and-hold, in-built PGA
- PSA L2 certified, Class B/SIL 2 compliant self-test library

## Target applications

- Residential air-conditioning ODU control, heat pump

## Functional block diagram





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# Outdoor unit solution overview

The following describes a demo for sensor-less, dual-motor control plus high-frequency PFC solution, based on Infineon's high-performance PSOC™ Control C3 MCU PSC3M5FDS2ACQ1.

### System CPU load test

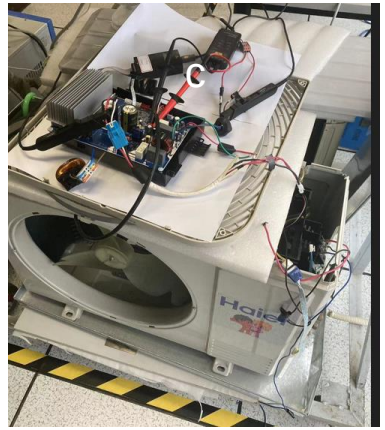
- PFC execution time: 3 µs
- Compressor drive FOC execution time: 11 µs
- Fan drive FOC execution time: 10 µs 80 kHz PFC control + 15 kHz fan motor control + 6 kHz compressor control with total CPU load less than 50%.

### Compressor drive features

- 6 kHz carrier frequency, single-shunt current sampling
- Sensor-less FOC algorithm with execution time <11 µs
- 5/7 segment SVPWM
- Field weakening algorithm
- Oriented closed loop startup
- High-performance torque compensation
- Ultra-low delay sensor-less PLL observer
- Dead time compensation
- Full protection features implemented
- Solution has been validated on mass production



**PSOC™ Control C3 dual-motor control with HPFC demo**



Test on 1.5 P air conditioner ODU

**Demo setup**


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# Outdoor unit solution overview (contd.)

## Fan drive features

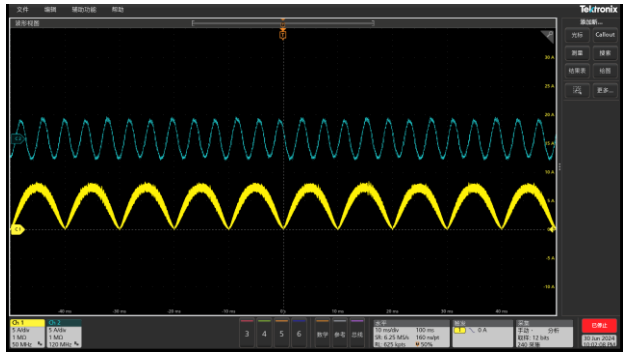
– Carrier frequency between 15 kHz and 20 kHz; sensor-less FOC algorithm, with execution time <10 µs
– Supports multi-stage headwind startup algorithm
– Supports headwind, tailwind and static direct close loop startup
– Single-shunt current sampling
– Three running mode controls: torque, power, and speed
– Solution has been validated on mass production

## High-frequency PFC

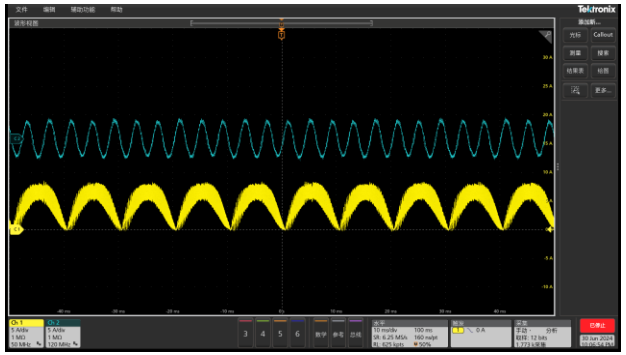
– Single-phase boost PFC, dual close loop control, CCM mode
– PFC algorithm execution is less than 3.2 µs (including current sample, voltage loop and current loop execution)
– 80 kHz PWM carrier frequency. PFC algorithm synchronized with PWM frequency. PF cosΦ > 99.8%, AC voltage range 150 V~265 V

## Test current waveforms

Test condition: 220 V AC input. Increase board output power up to 1000 W and capture compressor, and HPFC current waveforms.
CH1: inductor current, CH2 compressor motor phase current



Inductor current at 80 kHz



Inductor current at 40 kHz

80 kHz PFC inductor current is much better than 40 kHz on the same inductor (less current ripple). Higher PFC switching frequency enables reducing the inductor value/size (magnetic core and copper winding are reduced by around 50% at this power rating) and significantly reducing the system BOM cost.


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# Interleaved PFC and motor control: 4 kW heat pump demo

### Kit content

- Solution is for residential HVAC or heat pump control systems
- Provides a major improvement for the boost continuous current mode (CCM) power factor correction (PFC) and compressor control through one MCU. It is targeted at the 4 kW HVAC/heat pump market
- A new technology for compressor control through interleaving PFC control with an MCU, which is currently lacking in Infineon's solution for HVAC applications

### Nominal operation specification

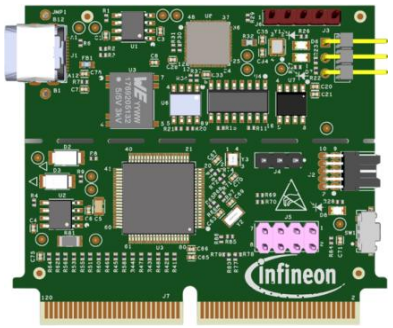
- Input AC voltage: 220 V ±20%, 20 A, 45 Hz~65 Hz, 4 kW
- PFC PWM frequency: 30kHz~40kHz
- DC output voltage: 310~400V
- Peak efficiency: 97.4%
- Power factor >98% with lower than 4.6% THD at full load operation
- Compressor phase current: 20 A

### Control scheme

- CCM 40 kHz switch frequency for the interleaved PFC
- FOC 4 kW Compressor control

### Featured components

- MCU PSOC™ Control C3 ×1
- Gate drive: 2ED24427N01F × 3, 2ED2181 × 1
- EasyPIM™ module: FB50R07W2E3



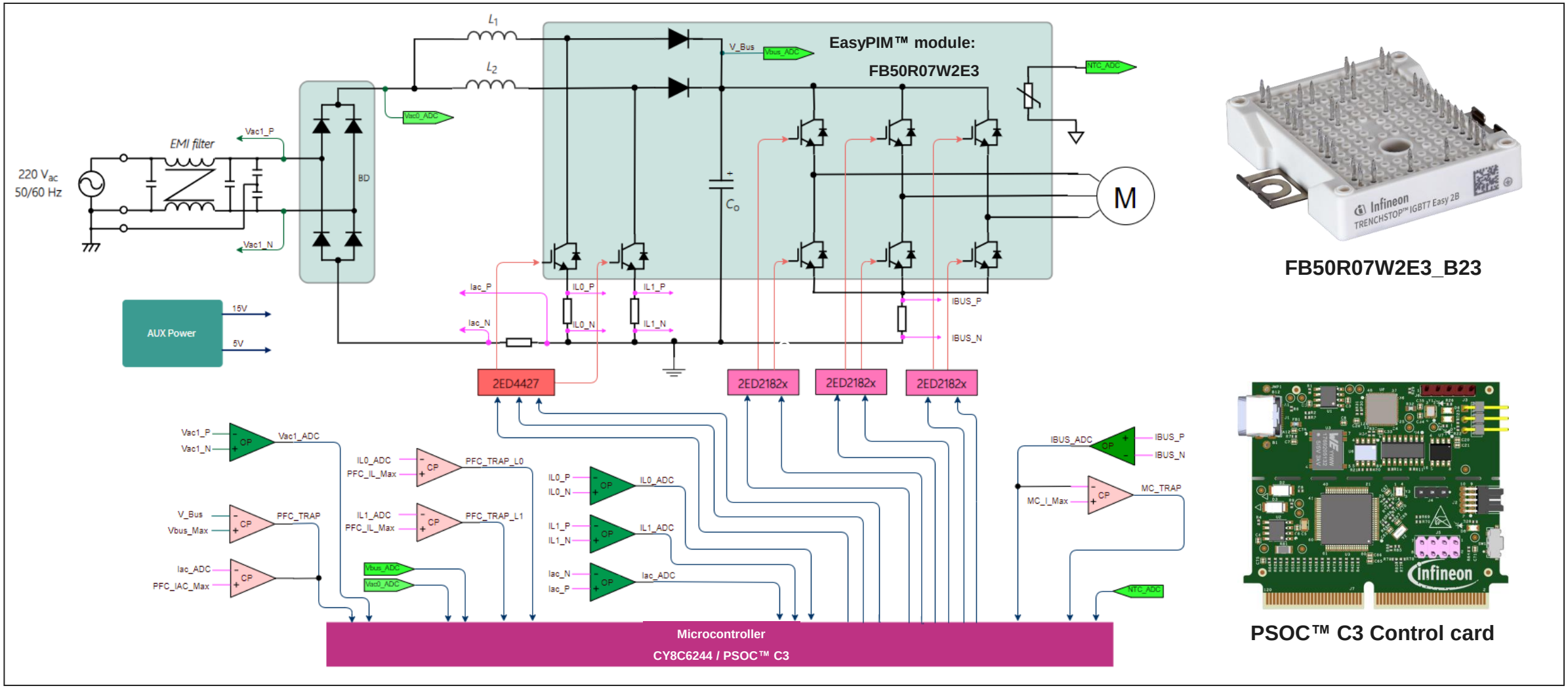
**PSOC™ C3 Control card**



Kit status – Available


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# Interleaved boost PFC and compressor control system diagram







FB50R07W2E3_B23




PSOC™ C3 Control card


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# Vienna PFC reference design overview

## Key features

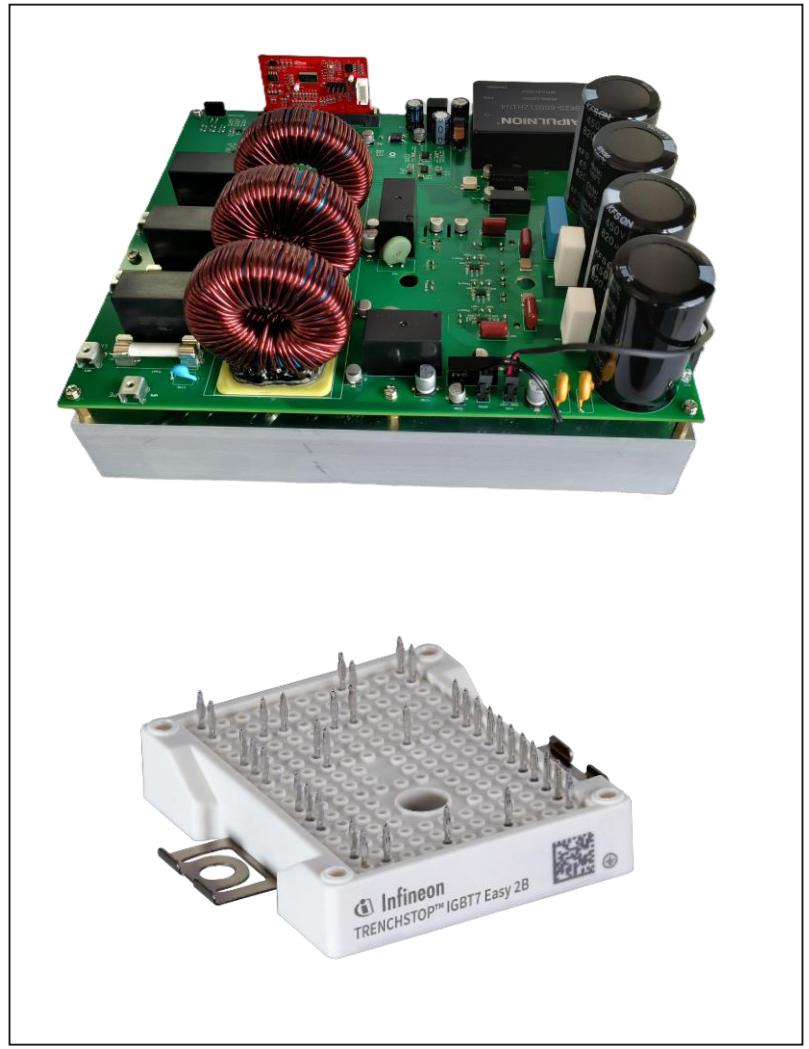
- Input AC voltage: 3Φ, 380 V ± 20%, 15 A, 45 Hz~65 Hz, 7 kW
- PWM frequency: 30 kHz~40 kHz
- DC output voltage: 600~800 V
- Peak efficiency: 97.4%
- Power factor >98% with lower than 2.2% THD at full load operation
- PWM drive signal: 3 channel signals for IGBT stage
- Distorted AC input: Running stable with distorted wave input

## Key products

- FS3L35R07W2H5_C56: Infineon Easy PIM™ module, 35 A / 1200 V / 650 V
- 1EDI20I12MF: 3 × Infineon isolated gate driver
- PSOC™ Control C3: Target for motor control + Vienna PFC + fan control

## Key benefits

- High efficiency, low cost BOM
- Low-cost voltage/current sample circuit; auxiliary power design simplified
- Provide comprehensive and flexible solution
- Self-adaptive input frequency
- Stable operation under distorted or unbalanced input





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# Resource mapping to different SMPS topologies

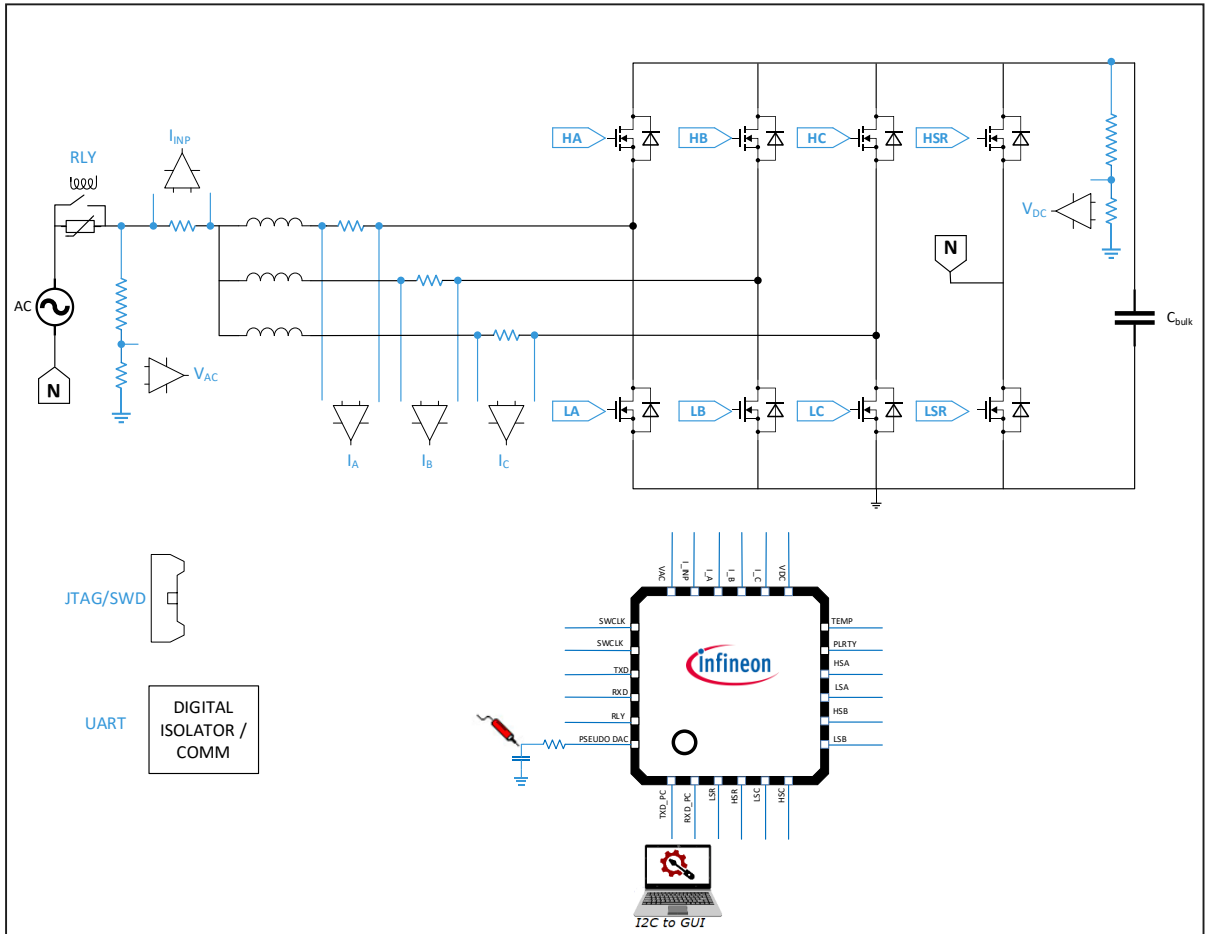
| Topology | | | 16x PWM # Switches (Pri) | 4x H PWM # Switches (Sec) | Total PWM outputs | Total PWM instances | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | Compl | Single | Total |
| DC/DC | HB LLC 1-PH | | 1x 1x2 | 2x 1x1 | 4 | 1 | 2 | 3 |
| | FB LLC 1PH | | 2x 1x2 | 2x 1x1 | 6 | 2 | 2 | 4 |
| | HB LLC 3-PH | | 3x 1x2 | 6x 1x1 | 12 | 3 | 6 | 9 |
| | FB LLC 2-PH | | 4x 1x2 | 4x 1x1 | 12 | 4 | 4 | 8 |
| | PSFB 2-stage | | 4x 1x2 | 4x 1x1 | 12 | 4 | 4 | 8 |
| | DAB 2-PH 2-stage | | 4x 1x2 | 4x 1x2 | 16 | 8 | - | 8 |
| | CLLC FB 2-Stage | | 4x 1x2 or 4x 1x1 | 4x 1x1 or 4x 1x2 | 16 | 4 | 4 | 8 |
| | DCX 2-stage | | 2x 1x2 | 2x 1x2 or 4x 1x1 | 8 | 2 or 4 | 4 or 0 | 6 or 4 |
| AC/DC DC/AC | AC 1PH | TP-PFC 3x | 3x 1x2<br>1x 1x2 slow | | 8 | 4 | - | 4 |
| | | TP-PFC 3x + PPB | 3x 1x2 + 1x 1x2<br>1x 1x2 slow | | 10 | 5 | - | 5 |
| | | HERIC 1-PH | 2x 1x2 + 2x 1x1 | | 6 | 2 | 2 | 4 |
| | AC 3PH | 3L-ANPC | 6x 1x2 + 6x 1x1 | | 18 | 6 | 6 | 12 |
| | | VIENNA (AC 3-PH) | 3x 1x2 + 6x 1x1 | | 12 | 3 | 6 | 9 |
| | | B6 | 3x 1x2 | | 6 | 3 | - | 3 |


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# Power topology: TP-PFC, three-phase interleaved

**Resource required from PSOC™ Control C3 Main Line:**

- **HR-PWM timers**
  - Three legs for controlling the high-frequency commutation
  - Single leg slow frequency for synchronous rectification
- **HPPASS:** for analog inputs reading:
  - Bus voltage for voltage loop regulation
  - Input voltage for angle estimation
  - Inductor currents for current loop regulation
  - Range detection for overtemperature or overvoltage and undervoltage detection
- **HPPASS: comparators** with internal **DACs**
  - Current protections
- **TRIGGER MUX**
  - Fully flexible interconnection of PWM outputs to any IOs.
  - ADC trigger from timers
  - KILL event from comparators or ADCs to timers
- **CORDIC:** for PLL implementation on input voltage phase detection
- **SCB:** serial communication with secondary side
- **GPIO:** for relay management, LED management



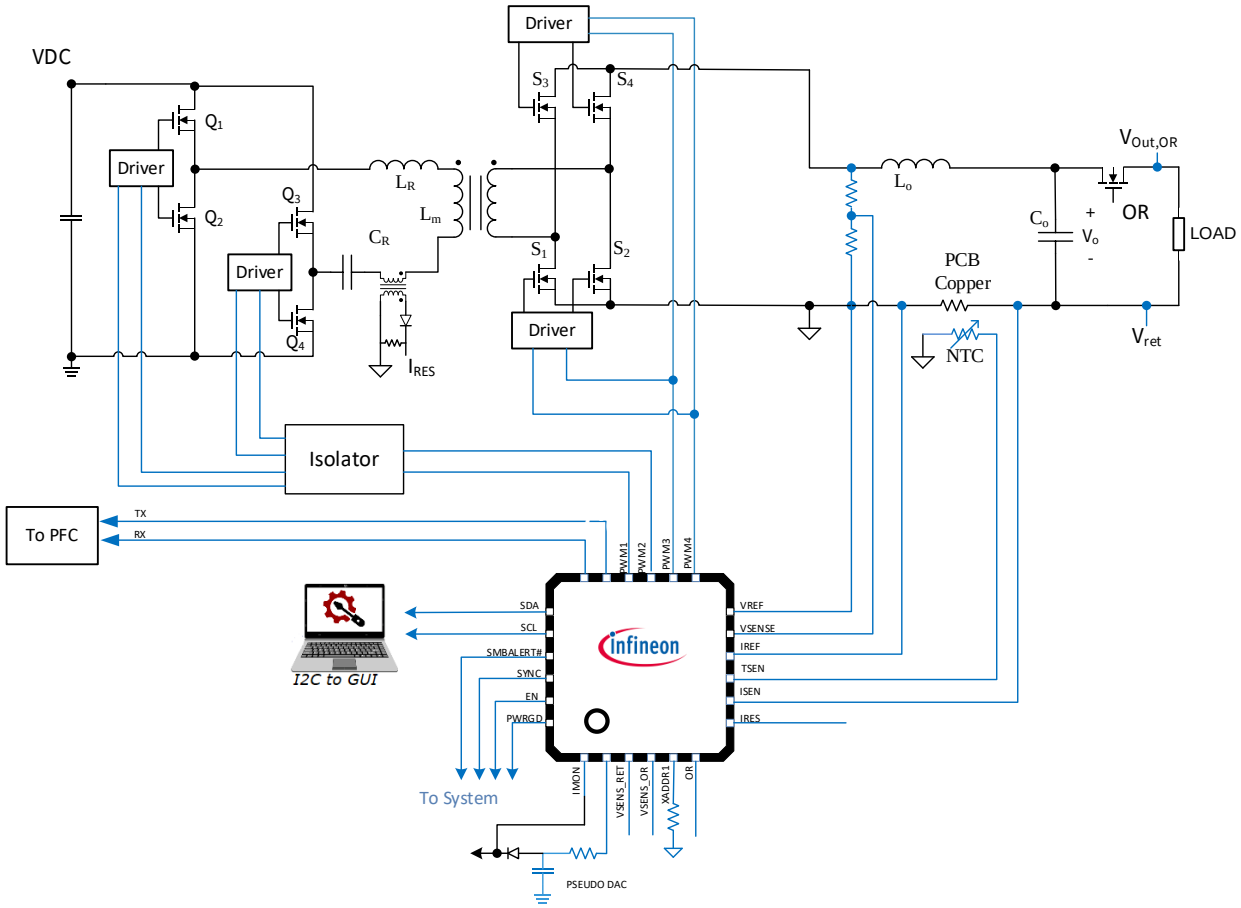

**Note**: This figure does not represent an MCU package recommendation and is limited to demonstrative purpose.


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# Power topology: FB LLC 1PH

**Resource required from PSOC™ Control C3 Main Line:**

- **HR-PWM timers**: primary and synchronous rectification with high resolution
- **HPPASS** to read analog inputs:
  - Output voltage for voltage loop implementation
  - Inputs as defined in MCRPS
- **HPPASS: comparators** with internal **DAC** for protections
- **HPPASS + Smart I/O™ + TRIGGER MUX:** potential hardware implementation of synchronous rectification handling
- **SCB:** serial communication with PFC
- **SCB:** (I2C) for PMBUS implementation
- **GPIO:** for output enabling, LED management



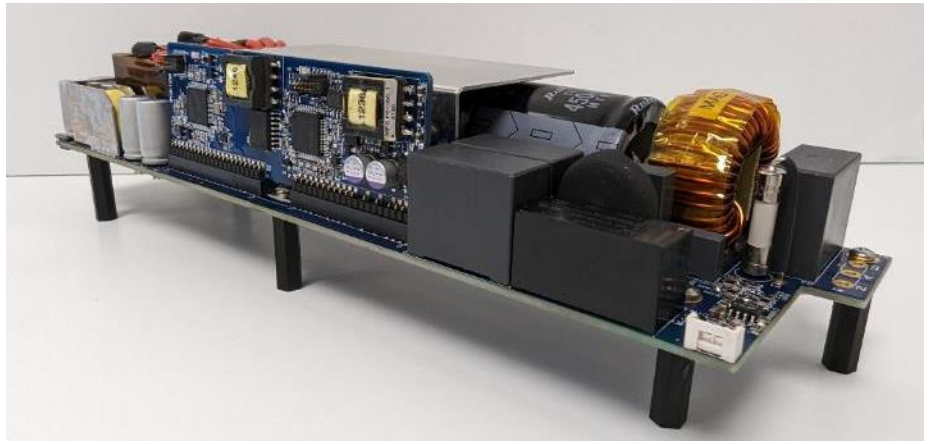

**Note**: This figure does not represent an MCU package recommendation and is limited to demonstrative purpose.


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# 2.7 kW PSU evaluation board

## EVAL_2K7W_12V_PSU

| PL | Type | SP No | Package | NDA Reqd | EC CN | AL NR | MY class | SI class | ECCN US | PCN No | Sort | Description |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 52 | EVAL_2K7W_12V_PSU | SP005987521 | | No | N_ | N | N | N | EAR99 | | TOBO | 2.7kW Bridgeless Totem Pole PFC + HB LLC using CoolSiC and CoolMOS for Server PSU Application |



## Features

- High efficiency TP-PFC + HB-LLC
- Exploring variable PFC switching frequency to reduce inductor size and/or losses
- High power density, efficiency enabled by CoolSiC™ 650 V
- Digitally controlled with PSOC™ Control C3 for both PFC and DC/DC

## Kit status

- **Available**

## Specifications

| PFC key requirements | Value |
|---|---|
| Input voltage | 180 - 270 $V_{AC}$ |
| Output voltage | 12 $V_{DC}$ |
| Max power | 2700 W |
| Peak (40% load) / full load efficiency at 240 VAC | > 95.8/ 94.6% (Peak (40% load) / full load efficiency at 240 VAC) |
| Hold up time at full load | 10ms |
| Dimensions | 265 X 73.5 X 42 mm |
| Power density | Power density at 3300 W/liter – 54.1 W/in$^3$ |

## Solution-featured devices

| | |
|---|---|
| Infineon components | › **Microcontroller: PSOC™ Control C3**<br>› CoolSiC™: IMZA65R072M1H<br>› CoolMOS™: IPW60R040C7, IPW60R024CFD7,<br>› OptiMOS™: BSC007N04LS6<br>› EiceDriver™ : 2EDB9259Y, 2EDB8259Y, 2EDR8259X, 2EDN7534B, 1EDB8275F<br>› ISOFACE™: 4DIR1400H<br>› CoolSET™: ICE2QR2280G,<br>› Miscellaneous device: TLS202B1V50, IDP40E65D2 |

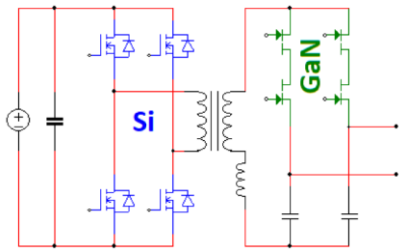
## Benefits

- Compact form factor
- Titanium efficiency
- Full digital control provide design flexibility
- One-stop-shop at Infineon for a total solution

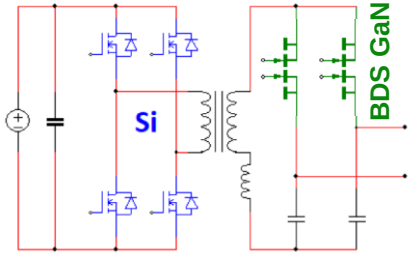

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# Power topology: Cycloconverter for microinverter application

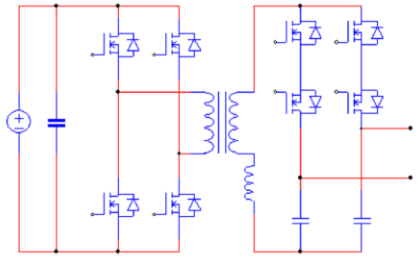
Common drain discrete GaN version




BDS GaN version




Si version



| Description | Recommended component |
|---|---|
| LV MOSFET | ISC014N08NM6 or ISC008N06NM6 |
| HV MOSFET | Discrete GaN version with IGT65R045D2<br>BDS GaN version (IGLT65R055B2)<br>Si version with IPT60R080G7 or IPT60R050G7 |
| Gate driver for LV MOSFET | 2EDL8034-F5B (120 V level-shift, DSO8) |
| Gate Driver for HV MOSFET | 2EDR8259X |
| Gate driver turn off diode | BAS3005A-02V |
| MCU | PSOC™ Control C3 - PSC3M5FDS2AFQ1 |
| Aux. PS | TLS203B0EJ V33 |

| | |
|---|---|
| **Module compatibility** | **60 / 66 / 72 / 78 cells** |
| **Minimum/Maximum input voltage** | 16 / 60 V |
| **Minimum/Maximum Start-up voltage** | 22 / 58 V |
| **Minimum/Maximum MPPT voltage** | 25 / 50 V |
| **Maximum short-circuit DC input current** | 18A |
| **Maximum continuous output power** | **500 W** |
| **Nominal (L-L) voltage/range** | 240 / 185-276 V |
| **Maximum continuous output current** | 2.1A |
| **Nominal frequency** | 50 / 60 Hz |
| **Total harmonic distortion** | <5% for >50% load condition |
| **Grid-tied power factor setting/range** | 1.0/ -0.85…+0.85 |
| **Peak efficiency** | **> 97%** |
| **CEC efficiency** | > 96% |
| **Testing ambient** | **Room temperature (~25 °C)** |
| **Cooling** | Natural convection – no fans<br>Optional heatsink |
| **Enclosure** | **No enclosure for the prototype** |
| **Dimensions (H x W x D)** | < 210 x 150 x 35 mm |
| **Weight** | < 1kg |


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# Ecosystem for motor control applications

## PSOC™ C3 software

Application SW

Protection, crypto

Motor Control Library

Custom SW

Complex/ Device driver

Abstraction Layer

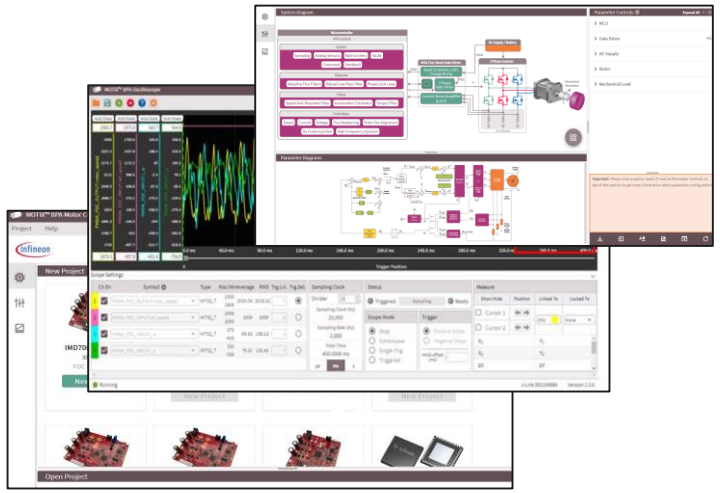
Low-level driver

MCU/ Host

**Portfolio of modular, interoperable SW building blocks for evaluation and productive use**

- **Motor control** FOC of BLDC/PMSM motor for applications such as **MHA**, **fans**, **drives**
- **Device driver (PDL/Hal Lite)** PSOC C3™
- Motor Control library with basic and advanced algorithms
- **User documentation** and **application notes**

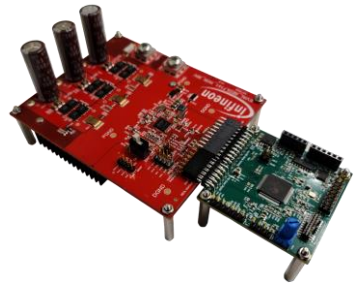
## PSOC™ C3 tools



**PC tools**

- Tool support for Motor Control Evaluation and design
- Device intitialization/ configuration
- Static and run-time parametrization
- Signal monitoring/ Tracing
- Oscilloscope

## PSOC™ C3 Embedded development



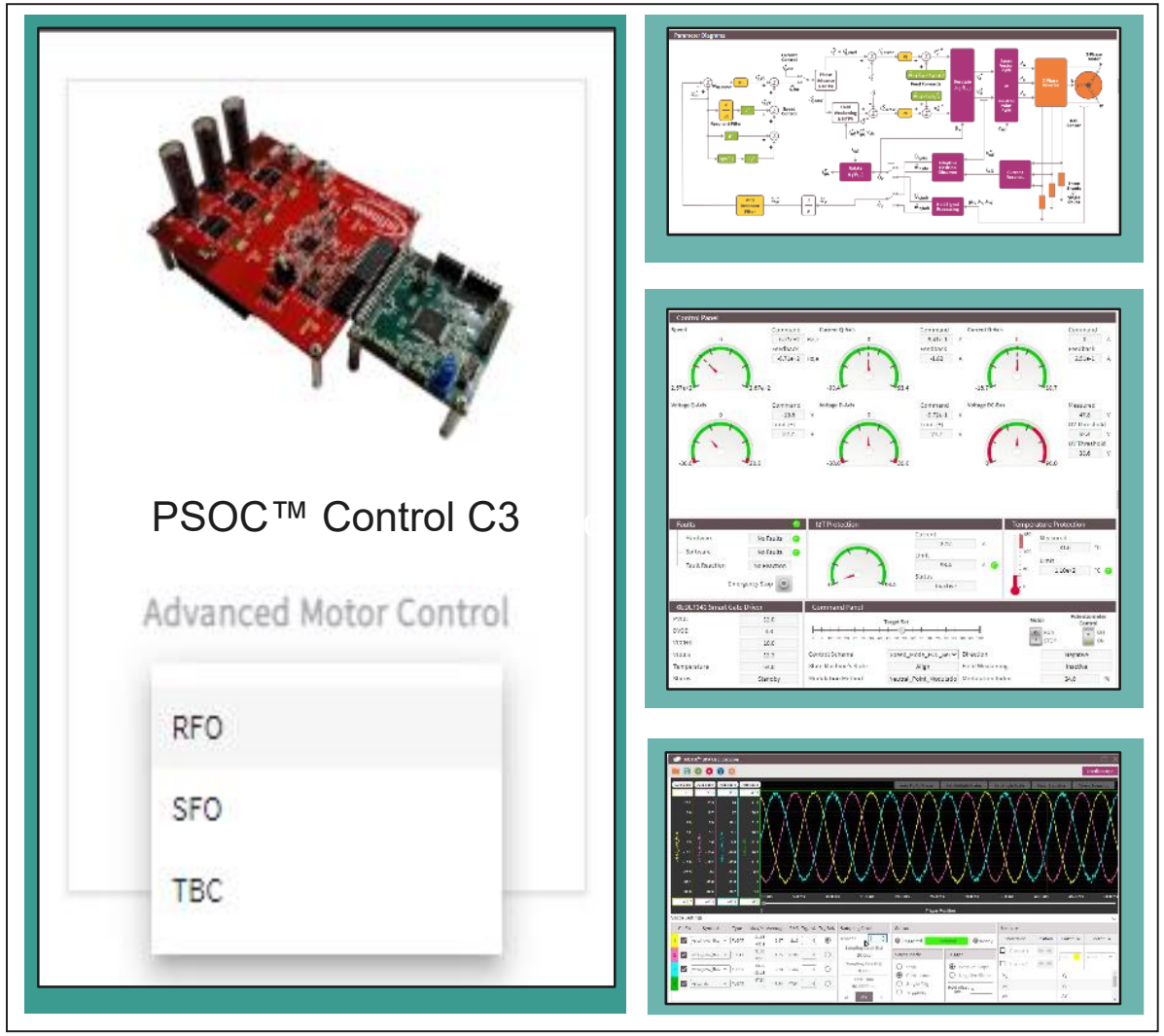
**Boards/ HW**

- Evaluation boards
- System reference designs
- Debuggers


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# Motor control tools for comprehensive development

- **Initial system setup – out of the box demo**
  - Automatic kit identification
  - Run pre-selected motor
- **Adapting firmware and parameters for customized systems involves adjusting for various factors, such as:**
  - Different types of motors
  - Various control and feedback methods, current sampling, and protection mechanisms
  - Distinct power stages
  - Use of different MCUs or allocation of resources on the same MCU, with the help of ModusToolbox™ Solution Personality
- **High sample rate Oscilloscope functionality**
  - To evaluate system performance, multiple signals representing physical values or internal parameters are observed
- **Test bench/dashboard for testing and tuning the system**
  - Real-time access to key parameters used for tuning
  - Setting of different protection methods and parameters

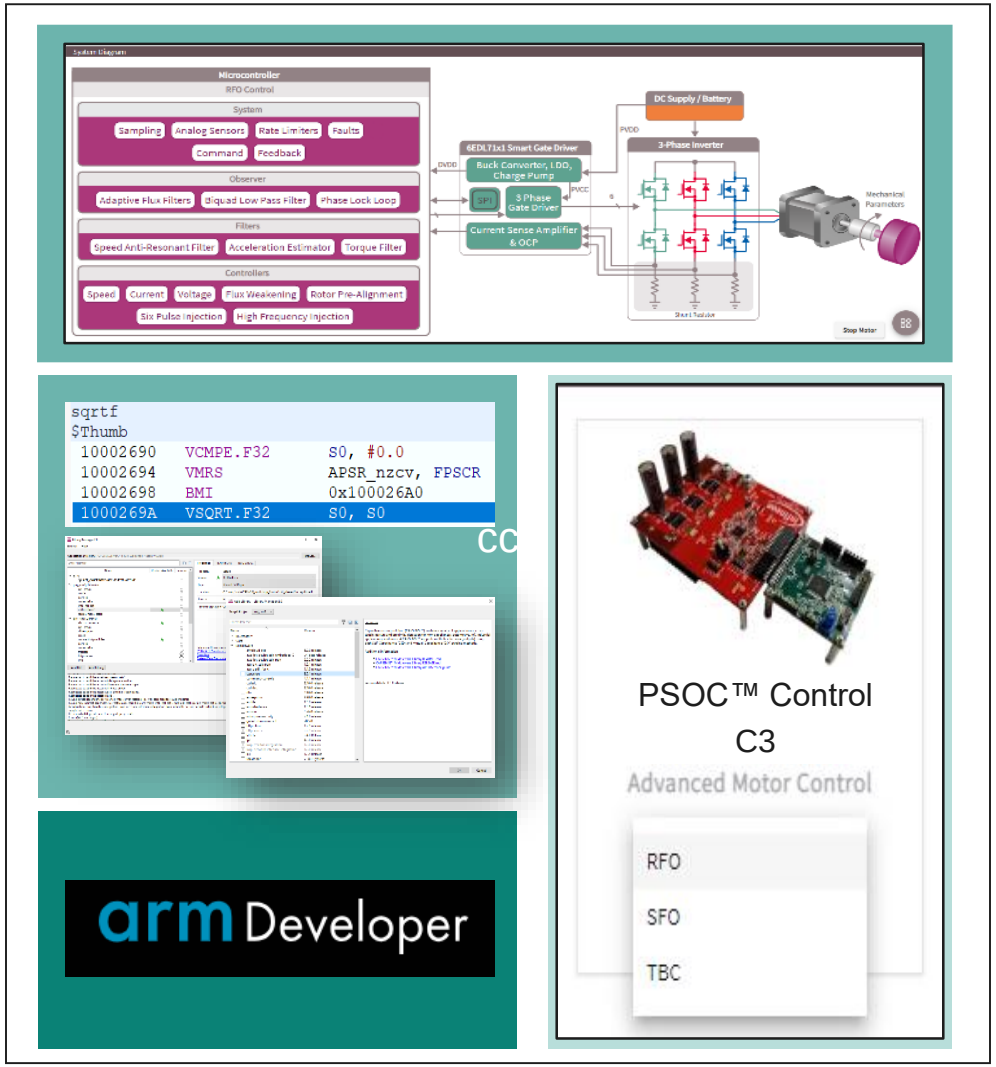




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# Software development motor control algorithms for ease of use

- **Accelerate software development with pre-tested libraries**
  - Control methods
  - Current sampling methods
  - Modulation schemes
  - Startup methods
  - Compensation options
  - Protection options
- **Optimized software to maximize hardware potential**
  - Usage of FPU Architecture with floating point libraries for easy readability
  - Clear SW architectural separation between HW-agnostic algorithm libraries and HW-specific libraries
  - Support for GCC, IAR, Keil MDK
- **Ensure software reliability with automated regression and verification flow**
- **Streamline feature integration with a well-defined process for third-party code**

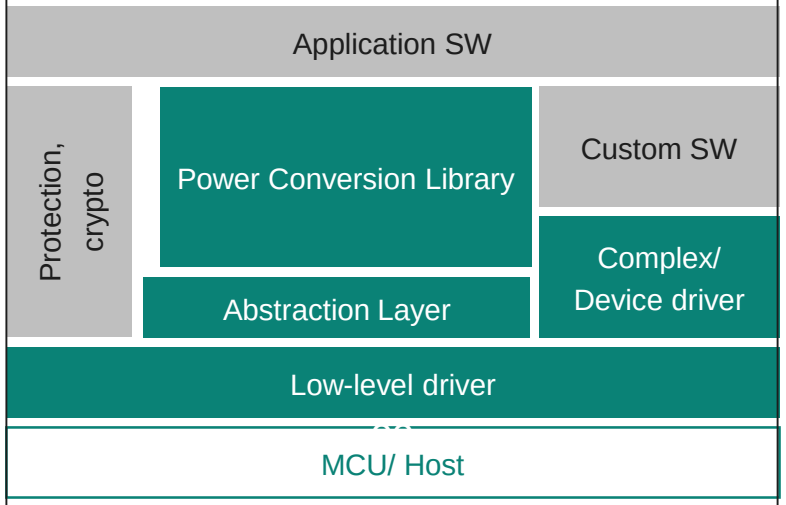




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# Ecosystem for power conversion applications

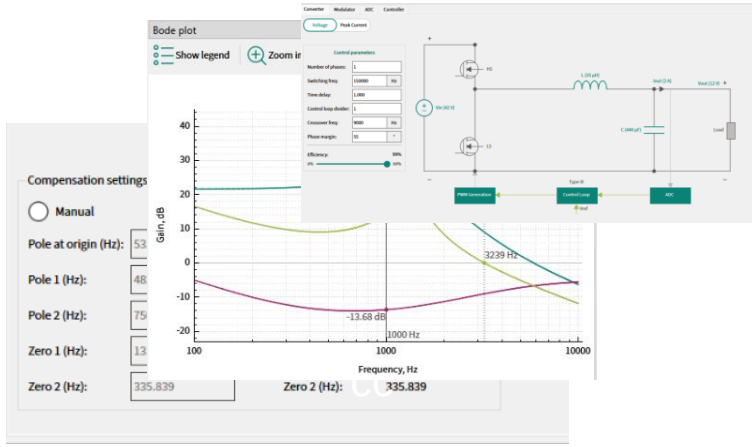
## PSOC™ C3 software




**Portfolio of modular, interoperable SW building blocks for evaluation and productive use**

- **Power Conversion Library**, Buck converter, voltge control mode, peak current control mode, and multi-phase
- MISRA C compliant
- **Device driver (PDL/Hal Lite)** PSOC C3™
- **User documentation** and **verification/ test reports**

## PSOC™ C3 tools




**PC tools**

- Tool support for power conversion evaluation and design
- Device intitialization/ configuration
- Static and run-time parametrization
- Signal monitoring/ tracing
- High samling oscilloscope

## PSOC™ C3 Embedded development



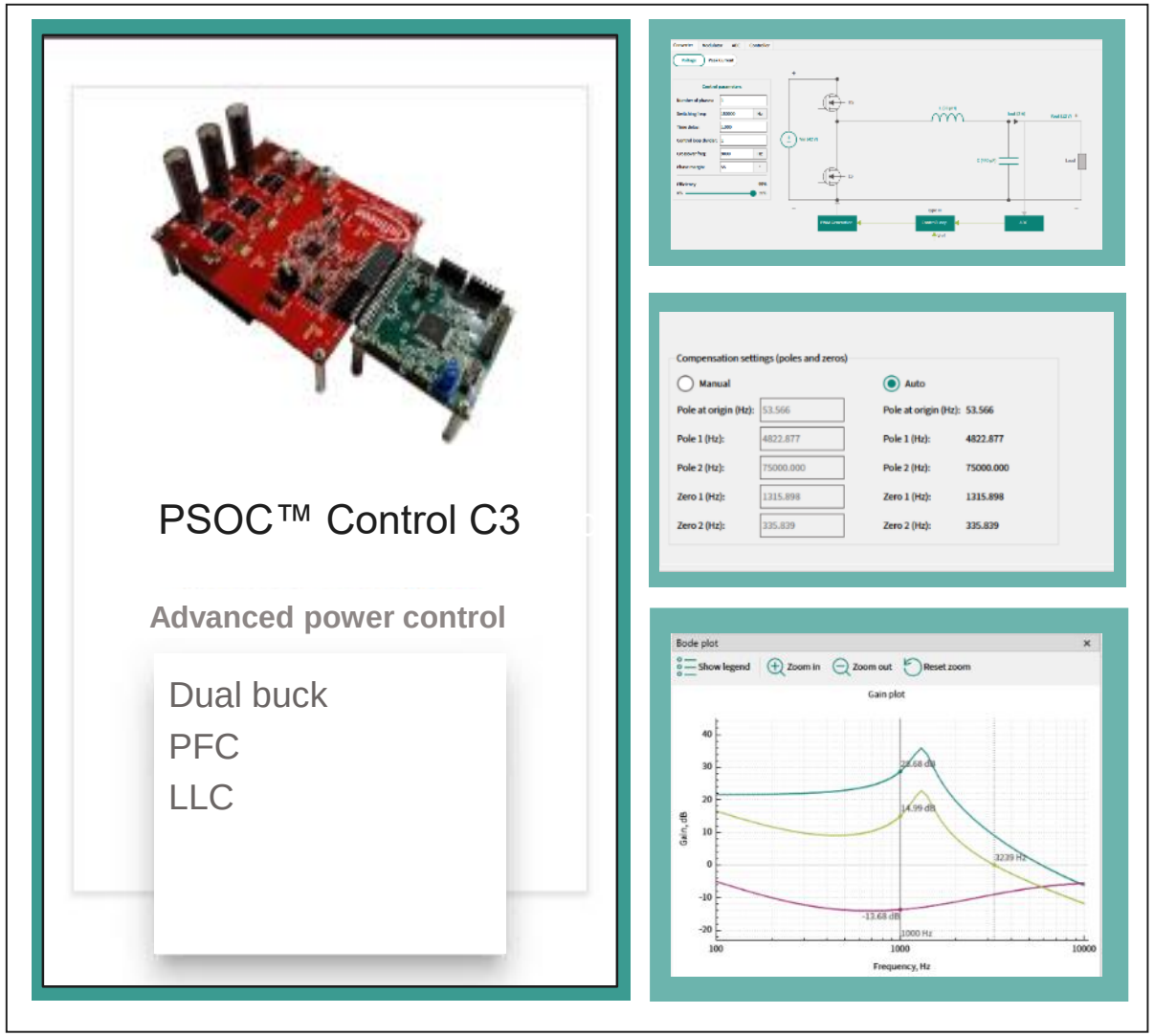

**Boards/ HW**

- Evaluation boards
- System reference designs
- Debuggers


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# Power conversion tools for comprehensive development

- **Initial system setup – Out of the box demo**
  - Automatic kit identification
  - Run pre-selected load
- **Adapting firmware and parameters for customized systems involves adjusting for various factors, such as:**
  - Different types of power conversion topologies
  - Various control and feedback methods, current sampling, and protection mechanisms
  - Distinct power stages
  - Use of different MCUs or allocation of resources on the same MCU, with the help of ModusToolbox™ Solution Personality
- **High sample rate oscilloscope functionality**
  - To evaluate system performance, multiple signals representing physical values or internal parameters are observed
- **Test bench/dashboard for testing and tuning the system**
  - Real-time access to key parameters used for tuning
  - Setting of different protection methods and parameters





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# Revision history

| Document revision | Date | Description of change |
|---|---|---|
| ** | 2026-01-23 | Initial release. |


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