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Drives & Motor Control Solution Brief

INTRODUCTION

Xilinx Electric Drives solutions simplify and accelerate development to create motor control implementations that meet the needs of Industrial IoT/Industry 4.0. Multiple offerings for beginner to advance users are available. Together with Xilinx's unique Zynq SoC architecture, which pair the capability of ARM application processors with deterministic FPGA fabric, users can create adaptable architectures for mixed criticality drive applications.

Zynq UltraScale+ MPSoC goes one step further. Designed with functional safety in mind, the two isolated domains enable a single-chip IEC 61508 SIL 3 solution.

Xilinx SoCs are being used in a variety of applications in Industrial, Vision, Healthcare, Automotive, Aerospace and Defense markets.

Xilinx SoC Inherent Benefits:

> Software flexibility with Programmable Logic acceleration for performance and latency critical functions

> Integration of complete IT-OT systems into a single chip Edge platform

> Futureproof against evolving standards & threats

> Built for harsh environments over Industrial lifecycles

Xilinx Drives & Motor Control Solution Benefits:

> Scale from single to multi-axis control with uncompromised determinism, performance, and power efficiency

> OT (Operational Technology) functions being isolated from IT (Information Techology) functions to address Mixed Criticality

> Develop algorithm in SW, optimize to HW using with Xilinx Vivado HLx and SDSoC Design Suite

> Fast and deterministic loop closure

> Flexible interfacing to changing companion chips
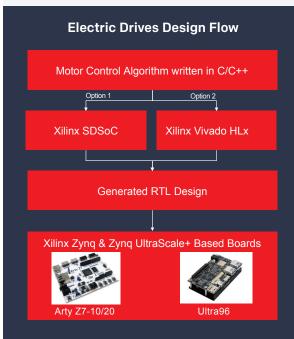
ELECTRIC DRIVES DEMONSTRATION PLATFORM

KEY OFFERINGS

> Industrial Motor Control Reference Design

> Open Source Code

> SPYN: Python Powered Control & Edge Analytics using PYNQ

> SPYN AI: Predictive Maintenance

For Advance Users

> High Performance Motor Control IP

Electric Drives Design Flow

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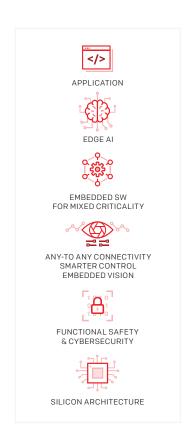
XILINX DRIVES & MOTOR CONTROL SOLUTION FOR ALL

Xilinx comprehensive motor control solution includes:

- Source code for Field Oriented Control offer as Open Source in GitHub

- Complete documentation on FOC algorithm, IPs, and Electric Drives Demonstration Platform

- User Guide for Xilinx Tools – SDSoC and Vivado HLS

- Whitepapers and YouTube tutorials

XILINX INDUSTRIAL & HEALTHCARE IOT SOLUTIONS STACK

IoT trends in Industrial and Healthcare applications have increased the complexity of embedded systems where the only scalable method in accelerating cost-effective products to market is a platform approach. Xilinx provides three key ingredients for architecting these systems:

- Xilinx's SoC portfolio enable a common processing subsystem combined with programmable logic to customize the functionality to fit a wide range of Industrial and Healthcare applications

- Xilinx's Industrial and Healthcare IoT Solutions Stack provides solutions for Functional Safety, Cybersecurity, Control, Communication, Vision Processing, Mixed Criticality Software, Machine Learning and Analytics at the Edge, supporting sub-10ns real-time decisions

- Xilinx offers high performance, low latency neural network-based or traditional machine learning solutions without compromising on power or physical footprint. Xilinx uniquely offers state of the art AI solutions on platforms meeting stringent long lifecycle requirements and extended temperatures for harsh conditions

APPLICATION

EDGE AI

EMBEDDED SW
FOR MIXED CRITICALITY

ANY-TO ANY CONNECTIVITY
SMARTER CONTROL
EMBEDDED VISION

FUNCTIONAL SAFETY
& CYBERSECURITY

SILICON ARCHITECTURE

SOFTWARE UPGRADABILITY AT NO CHARGE:

- PYNQ is an open-source python framework from Xilinx® that makes it easy to design embedded systems with Xilinx Zynq® Systems on Chips (SoCs)

EDDP	SPYN	SPYN AI	Solution
Motor Control Design Flow	PYNQ	PYNQ	Platform
Industrial Reference Design	Python Powered Control & Edge Analytics	Predictive Maintenance	Function
Same Hardware, Software Upgradeable →			

"The tremendous integration enabled by Zynq boosts control performance and encompasses safety, multiple communication buses, a display for easy setup and diagnosis and all relevant encoder types."
- Kollmorgen

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XILINX DRIVES & MOTOR CONTROL SOLUTION FOR ADVANCED USERS

Xilinx motor control solution for FPGA and SoC advanced user includes:

- Solution Powered by QDESYS
  - 15 Control Functions, All Modular
  - Dynamic Operation with Minimum Footprint
- Zynq-7000 based Three Level Inverter (TLIMOT)
  - Silicon-Carbide Technology
  - Fast Control Loop
  - Optimal Design for Size, Cost, EMI & more
  - Complete with exhaustive IP, Design Services
- Start to Finish Modular Mechanism
  - Extensible Concept
  - Full Parallelism
- High Precision DSP Capability
  - 48bit Operations, 18bit Precision

- Fully Documented IP
- Available Today
  - One-time Fee, Perpetual for the Customer
  - No Limit in Number of Projects, No Royalties
  - https://www.qdesys.com/products/motor-control-ip/

FULLY DOCUMENTED IP

| FOC | PID | CLARK | PARK | PWM-SVM |
| ATAN2 | SIN/COS | Rect2Pol | Encoder | IIR |

Xilinx - Exclusive Motor Control IP for Performance and Extensibility

EXPLORE OPEN SOURCE CODE ON GITHUB:

- EDDP – Industrial Motor Control Reference Design: https://github.com/Xilinx/IIoT-EDDP
- SPYN - Python Powered Control & Edge Analytics Motor Control: https://github.com/Xilinx/IIoT-SPYN
- SPYN AI - Predictive Maintenance for Industrial Motor: https://github.com/Xilinx/IIoT-SPYNAI

LEARNING FOR ALL:

YouTube Videos

- EDDP – Industrial Motor Control Reference Design: https://www.youtube.com/watch?v=amSb2_Md_w4
- SPYN - Python Powered Control & Edge Analytics for Motor Control:
  https://www.youtube.com/playlist?list=PLRr5m7hDN9TI05_Ib-QnOJddeV04v6Gl1

"4 axes, 16 or 97? A single SI6 drive controller can control up to two axes. Thanks to the modular system, the number of motors or axes to be controlled can be freely scaled. The SI6 drive controller is the most compact solution on the market."

- STÖBER Antriebstechnik GmbH

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Whitepaper

> Extreme Edge Analytics on Xilinx Zynq Portfolio:
> https://www.xilinx.com/support/documentation/white_papers/wp502-python.pdf

Webinar

> Python Powered Edge Analytics & Machine Learning:
> https://www.xilinx.com/video/soc/python-powered-edge-analytics-machine-learning.html

XILINX ELECTRIC DRIVES KIT:

> Xilinx Electric Drives Kit gives you access to all data listed above. Data is open source and maintained using GitHub

> Kits includes a Zynq based control board (Arty Z7-10), a power stage boards (EDPS), 12V BLDC reference motor and other components to get you started

> Buy the kit: https://shop.trenz-electronic.de/en/TEC0053-04-K1-EDDP-Motor-Control-Kit-with-Motor-Power-Supplies

ADDITIONAL RESOURCES:

> Xilinx SDSoC - https://www.xilinx.com/products/design-tools/software-zone/sdsoc.html

> Xilinx Vivado HLS - https://www.xilinx.com/products/design-tools/vivado/integration/esl-design.html

> Avnet Ultra96 - http://zedboard.org/product/ultra96

> Xilinx Motor Control Webpage - https://www.xilinx.com/applications/industrial/motor-control.html

> Xilinx Analytics and ML Webpage - https://www.xilinx.com/applications/industrial/analytics-machine-learning.html

> Xilinx IIoT Solution Stack - https://www.xilinx.com/products/technology/functional-safety.html#solutionStack

> PYNQ Hardware-Software Framework - http://www.pynq.io/

CONCLUSION:

Zynq and Zynq UltraScale+ SoC portfolio are the lowest total cost of ownership solution for integrated Industrial IoT/Industry 4.0 drive platforms. There has never been an easier path for getting started with Xilinx Motor Control solutions than the C/C++ language based Electric Drives kit, which is software upgradable to include Edge Analytics, Predictive Maintenance through integration of open-source Python libraries. Implement your own algorithms or modify the default field-oriented control source code available on GitHub along with full documentation and how-to tutorials.

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