

IIoT Electric Drives & Motor Control

INTRODUCTION

Electric drives and motors need electronics to create to appropriate currents and voltages to run a motor a given speed and torque. With Industrial IoT, Electric drives are expected to be a responsive member of a network doing sensor interfacing, data collection, edge intelligence, HMI and connectivity to the cloud.

AMD Electric Drives solutions simplify and accelerate development to create motor control implementations that meet the needs of Industrial IoT. Multiple offerings for beginner to advance users are available.

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

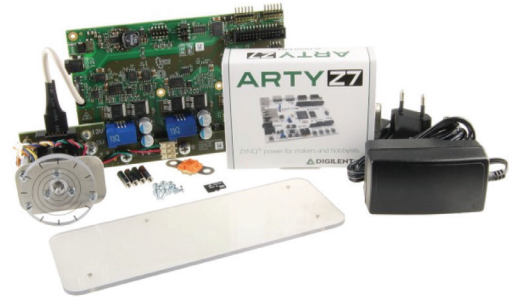
AMD Adaptive SoC Inherent Benefits:

- > Single or Multi-axis
- > High Efficiency
- > Fast Control Loops
- > Diverse and futureproof Networking Support
- > Deterministic Motor Control Performance, regardless of what else is in the same chip
- > Cybersecurity and Functional Safety
- > On-chip Predictive Maintenance or other Analytics
- > Compact Size
- > Scalable Embedded Platform that spans multiple products
- > Unified SW approach for lower Total Cost of Ownership
- > For harsh environments over Industrial lifecycles
- > Flexible interfacing to changing companion chips

SOFTWARE UPGRADABILITY AT NO CHARGE

EDDP	SPYN	SPYN AI	Solution
Electric Drives Design Flow	PYNQ™	Vitis AI with DPU	Platform
Industrial Reference Design	Python Powered Control & Edge Analytics	Control + Predictive Maintenance	Function
Same Hardware, Software Upgradeable →			

ELECTRIC DRIVES DEMONSTRATION PLATFORM



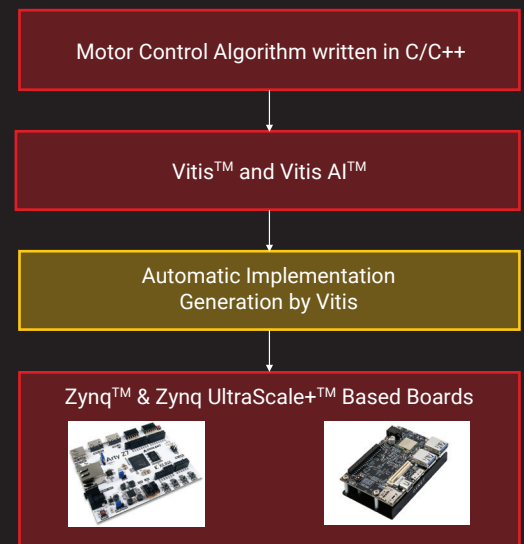
PLATFORM OFFER

- > Industrial Motor Control Reference Design
- > Open Source Code
- > SPYN: Python Powered Control & Edge Analytics using PYNQ
- > SPYN AI: Predictive Maintenance
- > SPYN X: Model Predictive Control

For Advanced Users

- > High Performance Motor Control IP

Electric Drives Design Flow



AMD DRIVES & MOTOR CONTROL SOLUTION FOR ALL

AMD 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 AMD Tools – Vitis and Vitis AI (Q4/CY2020)
- > Whitepapers, Workshop tutorials and YouTube demo videos

AMD 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. AMD provides three key ingredients for architecting these systems:

Industrial IoT Solutions Stack - www.xilinx.com/applications/industrial/motor-control.html#solutionStack

Industrial and Healthcare Resources Library - www.xilinx.com/applications/industrial/ism-resource-rooms.html

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

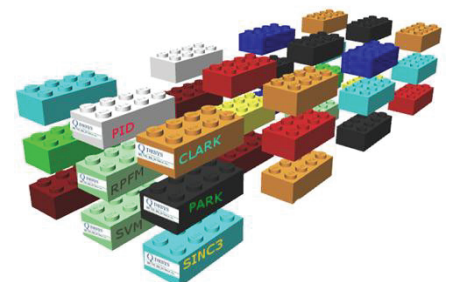
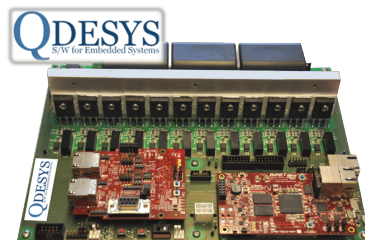
SOFTWARE UPGRADABILITY AT NO CHARGE

- > PYNQ is an open-source python framework from AMD that makes it easy to design embedded systems with Zynq™ SoCs
- > Vitis AI development environment is AMD's development platform for AI inference on AMD Adaptive Compute Platforms, including both edge devices and Alveo cards. It consists of optimized IP, tools, libraries, models, and example designs. It is designed with high efficiency and ease of use in mind, unleashing the full potential of AI acceleration on AMD Adaptive Compute Platforms.

AMD DRIVES & MOTOR CONTROL SOLUTION FOR ADVANCED USERS

AMD motor control solution for AMD Adaptive 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



FULLY DOCUMENTED IP

FOC	PID	CLARK	PARK	PWM-SVM
ATAN2	SINCOS	Rect2Pol	Encoder	IIR



“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

- > 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
 - > www.qdesys.com/products/motor-control-ip/

AMD - 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: www.youtube.com/watch?v=amSb2_Md_w4
- > SPYN - Python Powered Control & Edge Analytics for Motor Control
www.youtube.com/playlist?list=PLRr5m7hDN9TI05_Ib-QnOJddeV04v6GI1

Whitepapers

- > Key Attributes of an Intelligent IIoT Edge Platform - www.xilinx.com/support/documentation/white_papers/wp493-iiot-edge-platforms.pdf
- > Extreme Edge Analytics on Zynq Portfolio - www.xilinx.com/support/documentation/white_papers/wp502-python.pdf

Webinars

- > Electric Drives Demonstration Platform with Python Powered Edge Analytics & Machine Learning
www.xilinx.com/video/soc/python-powered-edge-analytics-machine-learning.html
- > Accelerating Predictive Maintenance with Python and Neural Network-Based Edge AI
www.xilinx.com/video/events/accelerating-predictive-maintencance-python-neural-network.html
- > SiC 3-Level Inverters and Finite-Set MPC for Power Electronics and Electrical Drives
www.xilinx.com/video/events/sic3-level-inverters-finite-set-mpc-power-electronics-and-drives.html

AMD ELECTRIC DRIVES KIT (EDDP)

- > AMD 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 HW support: Arty Z7-20, Ultra96v1, Ultra96v2, Ultra96v2 industrial grade

"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



ADDITIONAL RESOURCES

- > Vitis – www.xilinx.com/products/design-tools/vitis/vitis-platform.html
- > Avnet Ultra96 - <http://zedboard.org/product/ultra96-v2-development-board>
- > Avnet Ultra96 PMOD Adapter - <https://shop.trenz-electronic.de/en/TEP0006-01-Ultra96-Pmod-Adapter>
- > AMD Motor Control Webpage - www.xilinx.com/applications/industrial/motor-control.html
- > AMD Analytics and ML Webpage - www.xilinx.com/applications/industrial/analytics-machine-learning.html
- > AMD IIoT Solution Stack - www.xilinx.com/products/technology/functional-safety.html#solutionStack
- > PYNQ Hardware-Software Framework - www.pynq.io/
- > SPYNX (Open Source Community Contributed) - <https://github.com/stefan-ba/IIoT-SPYN>

CONCLUSION

Zynq and Zynq UltraScale+ Adaptive Compute Platform 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 AMD 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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