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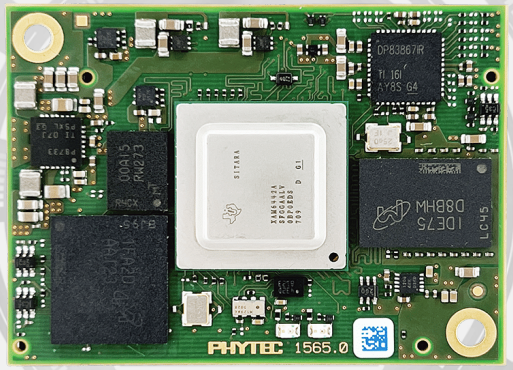
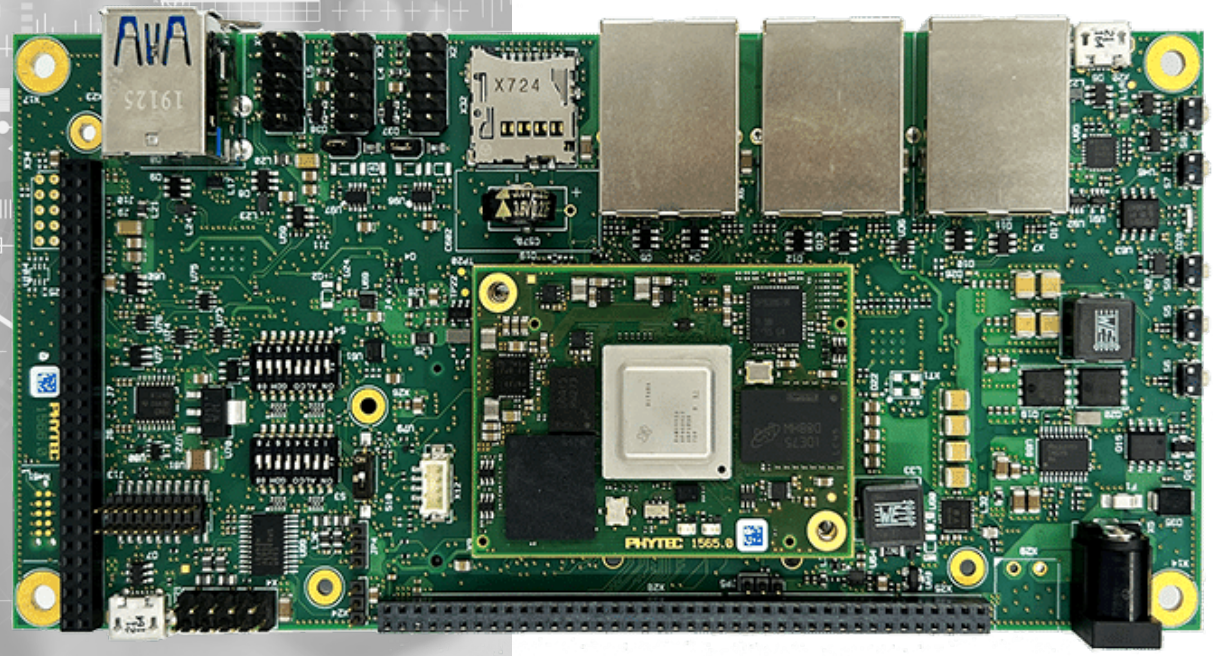
Industrial Ethernet protocols and
high-performance communication speeds





March 2022

PHYTEC

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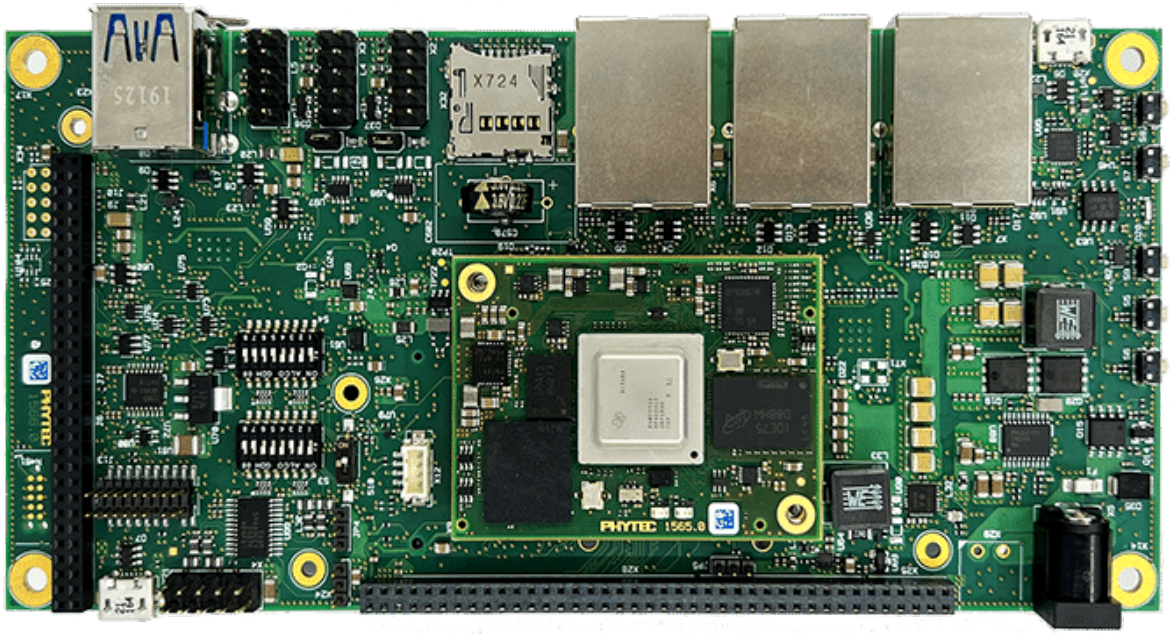
Agenda

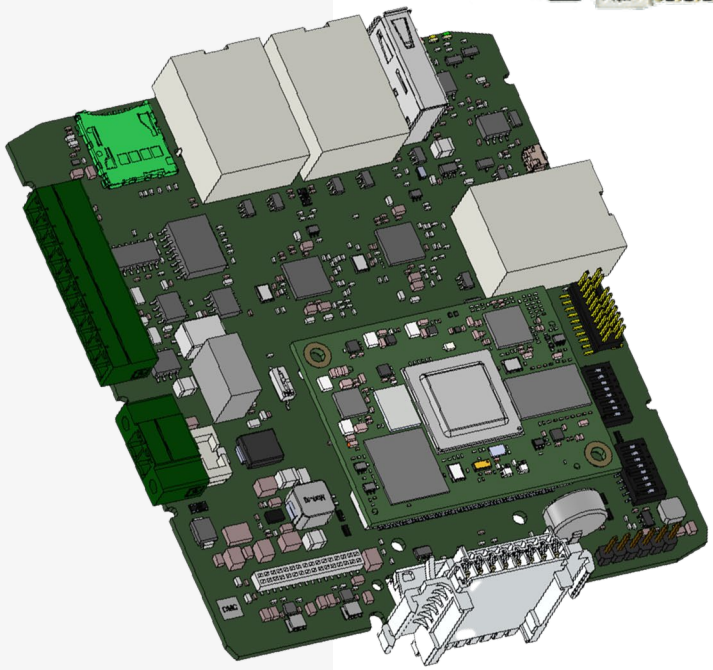
Overview

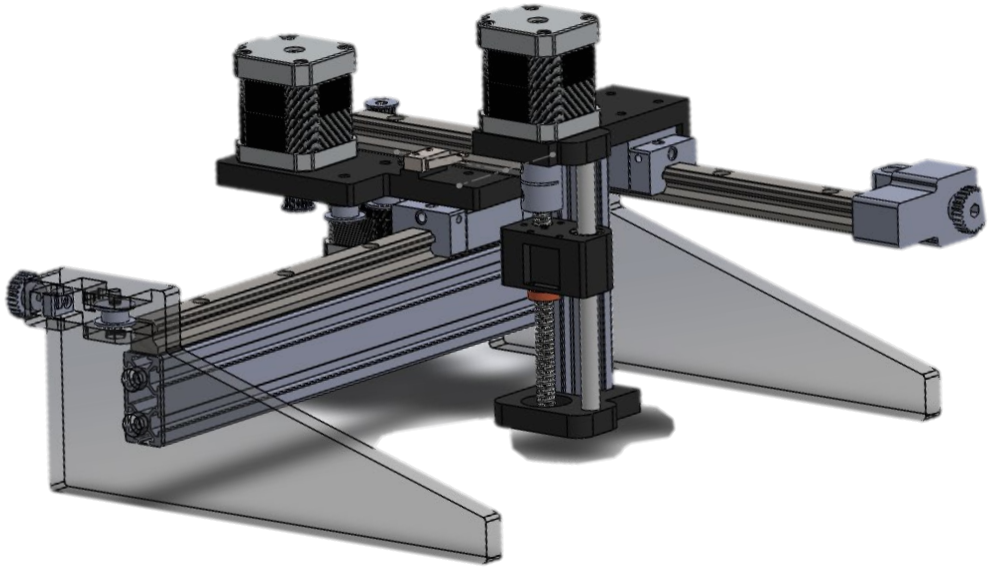
- TI Sitara AM6442 and AM24x
- What is a SOM?
- phyCORE-AM64x System on Module



Live Demo

- PROFINET (CSS JTAG load)
- EtherNET/IP (NOR Flash boot)
- EtherCAT (SD Card boot)



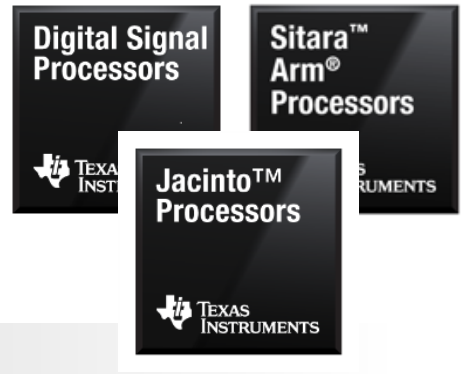


Next Steps

- Pen Plotter Demo Preview
- How to Get Started

TI Processors overview

Scalable, cost-optimized portfolio with accelerators, analog integration, robust connectivity, security and functional safety designed for automotive and industrial markets



SoCs

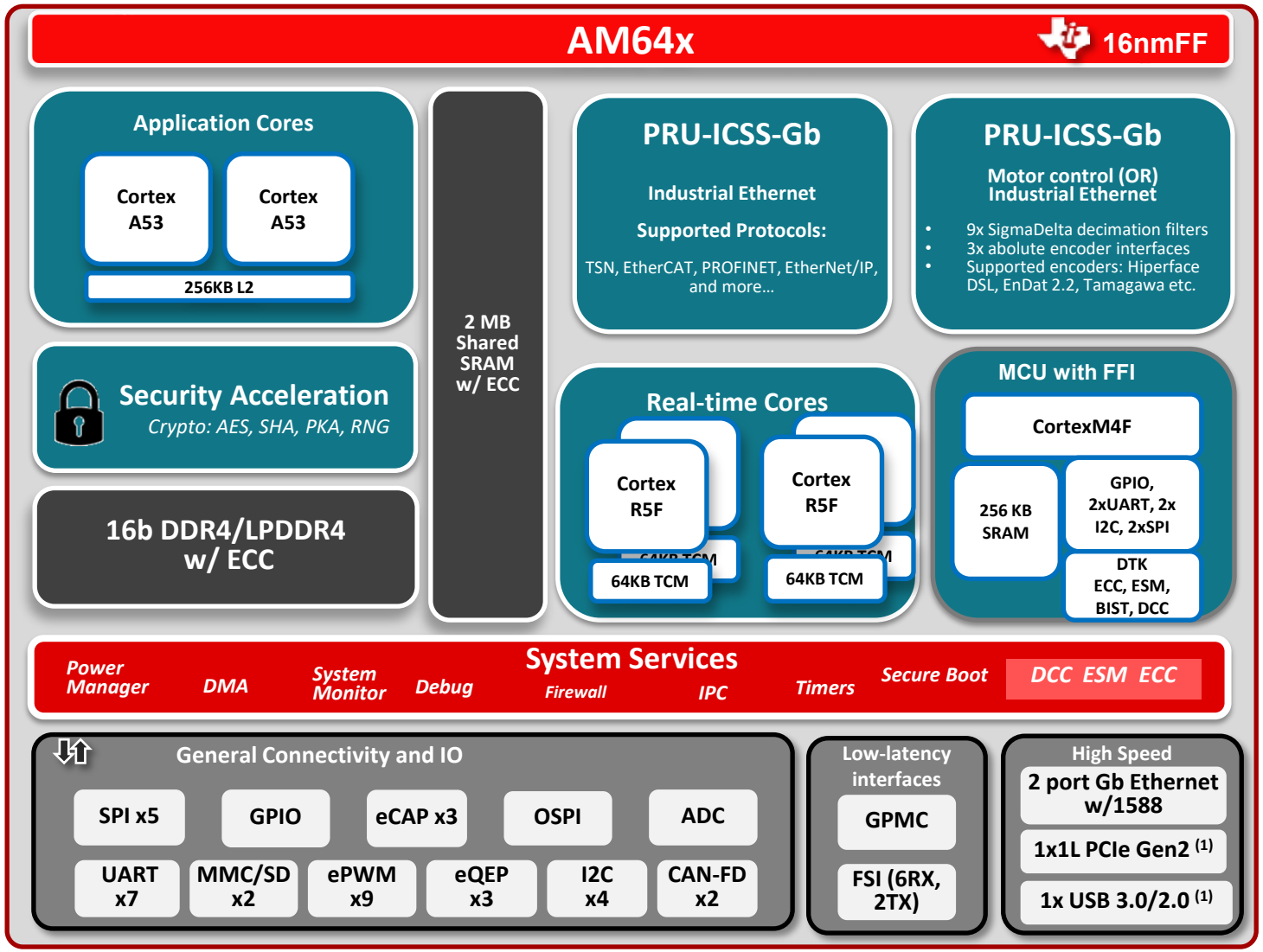
Single-core to quad-core **Arm Cortex-A53** and **A72 cores**	**Compute**	**Control**	Dual-core to quad-core **Arm Cortex-R5F** with optional Lock-Step support
Secure-boot, run-time security, tamper protection and **high-security modules**	**Functional Safety & Security**	**Analog**	High-level integration of high-performance **ADC, DAC, comparators** and **PWM**
Power-optimized **neural network accelerators, audio DSP,** and **GPU**	**Deep Learning & Accelerators**	**Connect**	**USB3, PCIe Switch, Ethernet Switch, Industrial Protocols, CAN-FD,** and more
Open source device enablement for **Mainline Linux, RTOS** and **Bare Metal** 3P software support – e.g. **AUTOSAR**, **QNX**	**Unified Software Platform**		Simplified tools (**SysConfig**) and libraries (**DSPLIB**, **TIDL, ...**) to accelerate development and performance entitlement

Power-optimized design | ASIL-B/D and SIL2 functional safety | -40 to 125C temperature range | Q100 automotive qualified options

Scalable platform with common software development kit and pin-to-pin compatibility in common packages

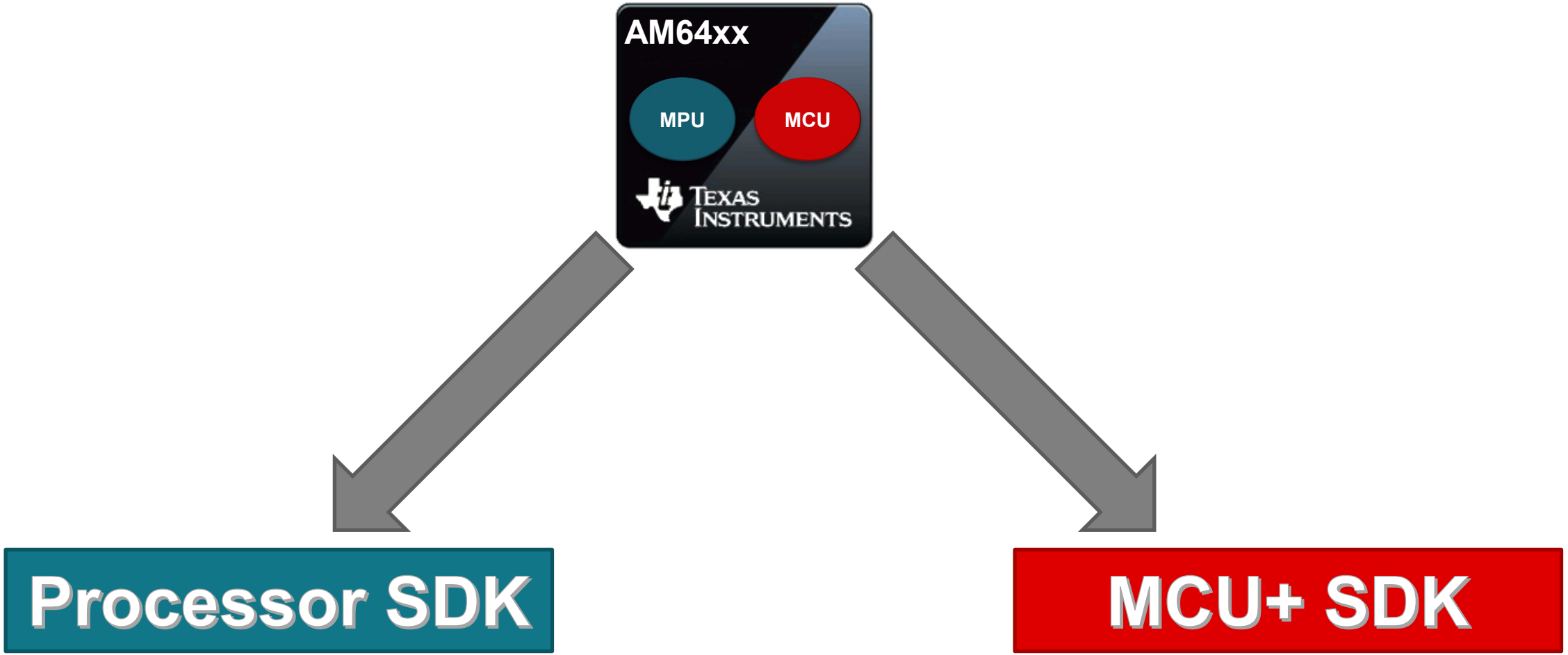
AM6442 Cortex®-A53 based processors

- **Cores & Memory**
  - Dual Cortex-A53 up to 1GHz (6K DMIPS)
  - Dual or Quad Cortex-R5F up to 800MHz (6.4K DMIPS)
  - >2MB on-chip SRAM
  - ECC on all critical memories
  - 16b LPDDR4/DDR4 controller with **inline** ECC, 1600 MT/s
- **Functional safety features**
  - 400MHz Cortex-M4F subsystem with **freedom from interference** (FFI) from rest of SoC for Safety monitoring
    - Dedicated Peripherals I2C, SPI, UART & GPIO
    - Tightly coupled memory of 256KB
  - Diagnostic tool kit for entire SoC voltage, temp, clock, ECC monitors and Error signaling
- **2xPRU-ICSS-Gb**
  - Enables up to 2x Gb industrial Ethernet protocols
  - 1x industrial Ethernet protocol + motor control current and position feedback
- **Peripheral / IO Highlight**
  - GPMC (32b parallel bus) and FSI (serial connection for use with TI's C2000 MCUs) offer low-latency interfaces to motor control front-end
  - PCIe Gen2, USB3.0/2.0, and 2-port Gb Ethernet Switch CPSW provide high-speed (Gbps) connectivity options
  - RS485 support on UART
  - Octal/Quad-SPI with execution-in-place support
- **Integrated analog**
  - 8-channel, 12-bit ADC with 4 MSPS
  - Simplified power solution, Integrated Voltage Monitors and SD card LDO
- **Package**
  - 17.2 x 17.2mm, 0.8mm ball pitch



(1) PCIe and USB 3.0 share the same SERDES

AM64x SoC | TI software offering

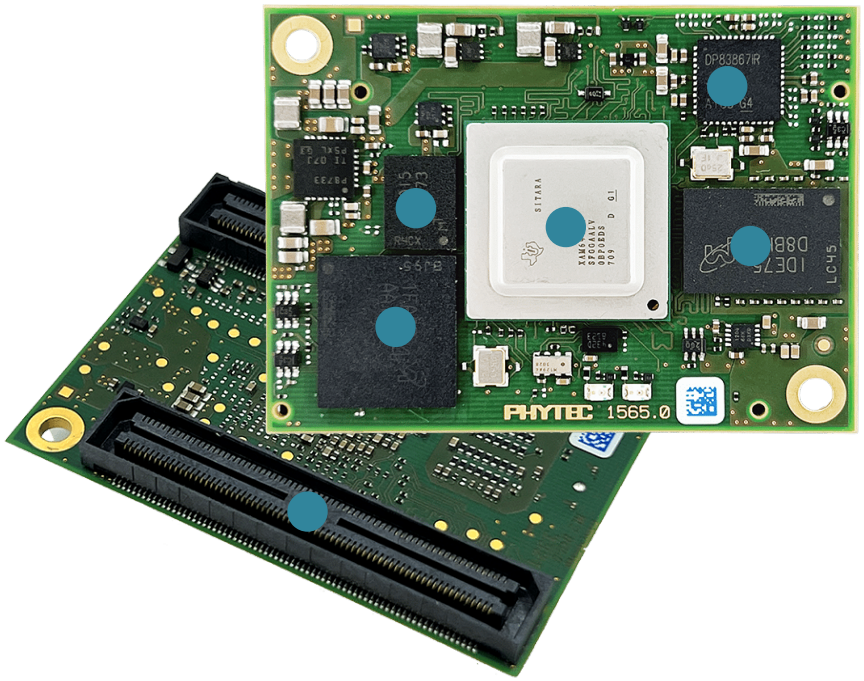


phyCORE-AM64x SOM

Product Highlights

Why use a phyCORE-AM64x System on Module (SOM)?

PHYTEC SOMs take everything common to an Embedded System – and modularize it.



Processor	TI Sitara AM6442
RAM	DDR4 512MB – 2GB
Flash	eMMC 4GB – 32GB NOR (OSPI) 64MB – 256MB
Ethernet	TI DP83867
I/O	4x PRU-ICSSG 1x eCAP, 3x eQEP, 9x PWM, 2 CAN FD
280 Pin High-Density connectors	

Advantages

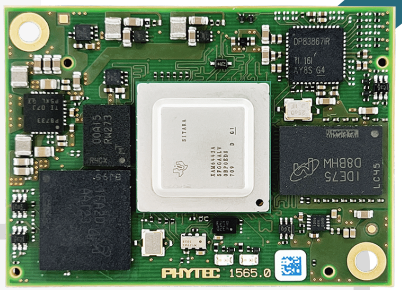
- ✓ Insert-ready solution to reduce your time to market
- ✓ High quality industrial design
- ✓ 10+ year lifecycle management

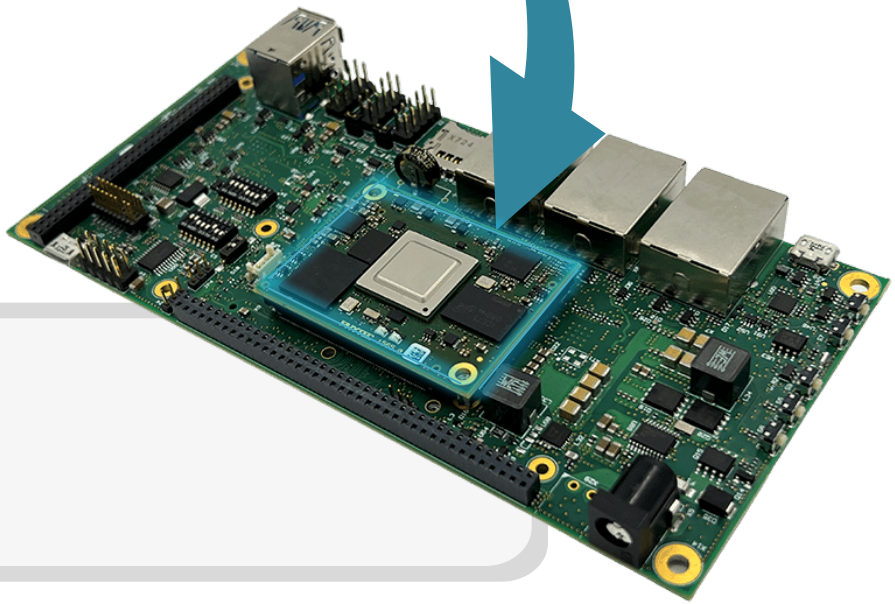
phyCORE-AM64x SOM

Product Highlights

AM6442 Processor to SOM

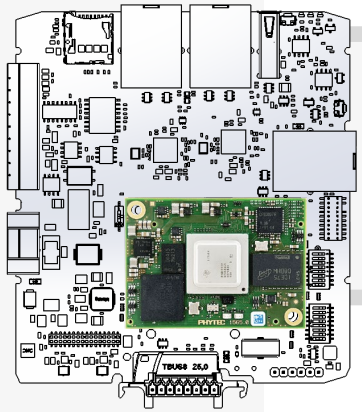
Built for Headless industrial applications (motor drivers and Programmable Logic Controllers), which require a unique combination of real-time processing and communications with applications processing.





Development Kit

For developing high volume professional applications; industrial factory upgrades and automation.



End Application

4x PRU-ICSSG Industrial Ethernet interfaces can be loaded with various communication protocol stacks such as TSN, EtherCAT®, PROFINET®, ETHERNET/IP® and more.

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AM6442 Product Demo

Materials

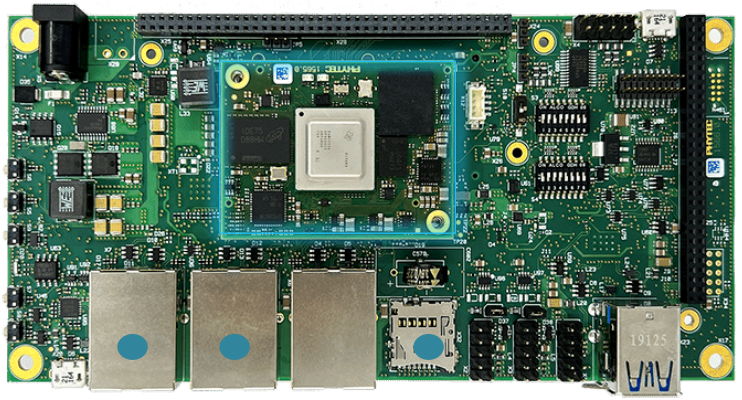
Main Board
- phyCORE-AM64x Development Kit: phyBOARD-Electra
- Software: Linux (Cortex-A53)

Secondary Boards
- Texas Instruments GPEVM
- 2x TI DP83869HM Ethernet PHYs
- Software: MCU+ freeRTOS (Cortex-R5)

Protocols

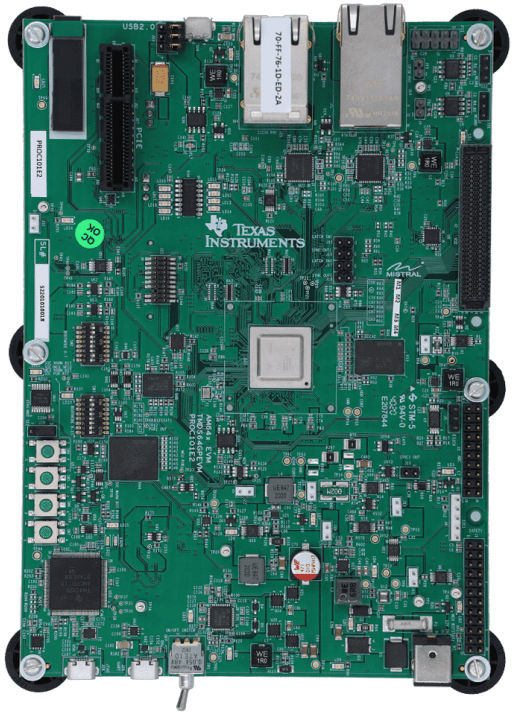
- PROFINET (CSS JTAG load)
- EtherNET/IP (NOR Flash boot)
- EtherCAT (SD Card boot)

Main Board



Processor	TI Sitara AM6442
RAM	2GB DDR4
Flash	16 GB eMMC
Ethernet	TI DP83867
Industrial Ethernet	TI DP83867
SD card	Linux

2x Secondary Boards



Industrial Ethernet	2x TI DP83869
Processor	TI AM2434
RAM	Not Populated (on chip SRAM)
Flash	64MB OSPI NOR
Ethernet	Not Populated

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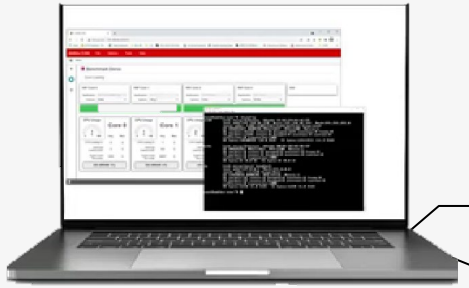
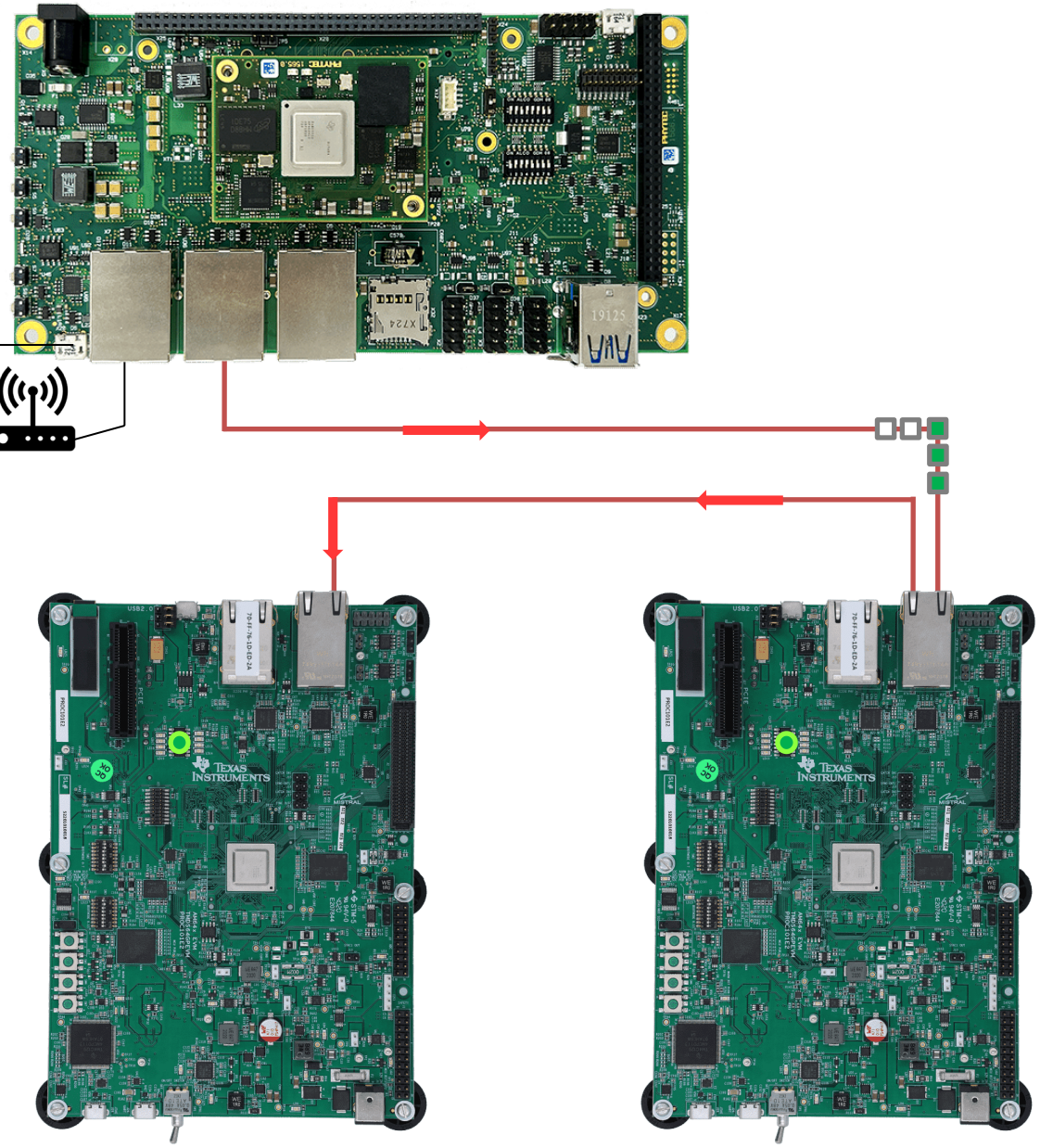
AM6442 Product Demo



PROFINET

- Open industrial standard for communication between controls and devices
- JTAG using TI CCS (Code Composer Studio)
- LED Stair Step
  1010 -> 0101 -> 1010 -> 0101



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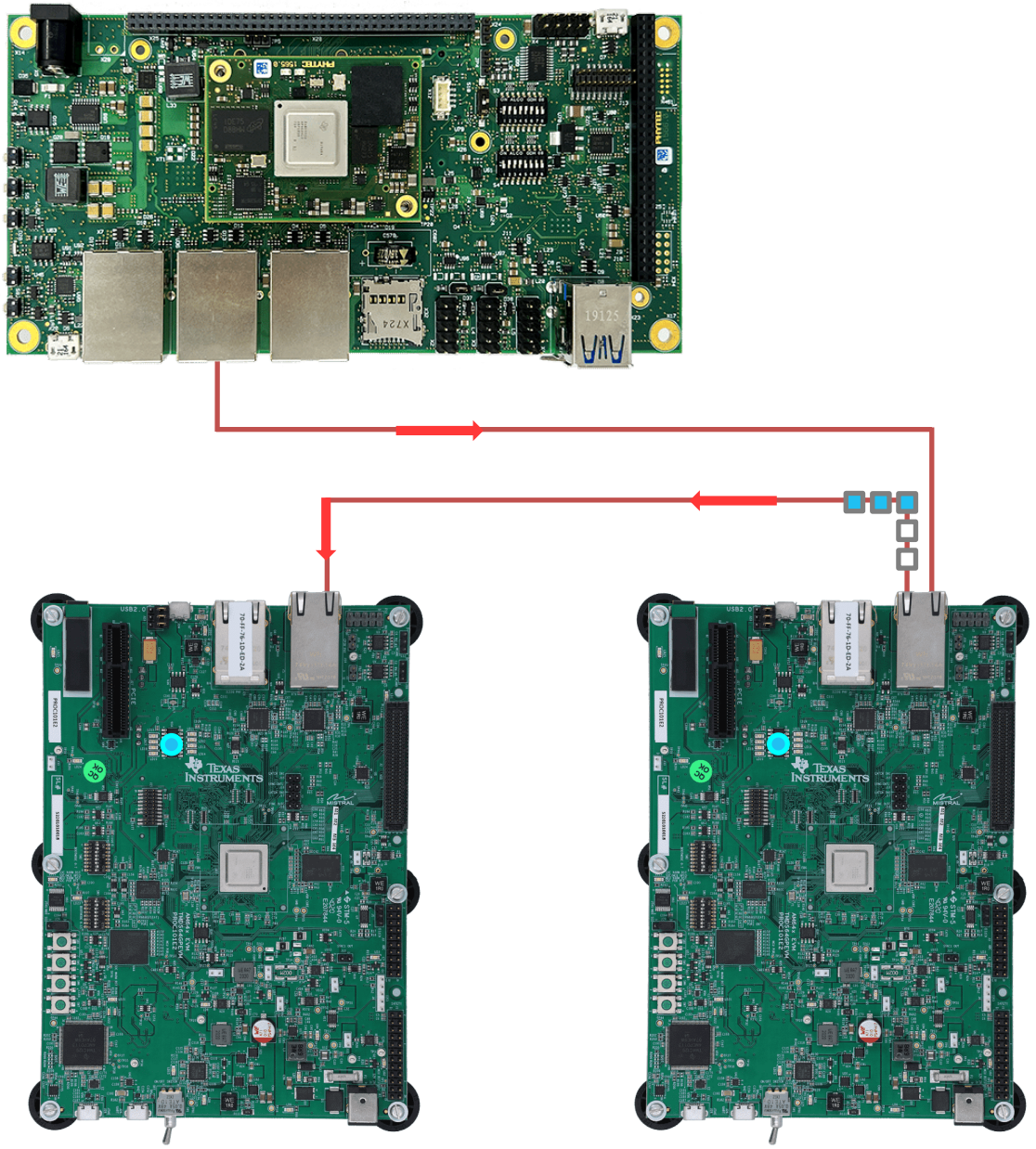
AM6442 Product Demo

EtherNet/IP

- Based on standard Internet and Ethernet standards
- OSPI Flash boot
- LED Alternating flash
  1001 -> 0110 -> 1001 -> 0110



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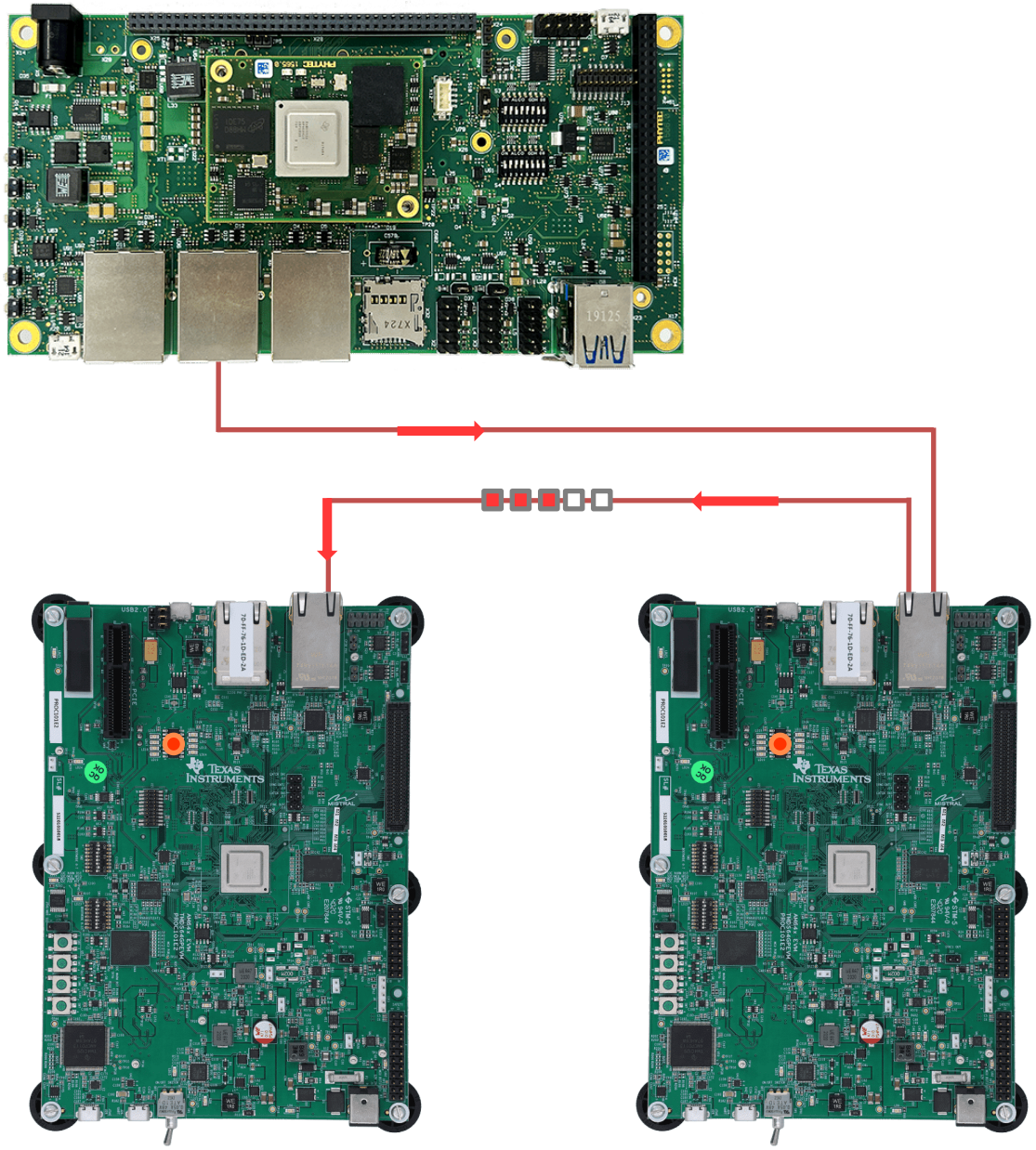
AM6442 Product Demo

EtherCAT

- Real-time protocol developed for automation industry
- Boot using SD card
- LED Alternating flash
  1111 -> 0000 -> 1111 -> 0000

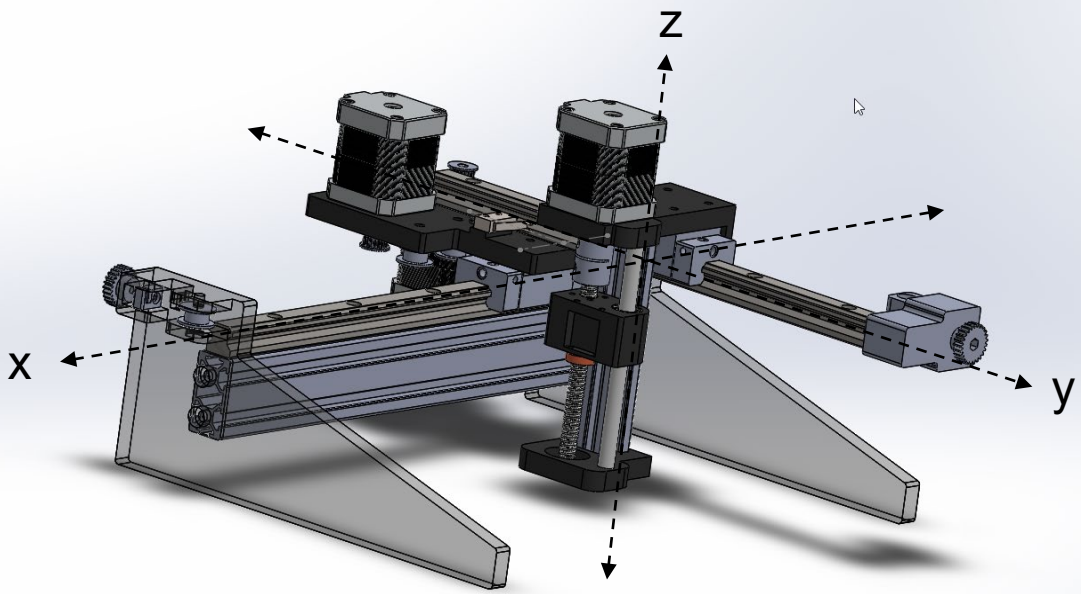


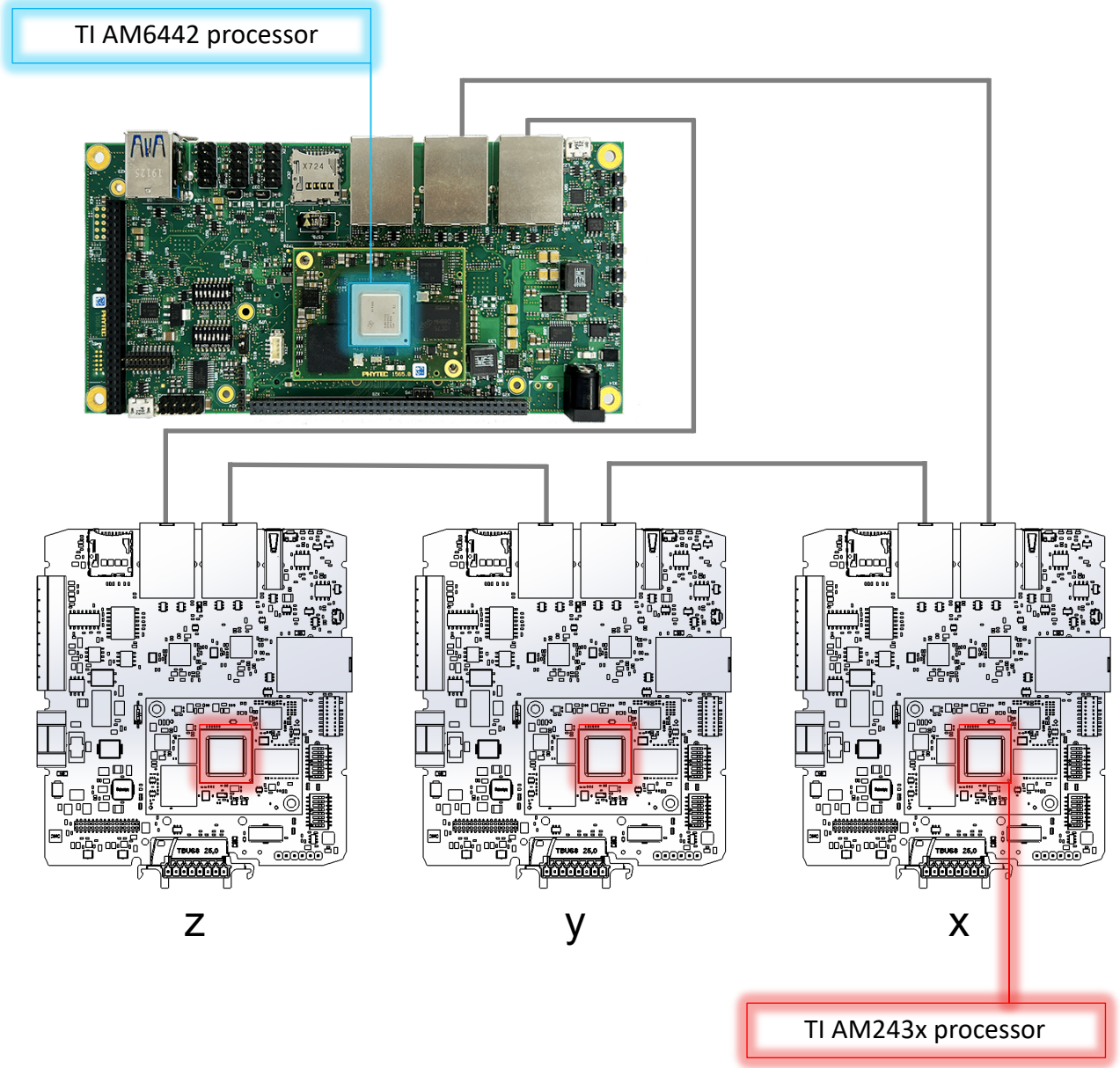
Pen Plotter Demo

AM6442 Product Demo

Practical Application

- Multi-axis motor control
- Each Pinger board becomes an axis (x, y, and z)
- CNC style pen plotter machine



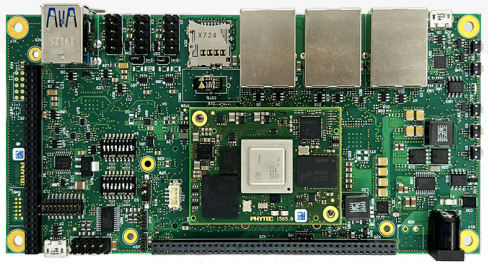


Get Started

Part Numbers and Order Details

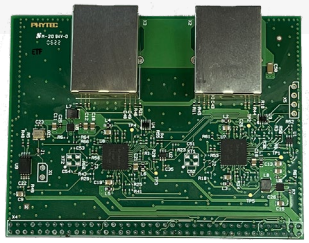
System on Module

PCM-072.A0
TI AM6442, 1GB RAM, 4GB eMMC, OSPI NOR, Dual Ethernet, 4x PRU-ICSSG, Security Chip, 2x CAN FD, PCIe 2.0, Industrial Temp -40 to +85 C
Availability: Production Q3/2022



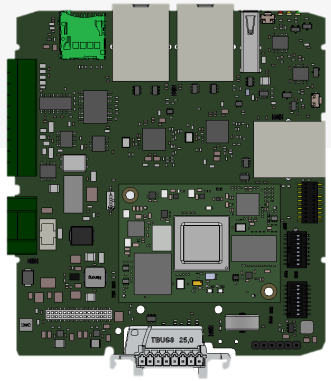
Dev Kit

KPB-07225
phyCORE-AM64x SOM + phyBOARD-Electra Carrier Board
Micro USB, Ethernet, Power cables
Pre-loaded Linux SD card ALPHA-PKGMAN DEMO
Availability: ALPHA Program. Join Now Production Q3/2022



Pinger Lite Expansion

PEB-EVAL-28.A0
phyBOARD-Electra Carrier board expansion featuring 2x TI DP83869
2x Ethernet cables
Pre-loaded freeRTOS SD card PINGER-ETHERCAT-DEMO
Availability: Reference Schematics available https://support.phytec.com



Pinger Board

PBA-C-28.A0
phyCORE-AM243x SOM + phyGATE-AM64x Carrier Board
Micro USB, 2x Ethernet, Power cables
Pre-loaded freeRTOS SD card PINGER-ETHERCAT-DEMO
Availability: Reference Schematics available https://support.phytec.com

Add-ons

Software
FRTOS-BSP-ALPHA SD card
Application instructions https://develop.phytec.com

Learn more at https://www.phytec.com/product/phycore-am64x/