

# AM64x Multi-Core Networking Arm Processors

*Supporting Industrial Networking, Real-time Control  
and Multi-Axis Motor Control on a Single Device*

**Sitara MPU**  
Sept 2024

# AM64x: Multi-Core Industrial Networking Arm Processor

## Sitara™ AM64x MPU Family

PCIe 2.0  
USB 3.1 / 2.0

1-2x 1GHz  
Cortex-A53s

2x Industrial  
Communication  
Subsystems  
(ICSSG: 4x GbE)

I2C, SPI, UART  
& GPIOs

1-4x 800MHz  
Cortex-R5Fs

2-port GbE Switch  
w/ TSN  
(CPSW: 2x GbE)

2x CAN-FD

2MB SRAM with  
inline ECC

ePWM, encoder I/Fs,  
eCAP & eQEP

12-bit ADC @ 4 MSPS  
(8 Channels)

DDR4 / LPDDR4 with inline  
ECC + OSPI/eMMC/SD I/Fs

SIL 2/3 Functional Safety  
(Uses ARM M4F subsystem)

Secure Boot

## Performance

- Up to two A53 application cores with up to 6.0k DMIPs
- Up to four R5F real-time cores with up to 6.7k DMIPs
- Functional Safety & secure boot + run-time security support

## Gigabit Industrial Ethernet

- Up to 5x independent GbE ports
- Up to 2x 2-port GbE TSN, cut-through switches (2-ext, 1-int port)

## 2x Industrial Communication Subsystems (ICSSG)

- Programmable real time peripheral connectivity
- Multi-protocol industrial networking support



## Motor Control

- > 3 axis motor control (FOC)
- Up to 12x multi-protocol position encoders
- Up to 36x on-chip sigma delta filters for current measurement

## Processing Scalability

- P2P compatibility with AM243x MCU family (17mm package)

# AM64x Family | Pin-to-pin compatibility

## Scalable:

- Multiple A53/R5F core options
- Maintain real-time performance even with Linux services running simultaneously

## Industrial:

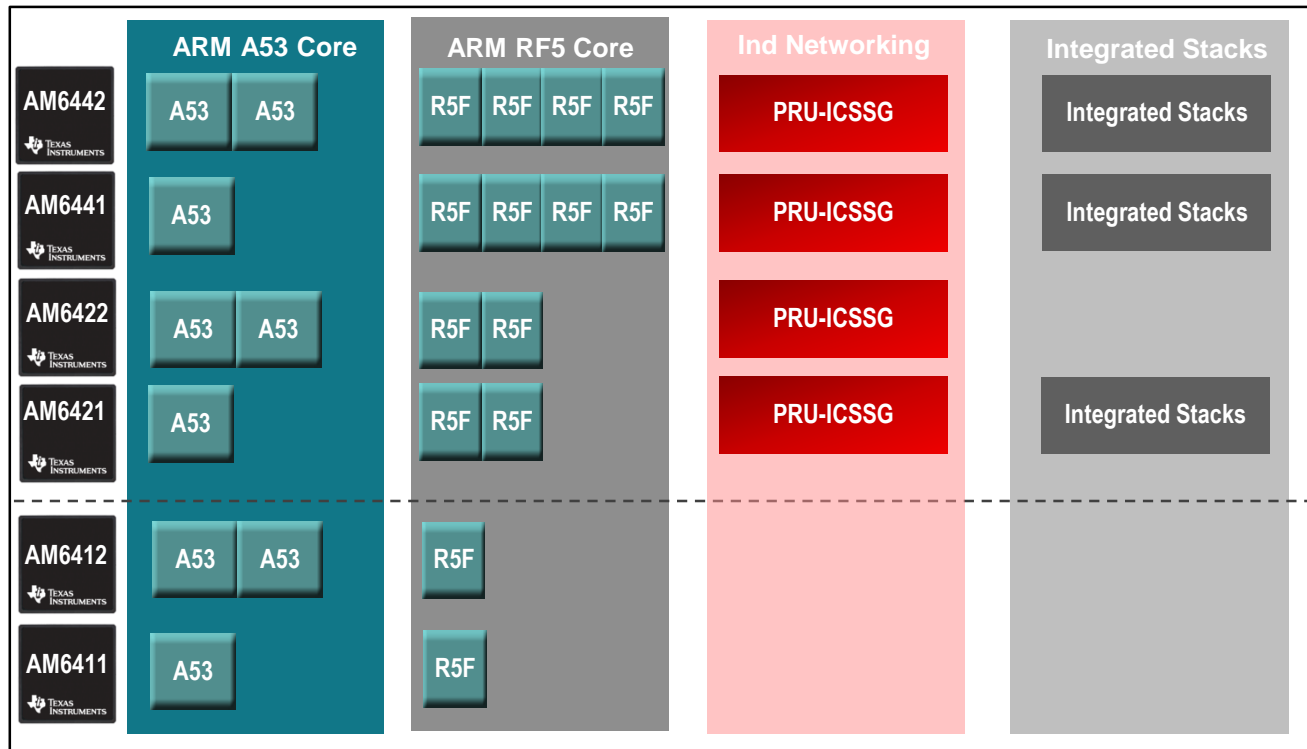
- Rated for -40 to 105C
- Industrial communications support (Profinet, EtherCAT, EtherNet/IP, and IO-Link)
- 100K Power-on-hours @ 105C
- SIL-3 FuSa with additional safety processor

## Package Options:

- 17x17mm package (Metal Lid)  
P2P with the AM243x MCU family

## Secure boot and runtime security

## Low power consumption (1 to 2W)





Pin-to-pin and Software Compatible Family of Processors

# AM64x Family Device Options

Device Options	AM6442	AM6422	Low Cost PCIe Option	AM6441	AM6421	Low Cost PCIe Option
			AM6412*			AM6411*
A53 Cores @ 1GHz	Dual 256KB L2	Dual 256KB L2	Dual 256KB L2	Single 256KB L2	Single 256KB L2	Single 256KB L2
R5F Cores @ 800MHz	Quad 256KB TCM	Dual 256KB TCM	Single 128KB TCM	Quad 256KB TCM	Dual 256KB TCM	Single 128KB TCM
M4F Cores @ 400MHz (256KB)	MF4 with FFI	MF4 with FFI	M4F	MF4 with FFI	MF4 with FFI	M4F
12-bit, 8-Channel, 4 MSPS ADC	Yes	Yes	No	Yes	Yes	No
Functional Safety (SIL 2 device / SIL 3 system)	Yes	Yes	No	Yes	Yes	No
ICSSG Industrial Communication Support (4x 10/100/1000 Gigabit Ethernet MAC's with MII/RGMII, 36x $\Sigma\Delta$ decimation filters, & 12x multi-protocol encoder I/Fs)	Yes	Yes	No	Yes	Yes	No
Industrial Communication Software Stacks (Profinet, EtherCAT, EtherNet/IP, & I/O Link)	Yes	No	No	Yes	Yes	No
Dual CAN-FD	Yes	No	No	Yes	Yes	No
1K Price	\$18.39 - \$12.59	\$12.18 - \$11.12	\$8.80 - \$8.03	\$17.34 - \$11.85	\$15.24 - \$10.38	\$7.99 - \$7.30

\* AM6412 and AM6411 have lower speed options for the A53, R5F, and PRU-ICSSG processors

# AM243/64x Device Options

 Functional Safety Option  
**AM6421BSDFHAALV**  
 Device Option

Device Option	Feature	Comment
C	Two Programmable Real-Time Unit Subsystems	Up to 80 real-time GPIOs with 3ns toggles and 6ns ISR. Direct connect high-speed / high-precision ADCs and other devices eliminating the need for small FPGAs. The ICSSG industrial communication features are not supported but the 2-port CPSW Ethernet switch/dual MAC is enabled and supports TSN
D	Option C + Industrial Communication Support	Device option D adds support for the ICSSG industrial communication features including up to 4x ICSSG 10/100/1000 Ethernet MACs (MII/RGMII), 36x sigma delta decimation filters, and 12x multi-protocol encoders I/Fs (HDSL, EnDat 2.2, Tamagawa etc. support). Supports HSR / PRP
E	Option D + EtherCAT and CAN-FD Support	Adds EtherCAT Device hardware accelerator and CAN-FD support. (CAN-FD and EtherCAT Device licenses are included). Option E or F is required to run the EtherCAT Device protocol.
F	Option E + Integrated Industrial Communication stacks	Includes EtherNet/IP, EtherCAT, Profinet RT/IRT, and IO-Link certified industrial networking software stacks (R5F binaries) powered by KUNBUS

Functional Safety	Feature	Comment
G	Non-Functional Safety Support	
F	Functional Safety Support	Device targeting SIL 2 / System Level SIL 3 with external safety processor





\* Standard CAN is supported on all device options

# AM64 OPNs

\* C: Two Programmable Real-Time Unit Subsystems  
 D: Option C + Industrial Communication Support  
 E: Option D + EtherCAT and CAN-FD Support  
 F: Option E + Integrated Industrial Communication stacks

Status	GPN	Orderable Part Number	Cortex-A53#	Speed Grade	Cortex-R5F#	Speed Grade	ETH	PCIe	Industrial Protocol*	Functional Safety	Tape & Reel	Junction Temp	Package
RTM	AM6411	AM6411BKCGHAALV	1	800MHz	1	400MHz	2	✓	C	No	No	-40 to 105C	17.2 x 17.2
		AM6411BSCGHAALV	1	1GHz	1	800MHz	2	✓	C	No	No	-40 to 105C	17.2 x 17.2
RTM	AM6412	AM6412BKCGHAALVR	2	800MHz	1	400MHz	2	✓	C	No	Yes	-40 to 105C	17.2 x 17.2
		AM6412BSCGHAALV	2	1GHz	1	800MHz	2	✓	C	No	No	-40 to 105C	17.2 x 17.2
RTM	AM6421	AM6421BSDGHAALVR	1	1GHz	2	800MHz	5	✓	D	No	Yes	-40 to 105C	17.2 x 17.2
		AM6421BSEFHAALVR	1	1GHz	2	800MHz	5	✓	E	Yes	Yes	-40 to 105C	17.2 x 17.2
		AM6421BSFFHAALV	1	1GHz	2	800MHz	5	✓	F	Yes	No	-40 to 105C	17.2 x 17.2
		AM6421BSFGHAALV	1	1GHz	2	800MHz	5	✓	F	No	No	-40 to 105C	17.2 x 17.2
RTM	AM6422	AM6422BSDFHAALVR	2	1GHz	2	800MHz	5	✓	D	Yes	Yes	-40 to 105C	17.2 x 17.2
		AM6422BSDGHAALV	2	1GHz	2	800MHz	5	✓	D	No	No	-40 to 105C	17.2 x 17.2
RTM	AM6441	AM6441BSEFHAALV	1	1GHz	4	800MHz	5	✓	E	Yes	No	-40 to 105C	17.2 x 17.2
		AM6441BSEGHAAALVR	1	1GHz	4	800MHz	5	✓	E	No	Yes	-40 to 105C	17.2 x 17.2
		AM6441BSFFHAALV	1	1GHz	4	800MHz	5	✓	F	Yes	No	-40 to 105C	17.2 x 17.2
RTM	AM6442	AM6442BSDGHAALV	2	1GHz	4	800MHz	5	✓	D	No	No	-40 to 105C	17.2 x 17.2
		AM6442BSEFHAALV	2	1GHz	4	800MHz	5	✓	E	Yes	No	-40 to 105C	17.2 x 17.2
		AM6442BSEGHAAALV	2	1GHz	4	800MHz	5	✓	E	No	No	-40 to 105C	17.2 x 17.2
		AM6442BSFFHAALV	2	1GHz	4	800MHz	5	✓	F	Yes	No	-40 to 105C	17.2 x 17.2
		AM6442BSFGHAALV	2	1GHz	4	800MHz	5	✓	F	No	No	-40 to 105C	17.2 x 17.2

# AM243/AM64x: Certified Stacks from TI

Protocol	Certified	Min. Cycle Time	Conformance Test /Certification	Key features supported
 (Device/client)	Yes	31.25 us	2.5.0	CiA402, CAN over EtherCAT (CoE), Servo Drive Profile (SoE), Ethernet over EtherCAT (EoE), File Access over EtherCAT (FoE), Distributed Clocks
 (Device/client)	Yes	1 ms	20.1	Address Conflict Detection (ACD), Quality of Service (QoS), Device Level Ring (DLR), Precision Time Protocol (PTP)
 (Device/client)	4Q24 Certification	1 ms (RT) 250 us (IRT)	2.44.1	Conformance Class A, B (RT), and C (IRT), Precision Time Control Protocol (PTCP), Media Redundancy Protocol (MRP)
 (Controller/Host)	Yes	All communication classes supported	1.1.3	Up to 8 channel IO Link Master per ICSS, IO-Link standard-compliant with Standardized Master Interface (SMI)

Detailed feature set for each protocol available in the Industrial Communications Toolkit

Release datasheets [EtherNet/IP](#) [EtherCAT](#) [PROFINET](#) [IO Link](#)

# AM64/AM243x: Industrial Communications support

Master/Controller		Acontis	Codesys	IBV	IGH	Moxel	Port
CC-Link TSN	Linux		--	--	--	--	Yes
EtherCAT	Linux	Yes (Native Driver)	Yes	Yes (Native Driver)	Yes (Native Driver)	--	--
	RTOS	Yes	--	Yes	--	--	--
EtherNet/IP	Linux	--	Yes	--	--	Yes	Yes
	RTOS	--	--	--	--	Yes	--
PROFINET	Linux	--	RT	--	--	CC-A/B v2.44	RT
	RTOS	--	--	--	--	CC-A/B v2.44	--

Slave/Device		TI	Codesys	Beckhoff	TMG	Moxel	Port
EtherCAT	Linux		--	--	--	--	--
	RTOS	Yes	--	Yes	--	--	Yes
EtherNet/IP	Linux	--	Yes	--	Yes	Yes	Yes
	RTOS	Yes	--	--	Yes	Yes	Yes
PROFIBUS	Linux	--	--	--	--	--	--
	RTOS	--	--	--	Yes	--	--
PROFINET	Linux	--	RT	--	RT	RT	RT
	RTOS	Yes	--	--	CC-A/B/C v2.43	CC-A/B/C v2.44	CC-A/B/C v2.43
CC-Link TSN	Linux	--	--	--	--	--	Y
	RTOS	--	--	--	--	--	Y

Linux = A53 Core  
RTOS = R5F Core



# AM64x: Additional Protocol Support

Protocol	Supported	Comment
OPC UA over TSN	3 <sup>rd</sup> Party or open source	SDK has 1.0.1 stack from open62541.org, will be updated. 3 <sup>rd</sup> parties such as PORT GmbH, Matrikon and be.services also available
Profinet over TSN (CC D)	TBD	
CC-Link IE TSN	3 <sup>rd</sup> Party	Contact PORT or other 3 <sup>rd</sup> party for support options
EtherCAT Main (Master)	3 <sup>rd</sup> Party	Contact Codesys (Linux), Acontis (Linux or RTOS), IBV (Linux or RTOS), or IGH (Native Driver)
Profinet Controller (Master)	3 <sup>rd</sup> Party	Contact Codesys (Linux), Molex (Linux or RTOS)
EtherNet/IP Scanner (Master)	3 <sup>rd</sup> Party	Contact Codesys (Linux), Molex (Linux or RTOS)

# AM64x: TSN Support



TSN Feature	Comment	Hardware Support		Software Support	
		CPSW 3G 2-port switch	ICSSG	Linux AM64x/62x	Free RTOS AM243x
802.1Q	VLANs	Yes	Yes	Yes	Yes
802.1AS-2020	Time Synchronization (AS-Rev)	Yes	Yes	802.1AS-2011 via PTP4L 802.1AS-2020 ~ 2H24	Yes
802.1Qbv	Time-Aware Shaper(TAS) / Enhancements Scheduled Traffic (EST)	Yes	Yes	Yes	Yes
802.1Qbu	Interspersed Express Traffic (IET): Frame Preemption	Yes	Yes	Yes	Yes (YANG support pending)
802.1Qav	Forward / Queuing of Time Sensitive Streams (FQTSS) also known as eAVB (Ethernet Audio Video Bridging)	Yes	No	CPSW: Yes ICSSG: No	CPSW: Yes ICSSG: No
802.1Qci	Per-Stream Filtering and Policing (PSFP)	No On/off gate support	No	CPSW: Partial ICSSG: No	CPSW: Partial ICSSG: No
802.1CB	Frame Replication and Elimination for Reliability (FRER)	No	No	Future silicon revisions to add support	
802.1Qch	Cyclic Queuing and Forwarding	Under Study	Under Study	Looking at configuration of the EST/Qbv scheduler	
802.1Qcr	Asynchronous Traffic Shaping	No	No	No plans to implement ; no customer requests	
802.1Qat	Stream Reservation Protocol (SRP)	N/A	N/A	Netconf/YANG	TBD Future software Community initiative in free RTOS/lwIP
802.1Qcc	Enhancements to SRP				
802.1BA	Audio Video Bridging (AVB) Systems	N/A	N/A	Feature to be implemented in Software (3 <sup>rd</sup> party Excelfore)	
Cut-through switching	No approved IEEE standard	Yes	Yes	Yes	Yes

# AM64x: Getting Started Design-in Resources

Tool	Link
AM64x SDK	<a href="https://www.ti.com/tool/PROCESSOR-SDK-AM64X">https://www.ti.com/tool/PROCESSOR-SDK-AM64X</a>
Linux SDKs release notes	<a href="#">AM64x Linux Release Notes (9.2)</a> <a href="#">AM64x Linux RT Release Notes (9.2)</a>
AM64x MCU+ SDK 9.0	<a href="#">AM64x MCU+ SDK 9.1</a>
Industrial communications SDK	<a href="#">AM64x Industrial Communications SDK (9.1)</a>
Linux Academy	<a href="#">Linux Academy for AM64x</a>
Power estimation calc	<a href="https://www.ti.com/lit/zip/sprm779">https://www.ti.com/lit/zip/sprm779</a>
Board design app notes	<a href="#">High Speed Interface Layout Guidelines</a> <a href="#">Hardware Design Guide for AM64x Devices</a> <a href="#">AM64x Schematic Checklist</a> <a href="#">AM64x/AM243x BGA Escape Routing (17m package)</a>
Pin mux / pin out configuration tool	<a href="https://www.ti.com/tool/SYSCONFIG">https://www.ti.com/tool/SYSCONFIG</a>
PRU feature set app note	<a href="#">PRU Subsystem Features and Comparison</a>
Functional safety documentation	Available under NDA on the <a href="#">My Secure server</a> (Includes Safe Torque Off Safety Function White Paper)
Security documentation	Available under NDA on the <a href="#">My Secure server</a>
Performance benchmarks app note	<a href="#">Sitara AM64x Benchmarks</a>

# AM64x: Getting Started Design-in Resources

Tool	Link
Servo Motor Control on AM64x App note	<a href="#">AM64x Single Chip Servo Motor Control Implementation and Benchmark</a>
Single Pair Ethernet + AM64x Reference design	<a href="#">Four-port single-pair Ethernet with power over data line reference design</a>
AM64x Videos	<p><b>Link to all AM64x Videos:</b></p> <ul style="list-style-type: none"><li>• <a href="#">AM64x Videos</a></li></ul> <p><b>AM64x Individual Videos:</b></p> <ul style="list-style-type: none"><li>• <a href="#">Building cloud-connected industrial machines</a></li><li>• <a href="#">Inter-Processor Communication (IPC) for AM64x processors</a></li><li>• <a href="#">Codesys PLC Controller on AM64x</a></li><li>• <a href="#">Foundries Factory AM64x cloud-based Linux development</a></li><li>• <a href="#">Wired and Wireless Networking on the AM64x</a></li><li>• <a href="#">TSN using Linux on the AM64x</a></li><li>• <a href="#">Sitara SK-AM64-out-of-box demo</a><ul style="list-style-type: none"><li>• <i>Video covers wired and wireless Linux Networking</i></li><li>• <i>Latest EVM revision is the <a href="#">SK-AM64B</a></i></li></ul></li></ul>
Industrial Communication Support App Note	<a href="#">Industrial Communication Protocols Supported on Sitara™ Processors and MCUs</a>
TPS65220 vs TPS65219 PMIC App note	<a href="#">Powering the AM64x with the TPS65220 or RPS65219 PMIC</a>
Industrial Comms including TSN and HSR	<a href="#">Industrial Communication Protocol Support for Arm®-based Microcontrollers and Processors</a>
Functional Safety White Paper	<a href="#">Functional Safety Support for Arm®-based Microcontrollers and Processors</a>