

NuMicro[®] MA35 Family

MA35D1 – High-Performance Edge IIoT Series

MA35D0 – Industrial Edge Device Series

MA35H0 – Industrial HMI Series

salesupport@nuvoton.com

Joy of innovation
NUVOTON

NuMicro[®] MA35D1 Series Features Highlight

High-Performance
with
Power Efficiency



Smooth Graphics
& Video Playback



Advanced
Security



High-Speed
Connectivity



Stacking DDR in
LQFP Package



Industrial Grade
Operating Temp.



MA35 Family



Rich
Design Resource



High-Performance
Edge IIoT Series



Rich Design Resource

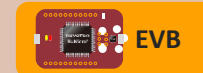
Graphics
Library



OS



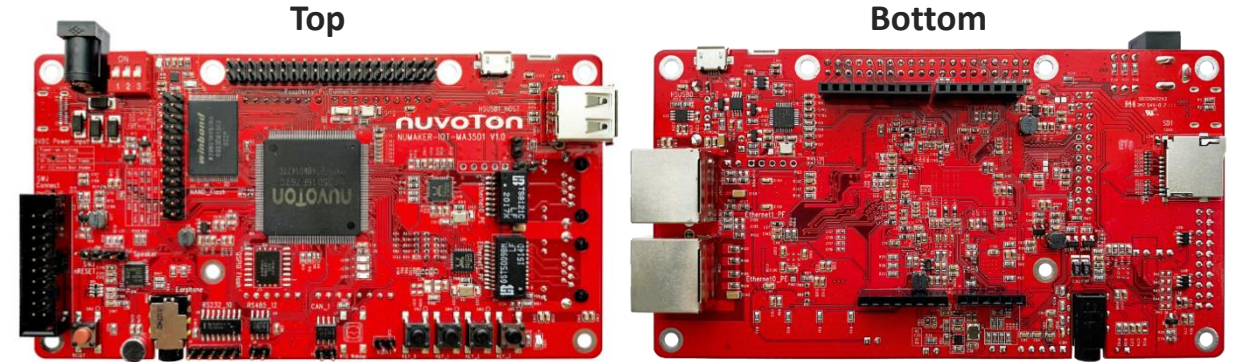
Platform
Resource



NuMaker-IoT-MA35D1-A1 EVB for Gateway

Features

- MA35D16F987C / LQFP216 package, stacking a 512 MB DDR
- Discrete power supply solution
- Memory Devices
 - NAND Flash 1 GB
 - QSPI-NAND Flash 512 MB
 - SD2.0 (Micro SD Slot) x1
- High-speed Connectivity
 - Gigabit Ethernet x1, Megabit Ethernet x1
 - USB2.0 HS Host x1, USB2.0 HS Host/Device x1
 - CAN FD x1
 - RS485 x1, RS232 x1
- 40-pin Raspberry Pi compatible connector
- Arduino UNO compatible extension connectors
- Audio Codec with Mic, Headset Jack
- Analog and Digital I/O
- Camera Interface x1

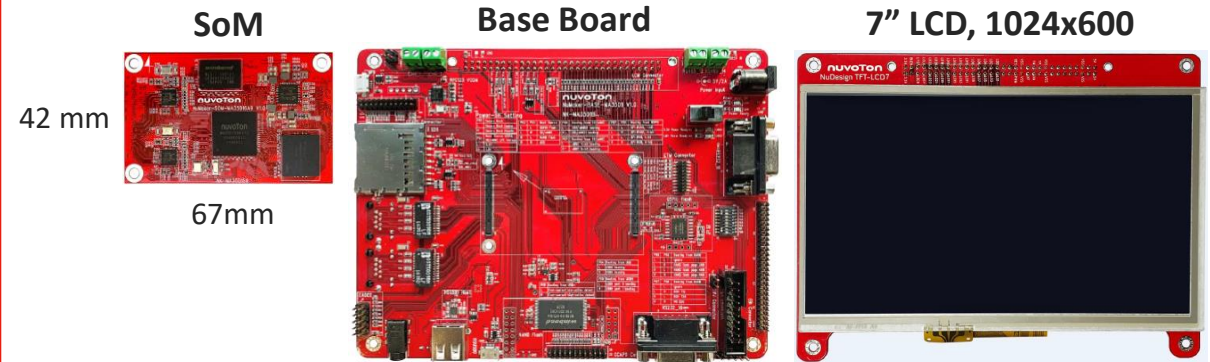


OS	 Linux	RTOS	OpenWRT
Linux Development Environment	 yocto PROJECT	 BuildRoot Making Embedded Linux Easy	U-BOOT

NuMaker-HMI-MA35D1-S1 EVB for HMI

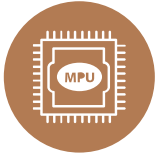
Features

- SoM
 - MA35D16A887C / BGA312 package, stacking a 256MB DDR
 - PMIC power solution
 - eMMC Flash 16 GB
 - Gigabit Ethernet PHY x2
- Base Board
 - Gigabit Ethernet x2
 - USB2.0 HS Host x1 & USB2.0 HS Host/Device x1
 - CAN FD x2
 - SD2.0 (Standard SD Slot) x1
 - SIM card slot x1
 - UART x2, RS485 x2, Analog and Digital I/O
 - Camera Interface x2
 - Audio Codec with Mic, Headset Jack
- 7" TFT-LCD (1024x600) with resistive touch



Graphics Library	LVGL	Qt	
OS	Linux	RTOS	
Linux Development Environment	yocto PROJECT	BuildRoot Making Embedded Linux Easy	U-BOOT

NuMicro[®] MA35D1 Series Features



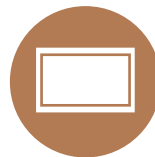
Core & Memory

- Dual 64-bit/32-bit Arm Cortex-A35 high-performance cores running up to 800 MHz
- One Arm Cortex-M4 real-time core running up to 180 MHz
- Supports discrete power supply and PMIC solutions
- Operating temperature (Tj): -40°C ~ +105°C
- Offering LQFP and BGA package parts with stacking a DDR3L SDRAM up to 512 MB



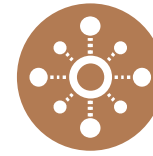
Security

- TrustZone
- Secure Boot
- **Trusted Secure Island (TSI)** an isolated secure hardware unit, which performs all the operations of the cryptographic accelerators
 - Crypto Engine: AES256, SHA512, ECC, RSA4096, SM2/3/4
 - True Random Number Generator (TRNG)
 - 8 Kbits One Time Programmable (OTP) memory with Key Store to protect key



Display and Video

- LCD RGB I/F display with the resolution up to 1080P@60 FPS
- Integrated a 2D Graphic Engine
- JPEG decoder, picture size up to 16368 x 16368
- H.264 decoder supports baseline, main profile, high profile, and resolution up to 1920 x 1080 @45 FPS
- 2 sets of CCIR601, CCIR656 and 4-bit Camera Interface, resolution up to 3M pixels

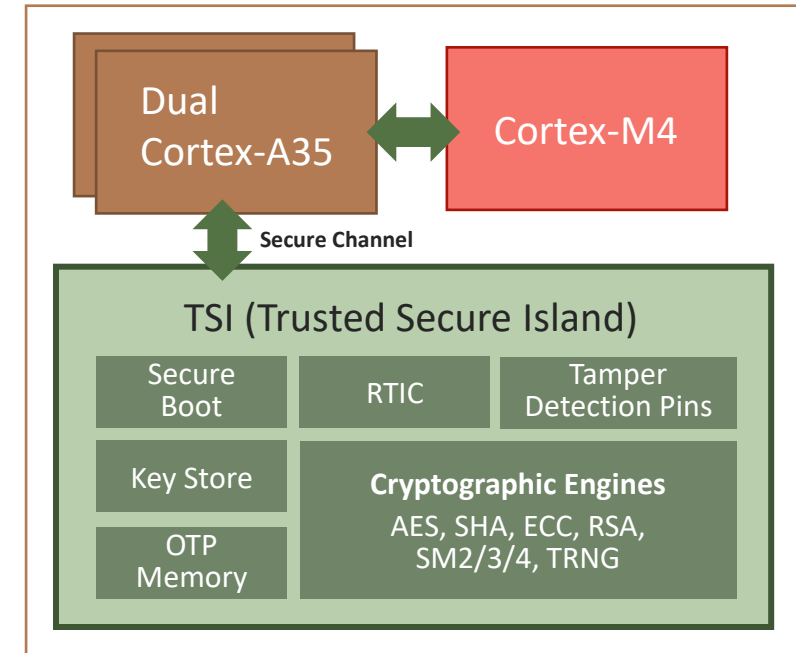


High-Speed Connectivity & I/O

- 4 sets of PDMA
- 2 sets of 10/100/1000 Mbps Ethernet
- 1 set of USB HS Host, 1 set of USB HS Host/Device dual role
- 1 set of SDIO3.0 and 1 set of SDIO2.0
- 4 sets of CAN FD
- 2 sets of QSPI
- 2 sets of I²S
- 4 sets of SPI/I²S
- 17 sets of UART
- 6 sets of I²C
- Number of GPIOs LQFP216 up to 154/ BGA up to 208
- 18-channel 28-bit Enhanced PWM (EPWM)
- 12-channel 32-bit Timer PWM (Timer PWM)
- 3 sets of QEI
- 3 sets of Enhanced Capture
- RTC with V_{BAT}
- 1 set of 12-bit 4.7 Msps EADC with 8 input channels or 4 differential input pairs
- 1 set of 12-bit 500 kps ADC with 8 input channels, supports 4/5-wire resistive touch

Advanced Security Features for Cyber Security

- The Nuvoton TSI is an isolated secure hardware unit where operation is not affected by MA35D1 system.
- Built-in cryptographic accelerators, Key Store, and OTP memory
- Performs all the security operations, including secure boot and tamper pins detection.
- The secure environment and features realize the **Protection, Detection, and Recovery** for IoT products.
- Easily established
 - **Execution Security**
 - TSI, TrustZone, Secure boot, Run-Time Integrity Checker (RTIC)
 - **Communication Security**
 - Hardware cryptographic accelerators
 - **Chip-level Storage Security**
 - Key Store and OTP memory, accessed by the cryptographic engines, without the need of CPU access
 - **System Security**
 - Tamper pins for tamper detection



The MA35D1 is a trusted system for IoT products' security requirements

NuMicro[®] MA35D0 Series

Key Specifications

New Option for Industrial
Edge Device Applications

- Dual 64-bit Arm[®] Cortex[®]-A35 cores @ 650 MHz
- 32 KB I/D L1 cache & 512 KB L2 cache
- Stacking 128/256 MB DDR in LQFP216 Package
- Operating temperature (Tj): -40°C ~ +125°C



Core &
Memory

- Arm[®] TrustZone[®] & Secure Boot
- Crypto Engines (AES-256, SHA-512, ECC-571, RSA-4096, SM2/3/4) & TRNG
- OTP Memory & Keystore



Practical
Security

- 2 sets of Megabit Ethernet with IEEE 1588v2
- USB 2.0 High Speed Host & Device
- SDIO3.0, QSPI, CAN FD, UARTs, I²S



High-Speed
Connectivity

- Display resolution up to 1280 x 800 @ 60 fps
- Display interface included RGB, SPI, i80



Display

- NuMicro[®] MA35D0 series is a **dual-core, high-performance MPU** designed for **industrial edge device application market**
- Provides **practical security functions** to meet network security requirements and **improve product protection capabilities**
- Supports **high-speed and diverse connectivity capabilities** to meet high-performance industrial edge device applications



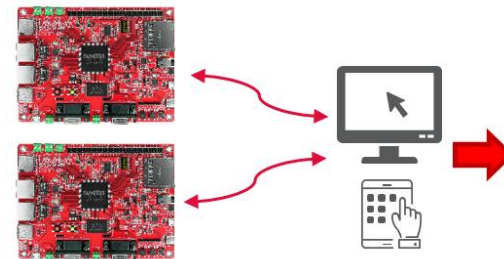
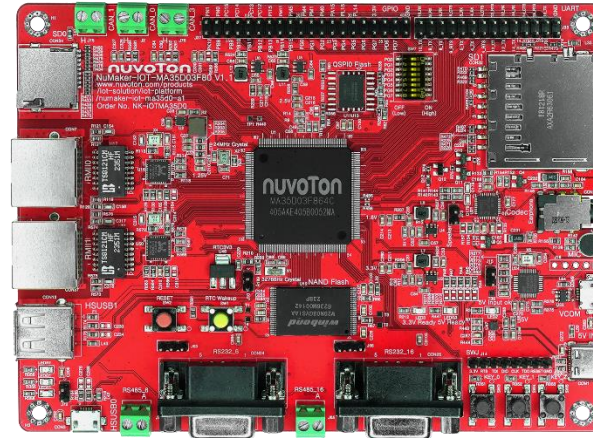
NuMaker-IoT-MA35D0-A1 EVB

Features

- MA35D03F864C / LQFP216 package (MCP with 256MB DDR)
- Dual Cortex-A35, CPU speed up to 650MHz
- Discrete power supply
- Memory Device
 - NAND Flash 1GB
 - QSPI NAND Flash 512MB
 - SD3.0 (Standard SD slot) x1, SD2.0(Micro SD slot) x1
- High-speed Connectivity
 - Megabit Ethernet x2
 - USB2.0 HS Host x1, USB2.0 HS Host/Device x1
 - CAN FD x3
 - RS485 / RS232 x2
- Audio Codec (NAU88C22YG) with Mic & Headset Jack
- Analog and Digital I/O header

EVb Info

- EVB Web Page for Introduction
- PN: NuMaker-IoT-MA35D0-A1
- Ordering Number: NK-IMA35D0A1



The MA35D0 EVB is pre-loaded with remote control example

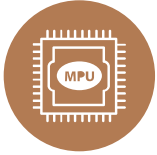
- Access the NuMaker-IoT-MA35D0-A1 system status via web browser
- exchange of EVBs information on the same network
- Could establish the connection with web server by Ethernet or Wi-Fi/4G
- Web server application integration of Node.js/HTML5

nuvoTon
NuMaker-IoT-MA35D0-A1
Remote Control Demo

Send message to all device:

Device Information IP: 192.168.0.183 UID: 002700F101675BD000000478 <input type="button" value="Identify Device"/>	Usage Information CPU: 49% MEM: 51/230 MB (22.17%) Temperature: 46°C	LED_R <input type="checkbox"/> Key0: 20 LED_G <input type="checkbox"/> Key1: 17 LED_Y <input type="checkbox"/> Key2: 12	
Device Information IP: 192.168.0.177 UID: 002700F101675BD000000460 <input type="button" value="Identify Device"/>	Usage Information CPU: 45% MEM: 49/230 MB (21.30%) Temperature: 44°C	LED_R <input type="checkbox"/> Key0: 5 LED_G <input type="checkbox"/> Key1: 3 LED_Y <input type="checkbox"/> Key2: 4	

NuMicro[®] MA35D0 Series Features



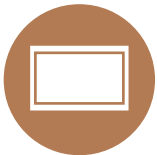
Core & Memory

- Dual 64-bit/32-bit Arm Cortex-A35 high-performance cores running up to 650 MHz
- 32 KB I/D L1 cache for each core, and a 512 KB shared L2 cache
- Supports discrete power supply and PMIC solutions
- Operating temperature (Tj): -40°C ~ +125°C
- Offering LQFP package parts with stacking a DDR SDRAM up to 256 MB



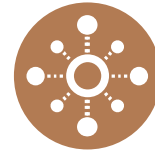
Security

- TrustZone
- Secure Boot
- Hardware Security Features
 - Crypto Engine: AES256, SHA512, ECC, RSA4096, SM2/3/4
 - True Random Number Generator (TRNG)
 - 8 Kbits One Time Programmable (OTP) memory with Key Store to protect key



Display

- LCD RGB I/F display with the resolution up to 1280 x 800@60 FPS
- Integrated a 2D Graphic Engine
- JPEG decoder, picture size up to 16368 x 16368



High-Speed Connectivity & I/O

- 4 sets of PDMA
- 2 set of 10/100 Mbps Ethernet
- 1 set of USB HS Host, 1 set of USB HS Host/Device dual role
- 1 set of SDIO3.0 and 1 set of SDIO2.0
- 3 sets of CAN FD
- 1 sets of QSPI
- 1 sets of I²S
- 2 sets of SPI/I²S
- 11 sets of UART
- 3 sets of I²C
- Up to 150x GPIO (LQFP216)
- 18-channel 28-bit Enhanced PWM (EPWM)
- 12-channel 32-bit Timer PWM (Timer PWM)
- RTC with V_{BAT}
- 1 set of 12-bit 500 ksps ADC with 8 input channels, supports 4/5-wire resistive touch

NuMicro[®] MA35H0 Series

Key Specifications

Core & Memory

- Dual 64-bit Cortex-A35 cores @ 650 MHz
- 32 KB I/D L1 cache & 512 KB L2 cache
- Stacking 128 MB DDR in LQFP216 Package
- Operating temperature (Tj): -40°C ~ +125°C

Display & Video

- Display resolution up to 1280 x 800 @ 60 fps
- Display interface included RGB, SPI, i80
- 2D Graphic Accelerator
- JPEG & H.264 decoder resolution up to 1280 x 800 @ 60fps

Practical Security

- Arm[®] TrustZone[®] & Secure Boot
- Crypto Engines (AES, SHA, ECC, RSA, SM) & TRNG
- OTP memory & Keystore

High-Speed Connectivity

- Megabit Ethernet with IEEE 1588v2
- USB 2.0 High Speed Host & Device
- SDIO3.0, QSPI, CAN FD, UARTs, I2S

New Option for Industrial HMI

- The NuMicro[®] MA35H0 series is a high-performance MPU designed for Industrial HMI applications
- Built-in display interface and 2D GFx & video decoder
- Supports TFT-LCD with a resolution of 1280 x 800, providing smooth graphics and video playback



NuMaker-HMI-MA35H0-A1 EVB

Features

- MA35H04F764C / LQFP216 package (MCP with 128MB DDR)
- Dual Cortex-A35, CPU speed up to 650MHz
- Discrete power supply
- Memory Device
 - NAND Flash 1GB
 - QSPI NAND Flash 512MB
 - SD3.0 (Standard SD slot) x1, SD2.0(Micro SD slot) x1
- High-speed Connectivity
 - Megabit Ethernet x1
 - USB2.0 HS Host x1, USB2.0 HS Host/Device x1
 - CAN FD x1
 - RS485 / RS232 x2
- Audio Codec (NAU88C22YG) with Mic & Headset Jack
- Analog and Digital I/O header
- 7" TFT-LCD(1024 x 600) with Resistive Touch

EVB Info

- [EVB Web Page for Introduction](#)
- PN: NuMaker-HMI-MA35H0-A1
- Ordering Number: NK-HMA35H0A1



EV Charging Station



Coffee Machine



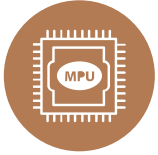
Industrial Control



Speed Meter



NuMicro[®] MA35H0 Series Features



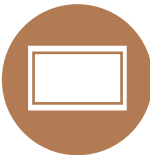
Core & Memory

- Dual 64-bit/32-bit Arm Cortex-A35 high-performance cores running up to 650 MHz
- 32 KB I/D L1 cache for each core, and a 512 KB shared L2 cache
- Supports discrete power supply and PMIC solutions
- Operating temperature (Tj): -40°C ~ +125°C
- Offering LQFP package parts with stacking a DDR SDRAM up to 128 MB



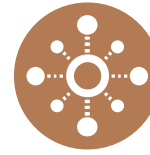
Security

- TrustZone
- Secure Boot
- Hardware Security Features
 - Crypto Engine: AES256, SHA512, ECC, RSA4096, SM2/3/4
 - True Random Number Generator (TRNG)
 - 8 Kbits One Time Programmable (OTP) memory with Key Store to protect key



Display

- LCD RGB I/F display with the resolution up to 1280 x 800@60 FPS
- Integrated a 2D Graphic Engine
- JPEG decoder, picture size up to 16368 x 16368
- H.264 decoder supports baseline, main profile, high profile, and resolution up to 1280 x 800 @60 FPS



High-Speed Connectivity & I/O

- 4 sets of PDMA
- 1 set of 10/100 Mbps Ethernet
- 1 set of USB HS Host, 1 set of USB HS Host/Device dual role
- 1 set of SDIO3.0 and 1 set of SDIO2.0
- 2 sets of CAN FD
- 1 sets of QSPI
- 1 sets of I²S
- 2 sets of SPI/I²S
- 6 sets of UART
- 3 sets of I²C
- Up to 150x GPIO (LQFP216)
- 18-channel 28-bit Enhanced PWM (EPWM)
- 12-channel 32-bit Timer PWM (Timer PWM)
- RTC with V_{BAT}
- 1 set of 12-bit 500 ksps ADC with 8 input channels, supports 4/5-wire resistive touch

NuMicro[®] MA35 Family P/N and Packages

Series & CPU DDR	MA35H0 Dual A35@650 MHz	MA35D0 Dual A35@650 MHz	MA35D1 Dual A35@800 MHz		
(External)				MA35D16A087C	
DDR	512 MB		MA35D16F987C	MA35D16A987C	
	256 MB	MA35D03F864C	MA35D16F887C	MA35D16A887C	
	128 MB	MA35H04F764C	MA35D03F764C	MA35D16F787C	
Package	LQFP216 (MCP DDR) (24 x 24 mm)	LQFP216 (MCP DDR) (24 x 24 mm)	LQFP216 (MCP DDR) (24 x 24 mm)	BGA312 (MCP DDR) (15 x 15 mm)	BGA364 (14 x 14 mm)
Features	<ul style="list-style-type: none"> • Megabit Ethernet • 2 sets of CAN-FD • 6 sets of UART • 154 x GPIO 	<ul style="list-style-type: none"> • 2 sets of Megabit Ethernet • 3 sets of CAN-FD • 11 sets of UART • 154 x GPIO 	<ul style="list-style-type: none"> • Sub-core Cortex-M4 @180 MHz • Megabit + Gigabit Ethernet • 4 sets of CAN-FD • 17 sets of UART • 154 x GPIO 	<ul style="list-style-type: none"> • Sub-core Cortex-M4 @180 MHz • 2 sets of Gigabit Ethernet • 4 sets of CAN-FD • 17 sets of UART • EADC • 208 x GPIO 	<ul style="list-style-type: none"> • Sub-core Cortex-M4 @180 MHz • 2 sets of Gigabit Ethernet • 4 sets of CAN-FD • 17 sets of UART • EADC • 208 x GPIO
Security	<ul style="list-style-type: none"> • TrustZone & Secure Boot • Practical Hardware Security 		<ul style="list-style-type: none"> • TSI Advanced Security • TrustZone & Secure Boot <ul style="list-style-type: none"> • Temper pins 		
Display & Video	• 720P Display + H.264 Decoder	• 720P Display	<ul style="list-style-type: none"> • 1080P Display + H.264 Decoder • 2 sets of Camera Interface 		
Operating Temp. (Tj)	-40°C ~ +125°C		-40°C ~ +105°C		

MA35 Family Function Comparison

Part Number & Functions	MA35H0	MA35D0	MA35D1
Cortex-A35	x2	x2	x2
CPU Frequency	650 MHz	650 MHz	800 MHz
Real-time Processor Cortex-M4	-	-	x1
Stacked DDR Size(MB)	128	128, 256	128, 256, 512
LCD Display (RGB)	24-bit/18-bit 1280x800	24-bit/18-bit 1280x800	24-bit/18-bit 1920x1080
2D Graphic & JPEG Decoder	√	√	√
H.264 Decoder	√	-	√
CMOS Sensor Interface	-	-	2
10 / 100Mb / 1Gb Ethernet MAC	10/100M x1	10/100M x2	10/100/1000M x2
USB 2.0 HS Host	1	1	1
USB 2.0 HS Host / Device	1	1	1
UART	6	11	17
ISO-7816 (Smart Card I/F)	2	2	2
Quad SPI	1	1	2
SPI/I ² S	2	2	4
I ² S	1	1	2
I ² C	3	3	6
CAN FD	2	3	4
SDHC/SDIO/eMMC	2	2	2
TSI (Trusted Secure Island)	-	-	√
Secure Boot	√	√	√
Tamper pins	-	-	√

Part Number & Functions	MA35H0	MA35D0	MA35D1	
Crypto	PRNG 512	√	√	√
	AES 256	√	√	√
	RSA 4096	√	√	√
	ECC	√	√	√
	TRNG 128	√	√	√
	SHA 512	√	√	√
	SM 2/3/4	√	√	√
	Key Store	√	√	√
	OTP 8K-bit	√	√	√
	External Bus Interface	√	√	√
32-bit Timer	12	12	12	
Enhanced Capture (ECAP)	-	-	3	
Enhanced PWM (EPWM)	18	18	18	
Quadrature Encoder Interface (QEI)	-	-	3	
12-bit ADC channel	8	8	8	
GPIO	154	154	154/ 208	
INT	4	4	4	
Watchdog	2	2	3	
Window Watchdog	2	2	3	
RTC (VBAT 3.3V)	√	√	√	
Power Control Pin for PMIC	√	√	√	
Temperature Sensor	√	√	√	
Operating Temperature (Tj)	-40°C to 125°C	-40°C to 125°C	-40°C to 105°C	
Package	LQFP216	LQFP216	LQFP216 BGA312 BGA364	

| The Advantages of Stacking the DDR SDRAM

- Nuvoton MPU provides LQFP and BGA package parts with stacking a 128 MB to 512 MB DDR2/DDR3 SDRAM
- The advantages of stacking the DDR SDRAM:

Stacking a large DDR up to 512 MB

Easy system design and manufacturing

Lower EMI interference

Reducing the PCB layers

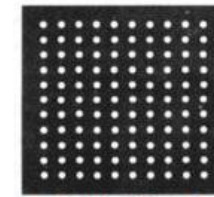
Reducing the PCB area

Saving BOM cost

Saving production cost



LQFP



BGA

**Nuvoton MPU stacking DDR SDRAM inside.
W/O External DDR SDRAM**

High-Performance with Power Efficiency

- The NuMicro MA35 Family is a multi-core microprocessor.
 - MA35D0/ MA35H0
 - Dual 64bit Cortex-A35 high-performance cores up to 650 MHz
 - MA35D1
 - Dual 64bit Cortex-A35 high-performance cores up to 800 MHz
 - One Cortex-M4 real-time processor up to 180 MHz
- Compared to Cortex-A7, Cortex-A35 has improved the overall performance 6% to 40%.
- The high-performance and real-time cores help edge data processing and enable the tiny AI/ML ability.
- For tiny AI/ML, we provide sample code in Keyword Spotting, Face Detection and People Counting



Cortex-A35 Offers more Efficiency over Cortex-A7



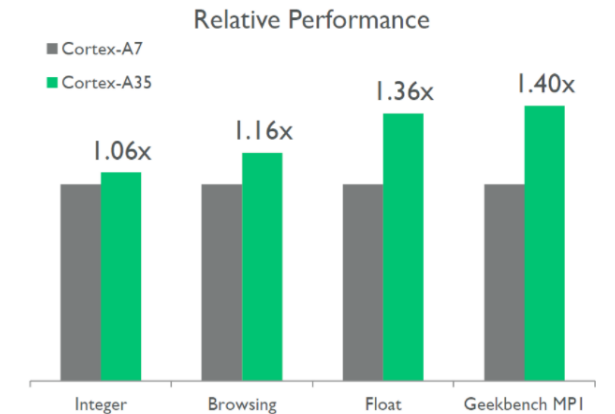
10% low power



6% to 40% performance uplift



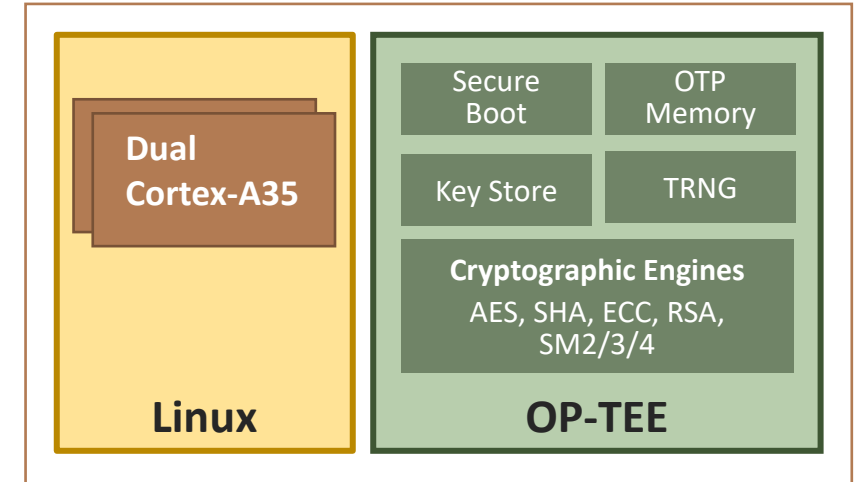
64b capable with full backwards compatibility



*Comparisons assume same process technology and implementation for both processors
*Captured from Arm Community blogs

Practical Security Features for Industrial HMI Applications

- **Root of Trust**, Internal Boot ROM with OTP key to satisfy the secure boot requirement
- **Built-in cryptographic accelerators**, Key Store, and OTP memory
- The secure environment and features **realize the Protection, Detection, and Recovery** for IoT products.
- Easily established
 - **Execution Security**
 - Trust Firmware–A , OP-TEE, Secure boot
 - **Communication Security**
 - Hardware cryptographic accelerators
 - **Chip-level Storage Security**
 - Key Store and OTP memory, accessed by the cryptographic engines, without the need of CPU access



The MA35H0 is a trusted system for Industrial HMI required security

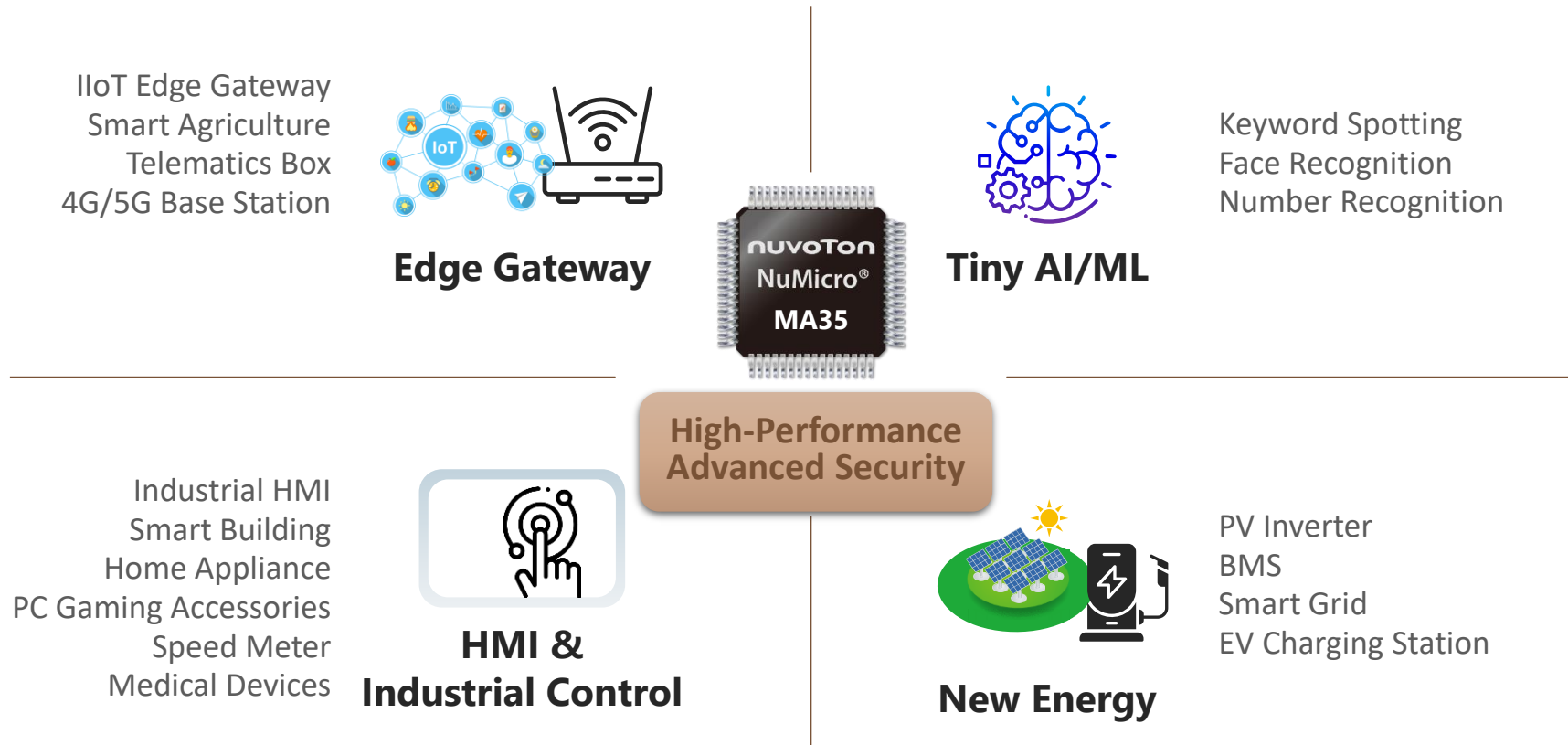
The Graphics and Video Acceleration for Industrial HMI

- For better user experience in graphics HMI, integrates an LCD display I/F, resolution up to 1280 x 800 at 60 FPS and with the features
 - Hardware cursor
 - On Screen Display (OSD)
- For increasing graphics performance, integrates the 2D graphics engine and with the features
 - BitBlt
 - Rotation
 - Multi-source Alpha Blending
 - Color Format Converting
- Supports video playback by hardware JPEG and H.264 decoder
- Supports 4/5-wire resistive touch without an external IC

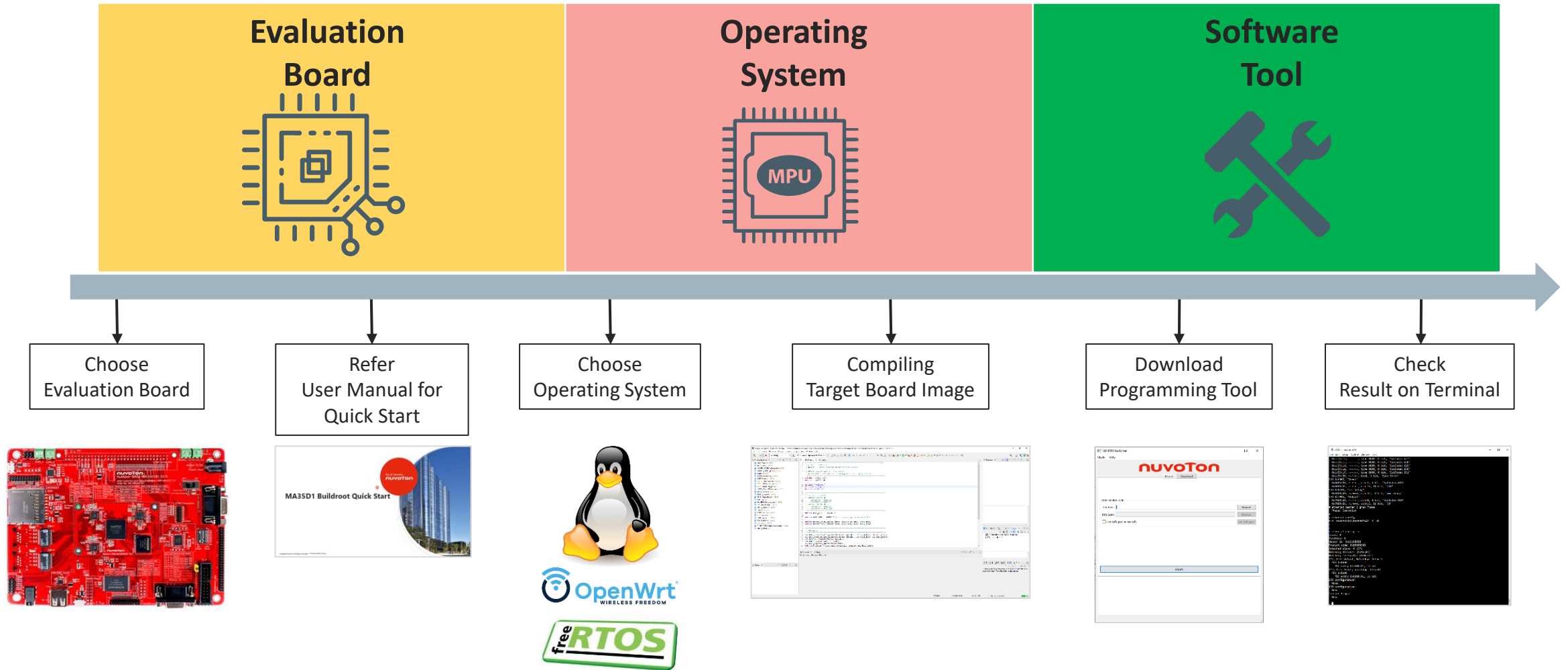


The MA35H0 provides more effective GUIs in high-resolution display

NuMicro[®] MA35 Family Targets Applications


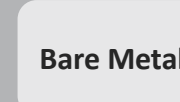
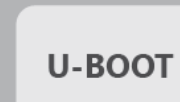


| Get Started with the NuMicro[®] MPU Platform

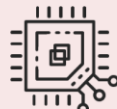
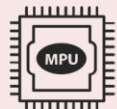




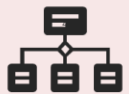



Rich MA35 Family Design Resource

Development Ecosystem for MPU

Graphics Library			
OS			
Linux Development Environment			

Nuvoton Webpage – MA35 Family Design Resource

Evaluation Board 	<ul style="list-style-type: none"> NuMaker-IoT-MA35D1-A1 <ul style="list-style-type: none"> User Manual Default Image NuMaker-HMI-MA35D1-S1 <ul style="list-style-type: none"> User Manual Default Image 	Operating System 	<ul style="list-style-type: none"> Linux <ul style="list-style-type: none"> Buildroot / Quick Start Yocto / Quick Start OpenWrt / README.md RTOS <ul style="list-style-type: none"> FreeRTOS RT-Thread
Expressway 	<ul style="list-style-type: none"> VMware Image RTP M4 Development Slide 	Hardware Reference 	<ul style="list-style-type: none"> Schematic, PCB, Gerber File & BOM Approved Vendor List Hardware Development Guide
Software & Debugging Tools 	<ul style="list-style-type: none"> Programming <ul style="list-style-type: none"> NuWriter SWriter NuLink2-Pro (Debug RTP) Pin Configure High-Speed IP Calibration 	Repository / Sample Code 	<ul style="list-style-type: none"> Nuvoton GitHub Nuvoton Gitee Sample code <ul style="list-style-type: none"> Example Code Linux Applications
Technical Documents 	<ul style="list-style-type: none"> Document Application Note User Manual 	Support 	<ul style="list-style-type: none"> Forum <ul style="list-style-type: none"> NuForum 牛臥堂 Sales and Agent Support Video Resource <ul style="list-style-type: none"> Youtube & Bilibili

| Contact Us

- MA35 Family Product Information
<https://www.nuvoton.com/products/microprocessors/arm-cortex-a35-mpus/>
- Sales Support Mail for Business Support
salesupport@nuvoton.com
- Nuvoton NuForum for Technical Support
<http://forum.nuvoton.com/>



Joy of innovation
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谢谢

謝謝

Děkuji

Bedankt

Thank you

Kiitos

Merci

Danke

Grazie

ありがとう

감사합니다

Dziękujemy

Obrigado

Спасибо

Gracias

Teşekkür ederim

Cảm ơn