Nuvoton Technology Introduction
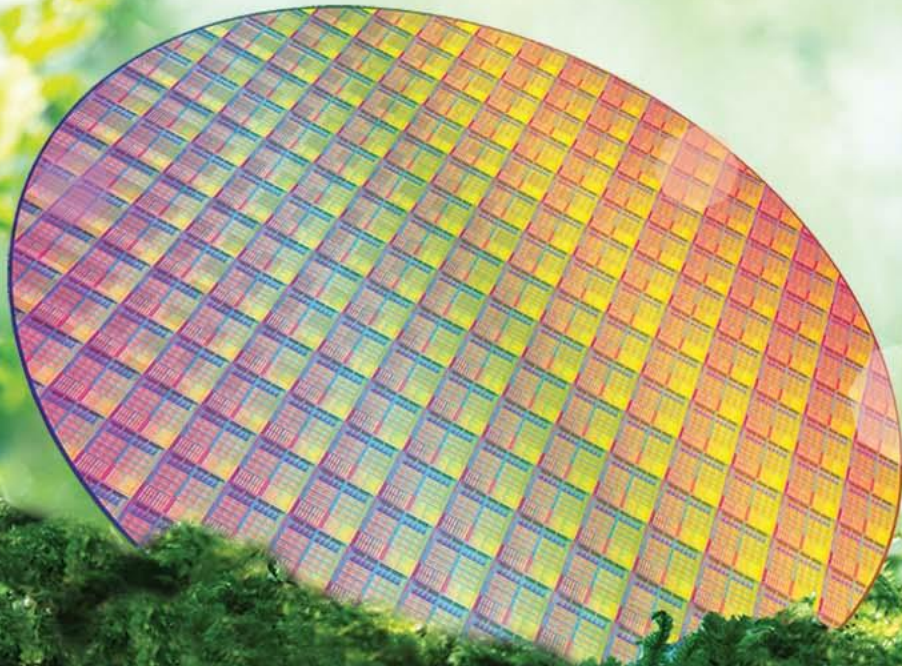
19th Nov, 2023

Vision Statement

以綠色半導體技術豐富人類生活的隱形冠軍

Be a hidden champion in providing sustainable semiconductors to enrich human life.

Nuvoton at a Glance

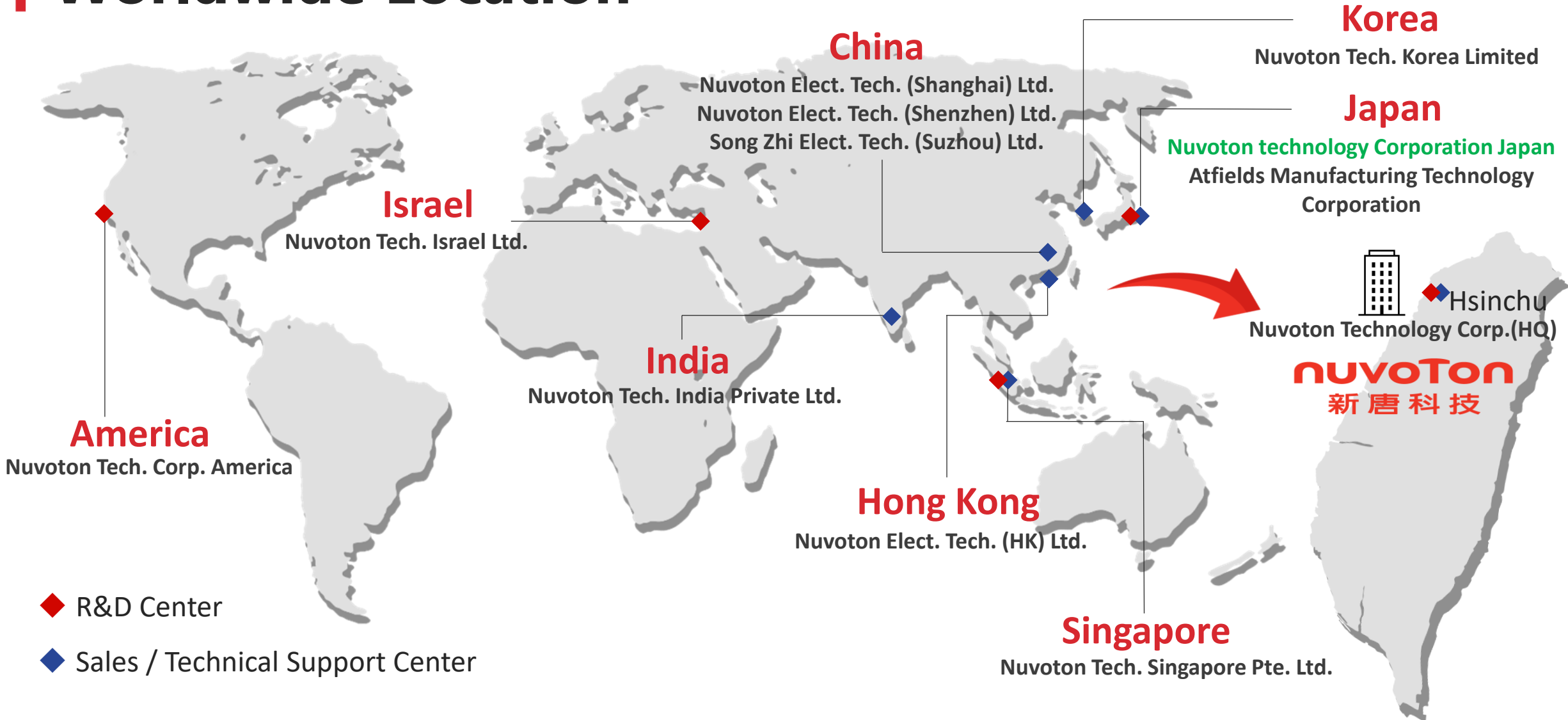|	
Number of employees	**Over 4,200 worldwide**
Capital	**NT$4,198 million**
Date of Establishment	**2008/7/1**
Date of IPO	**2010/9/27 (TSE:4919)**
Chairman	**Yuan-Mou Su**
President	**Hsin-Lung Yang**
Headquarters	**Hsinchu Science Park, Taiwan**
Main Shareholder	**Winbond holds 51.2% share**

Zhubei Building*

Headquarters

*Photo by Jeffrey Cheng

NuDeveloper Ecosystem – Make the engineers' job easier.

Worldwide Location

China
Nuvoton Elect. Tech. (Shanghai) Ltd.
Nuvoton Elect. Tech. (Shenzhen) Ltd.
Song Zhi Elect. Tech. (Suzhou) Ltd.

Korea
Nuvoton Tech. Korea Limited

Japan
Nuvoton technology Corporation Japan
Atfields Manufacturing Technology
Corporation

Israel
Nuvoton Tech. Israel Ltd.

Hsinchu
Nuvoton Technology Corp.(HQ)

America
Nuvoton Tech. Corp. America

India
Nuvoton Tech. India Private Ltd.

Hong Kong
Nuvoton Elect. Tech. (HK) Ltd.

Singapore
Nuvoton Tech. Singapore Pte. Ltd.

◆ R&D Center

◆ Sales / Technical Support Center

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新唐科技

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Business Groups

Microcontroller

MCU and MPU Platform
- NuMicro® MCU
- NuMicro® MPU
- NuMicro® IoT Platform

Core Technology
- Low Power with Analog Integration
- IoT Security
- Eco-system Platform

Smart Home Audio

Audio MCU and Component
- Audio MCU / DSP with Audio Enhancement
- Audio Component (Smart AMP, CODEC)
- NuSpeech / NuVoice / ChipCorder

Core Technology
- Low-power Mixed Mode Design
- Smart Home / AIoT

Cloud Security

Computing Security
- Secure Embedded Controller and Super I/O
- Trust Platform Module (TPM)
- Server Baseboard Management Controller (BMC)

Core Technology
- Security
- System Integration / Protection
- Mixed Mode ASIC

Foundry

Foundry Service
- 30 years of operations
- Highly efficient fab focused on high voltage and customized power process

Core Technology
- BCD Process
- UHV Process
- HVIC Process

Component

Power Component
- CSP MOSFET
- RF-GaN

Core Technology
- Ultra Low Impedance
- Small Size
- High Efficiency

Visual Sensing

Spatial Sensing Solution
- Image Sensor (3D TOF)
- DSP (HMI Display, Audio)

Core Technology
- High Quality Image, Depth and Sound
- Enhanced Graphic Processing
- Software Platform

Battery and Analog Solutions

Analog IC's for Battery / Power Application
- Battery Monitoring IC
- Motor Driver IC

Core Technology
- Analog Design
- SOI (Silicon on Insulator) Process

IoT with Security

MCU and Communication / Interface IC's
- Motor & Power Control MCU
- High Speed IF
- NFC Tag IC

Core Technology
- Low Power, Security
- High Speed Analog
- System Knowledge

Laser & GaN Technology

Laser & GaN Component
- High Power Laser Diode
- GaN Foundry

Core Technology
- High Power and High Reliability Laser Diode
- Epitaxial and full process service for GaN Power device

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NuMicro® MCU Platform

Power electronics control MCU series

KM1M4/7 series

IoT with Security Business Group
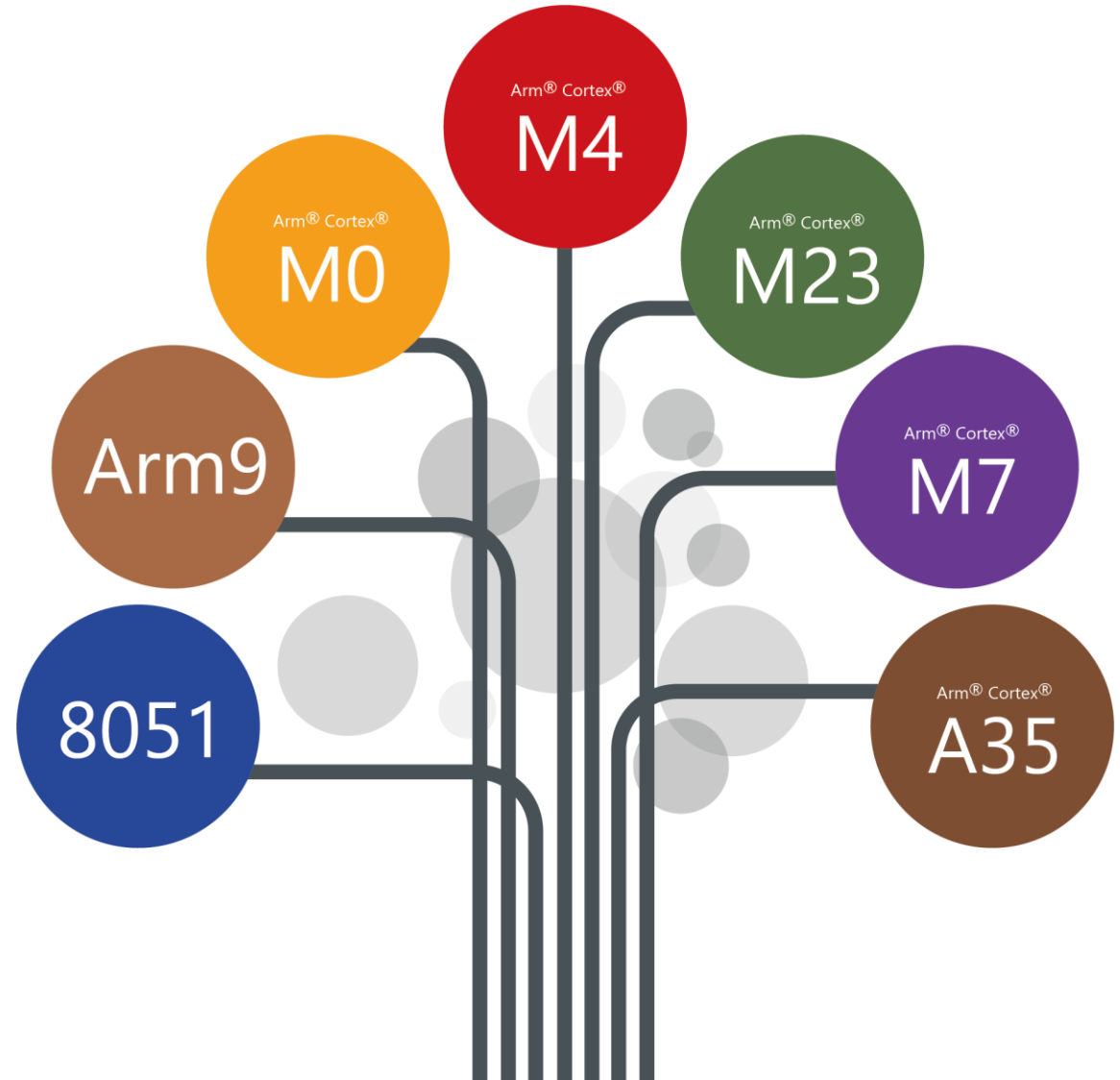
19th Nov, 2023

Joy of innovation
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NuMicro® MCU Cores

Cortex® A35
Industrial Control & HMI
Machine Learning
Edge Gateway
New Energy
AIoT

Cortex® M7
IoT Security
Low Power

Cortex® M23
IoT Security
Low Power

Cortex® M4
High Performance
Security
IoT

Cortex® M0
Comprehensive Platform
Industrial Control
Automotive

Arm 9™
Industrial Control
HMI
IoT

8051
Low Power
Industrial Control

Arm® Cortex® M4

Arm® Cortex® M0

Arm® Cortex® M23

Arm® Cortex® M7

Arm9

8051

Arm® Cortex® A35

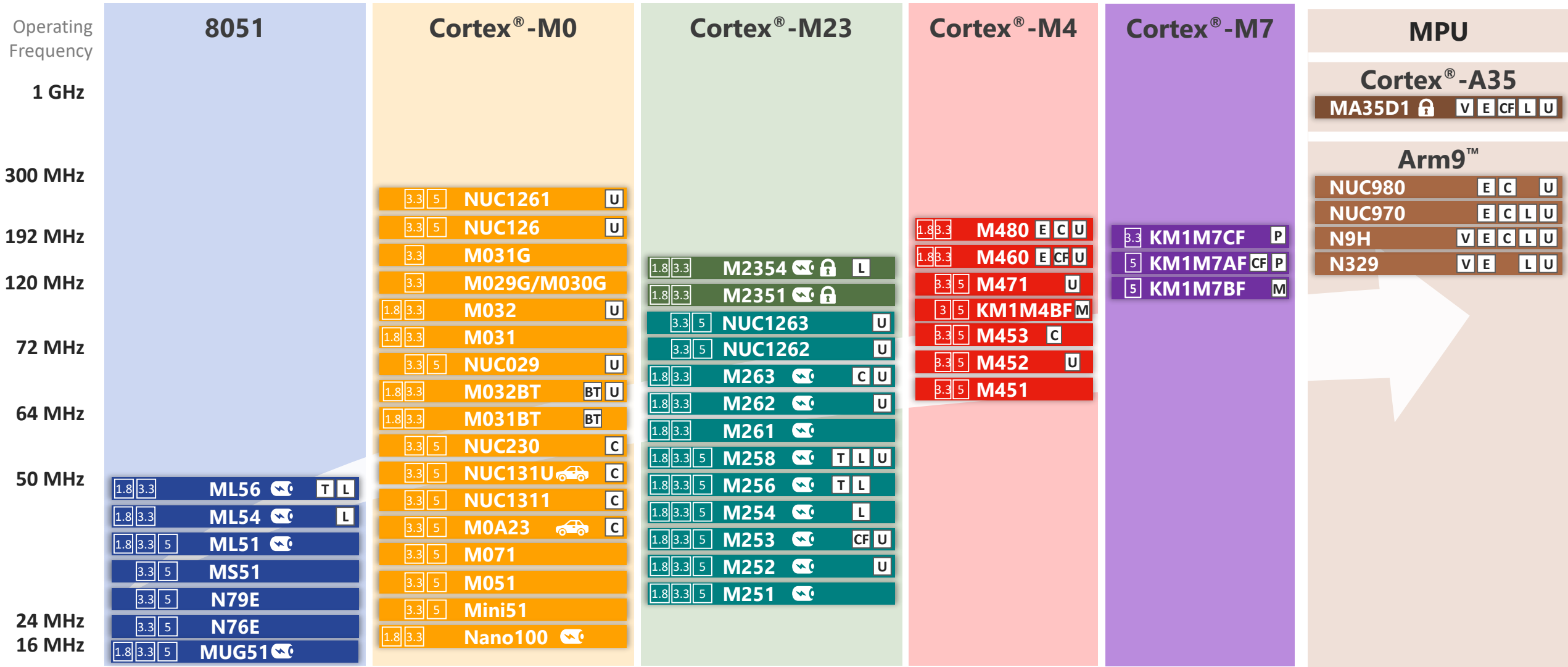NuDeveloper Ecosystem – Make the engineers' job easier.

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NuMicro® Ecosystem
Microcontroller Platform

M Motor P Power

Feature U USB C CAN CF CAN FD E Ethernet L LCD T Touch Key BT Bluetooth V Video Codec

🔋 Low Power 🔒 TrustZone 🚗 AEC-Q100 **Operating Voltage** 1.8 1.8V 3.3 3.3V 5 5V

Operating Frequency	8051	Cortex®-M0	Cortex®-M23	Cortex®-M4	Cortex®-M7	MPU

MPU

Cortex®-A35
MA35D1 🔒 V E CF L U

Arm9™
NUC980 E C U
NUC970 E C L U
N9H V E C L U
N329 V E L U

Cortex®-M0
- 3.3 5 NUC1261 U
- 3.3 5 NUC126 U
- 3.3 M031G
- 3.3 M029G/M030G
- 1.8 3.3 M032 U
- 1.8 3.3 M031
- 3.3 5 NUC029 U
- 1.8 3.3 M032BT BT U
- 1.8 3.3 M031BT BT
- 3.3 5 NUC230 C
- 3.3 5 NUC131U 🚗 C
- 3.3 5 NUC1311 C
- 3.3 5 M0A23 🚗 C
- 3.3 5 M071
- 3.3 5 M051
- 3.3 5 Mini51
- 1.8 3.3 Nano100 🔋

Cortex®-M23
- 1.8 3.3 M2354 🔋 🔒 L
- 1.8 3.3 M2351 🔋 🔒
- 3.3 5 NUC1263 U
- 3.3 5 NUC1262 U
- 1.8 3.3 M263 🔋 C U
- 1.8 3.3 M262 🔋 U
- 1.8 3.3 M261 🔋
- 1.8 3.3 5 M258 🔋 T L U
- 1.8 3.3 5 M256 🔋 T L
- 1.8 3.3 5 M254 🔋 L
- 1.8 3.3 5 M253 🔋 CF U
- 1.8 3.3 5 M252 🔋 U
- 1.8 3.3 5 M251 🔋

Cortex®-M4
- 1.8 3.3 M480 E C U
- 1.8 3.3 M460 E CF U
- 3.3 5 M471 U
- 3 5 KM1M4BF M
- 3.3 5 M453 C
- 3.3 5 M452 U
- 3.3 5 M451

Cortex®-M7
- 3.3 KM1M7CF P
- 5 KM1M7AF CF P
- 5 KM1M7BF M

8051
- 1.8 3.3 ML56 🔋 T L
- 1.8 3.3 ML54 🔋 L
- 1.8 3.3 5 ML51 🔋
- 3.3 5 MS51
- 3.3 5 N79E
- 3.3 5 N76E
- 1.8 3.3 5 MUG51 🔋

Operating Frequency scale:
1 GHz, 300 MHz, 192 MHz, 120 MHz, 72 MHz, 64 MHz, 50 MHz, 24 MHz, 16 MHz

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| Product Information / Documents / Selection | • **Social Media & Knowledge Base**: LinkedIn / Facebook / Twitter / WeChat
• **Video Platform**: YouTube / bilibili
• **Open Resource**: Github / Gitlab / Gitee | • Nuvoton Direct
• Tmall
• TechDesign
• DigiKey |

Digital Platform

Development Platform

arm KEIL • **IAR Embedded Workbench** • NuEclipse

IDE

Nu-Link2-Pro/Nu-Link2-Me
Nu-Link-Gang

Debugger & Programmer

NuMaker Series /

Evaluation Board

MCU BSP (API Compatible) /
Linux BSP/ Peripheral Driver
/ Library / Rich Sample Code
Third party resource

BSP & Example Code

CodeGenerator
PinView / PinConfig
/ ClockConfig
/ ICP/ISP Programming
/ Nu-Link Command
/ USB to Serial Port / Motor
parameter identification tool

Software Tool(NuTool)

Platform

HMI Platform
AppWizard · SEGGER The Embedded Experts
SQUARELINE · LVGL
Qt

IoT Device and Gateway
arm PELION · amazon webservices · Alibaba Cloud · Microsoft Azure · Allxon
arm MBED · AliOS · Azure RTOS · RT-Thread · RTOS · Linux · OpenWrt
WiFi · LTE · NB-IoT · LoRa · Bluetooth

DALI 2 Solutions
Supports all control gear and control/ input device certified library protocol.

102	103
202	303
206	304
207	
208	
209	

Reference Design Platform

| BMS | LCD Touch Key | Cold Chain | Thermostat | Motor Kit |
| Lighting Control | HDMI2.1 | USB Type-C PD3.1 | AR & VR | Digital Power |

8051 / M0 / M23 / M4 / M7 / Arm9 / A35 based Microcontroller

NuMicro® Microcontroller Platform

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NuMicro® Presence in 60 Countries

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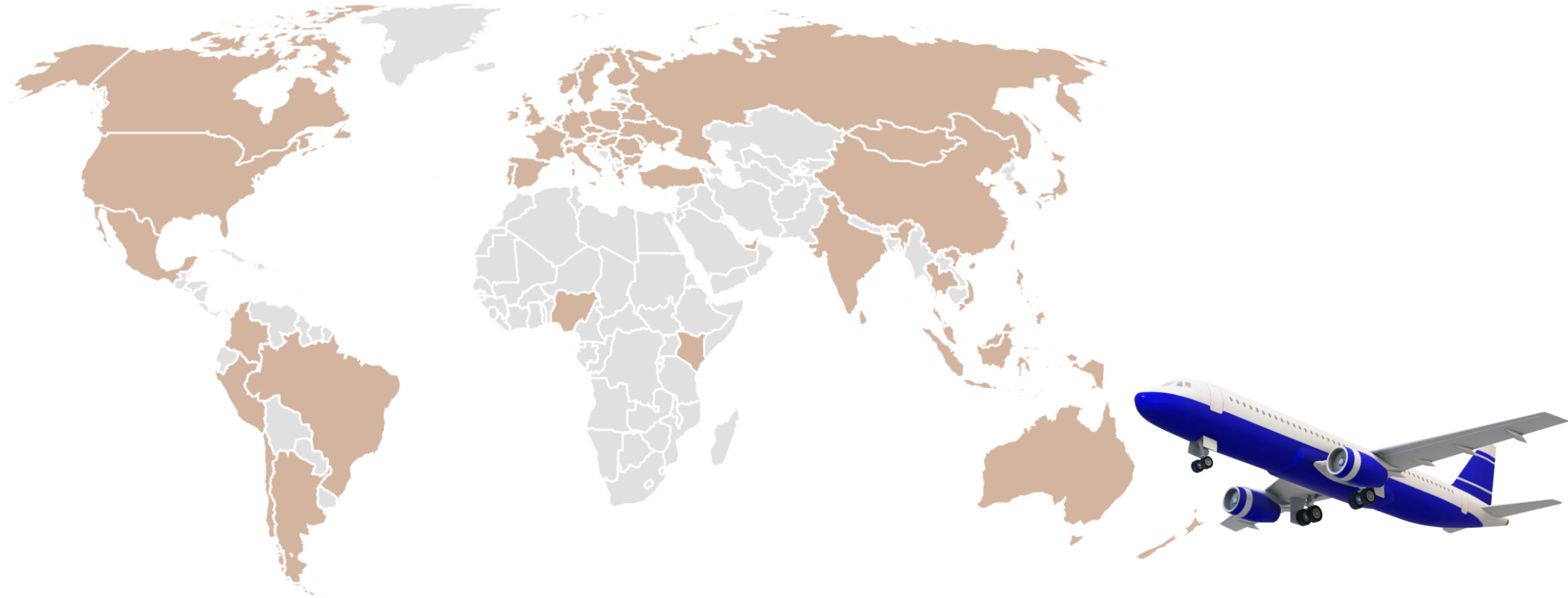
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Why Nuvoton?

Security
Integral Security Solution

Brand
Nuvoton – A leading microcontroller provider

Immunity
4.4 kV EFT, 8 kV ESD

Scalability
8051 ➟ M0 ➟ M23 ➟ M4 ➟ M7 ➟ Arm9 ➟ A35

Rich Development Platform
Evaluation Board / NuTool

Longevity
Over 10 years

Multiple IDE
KEIL, IAR, NuEclipse

Technology
>30 years of experience

Technical Support
Local & Taiwan HQ

Availability
Standard lead time

nuvoTon Microcontroller

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NuMicro® Ecosystem
NTCJ MCU Platform

M Motor P Power

Feature U USB C CAN CF CAN FD E Ethernet L LCD T Touch Key BT Bluetooth V Video Codec

🔋 Low Power   🔒 TrustZone   🚗 AEC-Q100   **Operating Voltage** 1.8 1.8V 3.3 3.3V 5 5V

Operating Frequency	8051	Cortex®-M0	Cortex®-M23	Cortex®-M4	Cortex®-M7	MPU

Cortex®-A35
1 GHz — MA35D1 🔒 V E CF L U

Arm9™

300 MHz
- NUC980 E C U
- NUC970 E C L U
- N9H V E C L U
- N329 V E L U

Cortex®-M0
- 3.3 5 NUC1261 U
- 3.3 5 NUC126 U
- 3.3 M031G
- 3.3 M029G/M030G
- 1.8 3.3 M032 U
- 1.8 3.3 M031
- 3.3 5 NUC029 U
- 1.8 3.3 M032BT BT U
- 1.8 3.3 M031BT BT
- 3.3 5 NUC230 C
- 3.3 5 NUC131U 🚗 C
- 3.3 5 NUC1311 C
- 3.3 5 M0A23 🚗 C
- 3.3 5 M071
- 3.3 5 M051
- 3.3 5 Mini51
- 1.8 3.3 Nano100 🔋

Cortex®-M23
- 1.8 3.3 M2354 🔋🔒 L
- 1.8 3.3 M2351 🔋🔒
- 3.3 5 NUC1263 U
- 3.3 5 NUC1262 U
- 1.8 3.3 M263 🔋 C U
- 1.8 3.3 M262 🔋 U
- 1.8 3.3 M261 🔋
- 1.8 3.3 5 M258 🔋 T L U
- 1.8 3.3 5 M256 🔋 T L
- 1.8 3.3 5 M254 🔋 L
- 1.8 3.3 5 M253 🔋 CF U
- 1.8 3.3 5 M252 🔋 U
- 1.8 3.3 5 M251 🔋

Cortex®-M4
- 1.8 3.3 M480 E C U
- 1.8 3.3 M460 E CF U
- 3.3 5 M471 U
- 3 5 KM1M4BF M
- 3 5 KM103HFD M
- 3 5 KM103HFB M
- 3.3 5 M453 C
- 3.3 5 M452 U
- 3.3 5 M451

Cortex®-M7
- 3.3 KM1M7CF CF P
- 5 KM1M7AF CF P
- 5 KM1M7BF M

8051
- 1.8 3.3 ML56 🔋 T L
- 1.8 3.3 ML54 🔋 L
- 1.8 3.3 5 ML51 🔋
- 3.3 5 MS51
- 3.3 5 N79E
- 3.3 5 N76E
- 1.8 3.3 5 MUG51 🔋

192 MHz
120 MHz
72 MHz
64 MHz
50 MHz
24 MHz
16 MHz

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NuMicro® Ecosystem

Microcontroller Platform

Feature | U USB | C CAN | CF CAN FD | E Ethernet | L LCD | T Touch Key | BT Bluetooth | V Video Codec | M Motor | P Power

Low Power | TrustZone | AEC-Q100 | **Operating Voltage** | 1.8 1.8V | 3.3 3.3V | 5 5V

Operating Frequency	8051	Cortex®-M0	Cortex®-M23	Cortex®-M4	Cortex®-M7	MPU

Cortex®-A35
MA35D1 🔒 V E CF L U — 800 MHz

Arm9™
NUC980 E C U
NUC970 E C L U
N9H V E C L U
N329 V E L U

Cortex®-M0:
- 3.3 5 NUC1261 U — 300 MHz
- 3.3 5 NUC126 U
- 3.3 M031G — 192 MHz
- 3.3 M029G/M030G — 120 MHz
- 1.8 3.3 M032 U
- 1.8 3.3 M031 — 72 MHz
- 3.3 5 NUC029 U
- 1.8 3.3 M032BT BT U
- 1.8 3.3 M031BT BT — 64 MHz
- 3.3 5 NUC230 C
- 3.3 5 NUC131U 🚗 C — 50 MHz
- 3.3 5 NUC1311 C
- 3.3 5 M0A23 🚗 C
- 3.3 5 M071
- 3.3 5 M051
- 3.3 5 Mini51 — 24 MHz
- 1.8 3.3 Nano100 — 16 MHz

Cortex®-M23:
- 1.8 3.3 M2354 🔒 L
- 1.8 3.3 M2351 🔒 — 120 MHz
- 3.3 5 NUC1263 U
- 3.3 5 NUC1262 U
- 1.8 3.3 M263 C U — 72 MHz
- 1.8 3.3 M262 U — 64 MHz
- 1.8 3.3 M261
- 1.8 3.3 5 M258 T L U
- 1.8 3.3 5 M256 T L — 50 MHz
- 1.8 3.3 5 M254 L
- 1.8 3.3 5 M253 CF U
- 1.8 3.3 5 M252 U — 24 MHz
- 1.8 3.3 5 M251

Cortex®-M4:
- 1.8 3.3 M480 E C U — 192 MHz
- 1.8 3.3 M460 E CF U
- 3.3 5 M471 U — 120 MHz
- 3 5 **KM1M4BF** M
- 3.3 5 M453 C — 72 MHz
- 3.3 5 M452 U
- 3.3 5 M451

Cortex®-M7:
- 3.3 KM1M7CF CF P — 192 MHz
- 5 KM1M7AF CF P
- 5 KM1M7BF M — 120 MHz

8051:
- 1.8 3.3 ML56 T L — 50 MHz
- 1.8 3.3 ML54 L
- 1.8 3.3 5 ML51
- 3.3 5 MS51
- 3.3 5 N79E
- 3.3 5 N76E — 24 MHz
- 1.8 3.3 5 MUG51 — 16 MHz

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KM1M4BF Series MCU

Flash Memory/
SRAM (Kbytes)

264 / 16		KM1M4BF54K	KM1M4BF53K	KM1M4BF52K
136 / 16	KM1M4BF05G	KM1M4BF54G	KM1M4BF53G	KM1M4BF52G

LQFP48 (7 x 7 mm) Pitch 0.5 mm	LQFP64 (10 x 10 mm) Pitch 0.5 mm	LQFP80 (12 x 12 mm) Pitch 0.5 mm	LQFP100 (14 x 14 mm) Pitch 0.5 mm

Package

- **Arm® Cortex®-M4F core**
- **Runs up to 120 MHz**
- **Operating voltage:** 2.9V ~ 5.5V

Features:

- Motor & PFC (power factor correction) control
  - Synchronous control ADC
  - Duty adjustment
  - Dead time auto-adjustment
- High speed ADC (2 Msps)
- Build-in differential variable gain amplifier & window comparator
- Read While Write (RWW) on Flash
- Safety functions
  - Memory ECC
  - Clock error detection
  - ADC failure diagnosis
  - Power supply voltage detection

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KM1M4BF Series Features
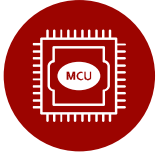
System

- Arm® Cortex®-M4F core
- Runs up to 120 MHz
- Up to 264 KB Flash Memory for instruction
- Up to 32 KB Flash Memory for data
- Up to 16 KB SRAM
- Operating voltage: 2.9V ~ 5.5V
- Operating temperature: Tc= -40°C ~ +110°C
- 8-channel PDMA
- ESD HBM 2kV
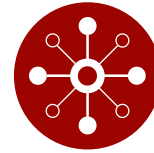
Peripherals

- 8 sets of motor & power control PWM
  - Complementary PWM output
  - Dead time insert, Output shift
  - Duty cut, period cut
  - Synchronous ADC trigger
- 14 sets of 16-bit timer
- Up to 7 sets of UART
- Up to 7 sets of I^{2}C
- Up to 7 sets of SPI
- Up to 85 GPIO (LQFP100)
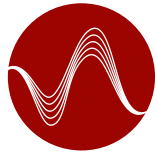
Analog

- 3 sets of 12-bit 2 Msps ADC, up to 23-channel
- 6 sets of 8-bit DAC
- 1 set of 10-bit DAC
- 2 sets of differential variable gain amplifier (VGA)
- 4 sets of comparator

Security

- Memory ECC
- Memory protection
- Clock monitoring
- ADC error detection
- Power supply voltage detection

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Air Conditioner

Features

- Control up to 2 motors & PFC (power factor correction) simultaneously
- No need for PFC IC, cost-effective
- Motor parameter identification tool
- Model based design support (simulation tool)
- Reference system (Motor Kit) for high voltage motor control (AV 100V/220V input) and low voltage motor control (DC 24V/48V input)

Application

- BLDC motor control applications
  Air conditioner, Heat pump, Washing machine, Refrigerator, Dishwasher, e-Bike, Electric tool, etc.

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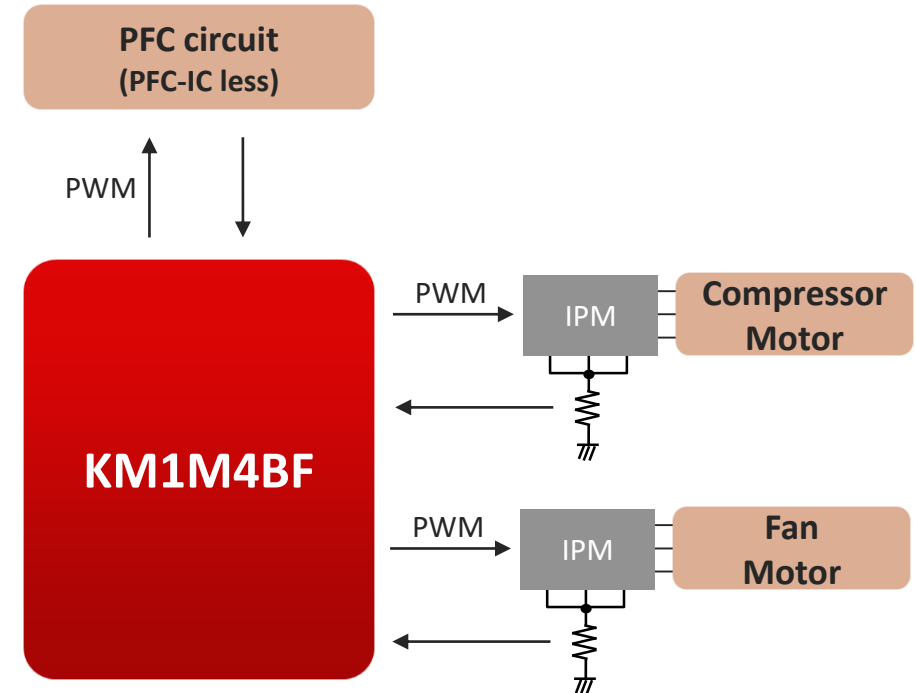
PSG – KM1M4BF Series MCU

| Part No. | Core speed (MHz) | Flash (KB) | SRAM (KB) | Data Flash | I/O | Timer (16-bit) | Power control PWM | Connectivity | | | | ADC(12-bit) | | DAC (8-bit) | DAC (10-bit) | Comparator | VGA | Flash/SRAM ECC | CRC | Package |
								Clock synchronous	UART	SPI	I²C	Channel	Unit							
KM1M4BF05G	120	136	16	8	37	14	8	4	4	4	4	10	3	6	1	4	2	v	v	LQFP48 (7x7)
KM1M4BF54G	120	136	16	8	51	14	8	7	7	7	7	13	3	6	1	4	2	v	v	LQFP64 (10x10)
KM1M4BF54K	120	264	16	32	51	14	8	7	7	7	7	13	3	6	1	4	2	v	v	LQFP64 (10x10)
KM1M4BF53G	120	136	16	8	65	14	8	7	7	7	7	18	3	6	1	4	2	v	v	LQFP80 (12x12)
KM1M4BF53K	120	264	16	32	65	14	8	7	7	7	7	18	3	6	1	4	2	v	v	LQFP80 (12x12)
KM1M4BF52G	120	136	16	8	85	14	8	7	7	7	7	23	3	6	1	4	2	v	v	LQFP100 (14x14)
KM1M4BF52K	120	264	16	32	85	14	8	7	7	7	7	23	3	6	1	4	2	v	v	LQFP100 (14x14)

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NuMicro® Ecosystem

Microcontroller Platform

Feature | U USB | C CAN | CF CAN FD | E Ethernet | L LCD | T Touch Key | BT Bluetooth | V Video Codec | M Motor | P Power

Low Power | TrustZone | AEC-Q100 | **Operating Voltage** | 1.8 1.8V | 3.3 3.3V | 5 5V

Operating Frequency	8051	Cortex®-M0	Cortex®-M23	Cortex®-M4	Cortex®-M7	MPU

Cortex®-A35
MA35D1 🔒 V E CF L U — 800 MHz

Arm9™

Frequency	Cortex-M0	Cortex-M23	Cortex-M4	Cortex-M7	MPU
300 MHz					NUC980 E C U / NUC970 E C L U
	3.3 5 NUC1261 U			3.3 KM1M7CF CF P	N9H V E C L U
192 MHz	3.3 5 NUC126 U		1.8 3.3 M480 E C U	5 KM1M7AF CF P	N329 V E L U
	3.3 M031G		1.8 3.3 M460 E CF U	5 KM1M7BF M	
120 MHz	3.3 M029G/M030G	1.8 3.3 M2354 🔒 L	3.3 5 M471 U		
	1.8 3.3 M032 U	1.8 3.3 M2351 🔒	3 5 KM1M4BF M		
72 MHz	1.8 3.3 M031	3.3 5 NUC1263 U	3.3 5 M453 C		
	3.3 5 NUC029 U	3.3 5 NUC1262 U	3.3 5 M452 U		
	1.8 3.3 M032BT BT U	1.8 3.3 M263 C U	3.3 5 M451		
64 MHz	1.8 3.3 M031BT BT	1.8 3.3 M262 U			
	3.3 5 NUC230 C	1.8 3.3 M261			
	3.3 5 NUC131U C	1.8 3.3 5 M258 T L U			
50 MHz	3.3 5 NUC1311 C	1.8 3.3 5 M256 T L			
	3.3 5 M0A23 C	1.8 3.3 5 M254 L			
1.8 3.3 ML56 T L	3.3 5 M071	1.8 3.3 5 M253 CF U			
1.8 3.3 ML54 L	3.3 5 M051	1.8 3.3 5 M252 U			
1.8 3.3 5 ML51	3.3 5 Mini51	1.8 3.3 5 M251			
3.3 5 MS51					
24 MHz 3.3 5 N79E	3.3 Nano100				
3.3 5 N76E					
16 MHz 1.8 3.3 5 MUG51					

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KM1M7AF/KM1M7BF Series MCU

Flash Memory/ SRAM (Kbytes)

	HQFP100	HQFP144
512 / 64	KM1M7AF02N KM1M7AF12N KM1M7AF52N KM1M7AF62N KM1M7BF02N	KM1M7AF00N KM1M7AF10N KM1M7AF50N KM1M7AF60N KM1M7BF00N
384 / 48	KM1M7AF02M KM1M7AF12M KM1M7AF52M KM1M7AF62M KM1M7BF02M	KM1M7AF00M KM1M7AF10M KM1M7AF50M KM1M7AF60M KM1M7BF00M
256 / 32	KM1M7AF02K KM1M7AF12K KM1M7AF52K KM1M7AF62K KM1M7BF02K	KM1M7AF00K KM1M7AF10K KM1M7AF50K KM1M7AF60K KM1M7BF00K
Package	HQFP100 (14 x 14 mm) Pitch 0.5 mm	HQFP144 (20 x 20 mm) Pitch 0.5 mm

	KM1M7AF	KM1MBAF
CAN FD	✓	
High resolution PWM	✓	

- **Arm® Cortex®-M7 core**
- **Runs up to 160 MHz**
- **Operating voltage:** 3.5V ~ 5.5V

Features:

- Converter & Inverter control (KM1M7AF series) : High resolution PWM, Synchronous control ADC, Duty cut / Period cut function
- Motor & PFC control (KM1M7BF series) : Synchronous control ADC, Duty adjustment, Dead time auto-adjustment
- High speed ADC (2 Msps)
- CAN FD (KM1M7AF5/6)
- Build-in differential variable gain amplifier (KM1M7AF0/1, KM1M7BF series)
- Read While Write (RWW) on Flash
- Safety functions
  - Memory ECC
  - Clock error detection
  - ADC failure diagnosis
  - Power supply voltage detection

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KM1M7AF/KM1M7BF Series Features
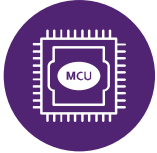
System

- Arm® Cortex®-M7 core
- Runs up to 160 MHz
- Up to 512 KB Flash Memory for instruction
- Up to 64 KB Flash Memory for data
- Up to 64 KB SRAM
- Operating voltage: 3.5V ~ 5.5V
- Operating temperature: Tc=-40°C ~ +110°C
- 16-channel PDMA
- ESD HBM 2kV

Analog

- 3 sets of 12-bit 2 Msps ADC, up to 32-channel
- Up to 15 sets of 8-bit DAC
- Up to 2 sets of 10-bit DAC
- 5 sets of differential variable gain amplifier (KM1M7AF0/1, KM1M7BF series)
- 5-channel comparator

Peripherals

- Up to 12 sets of motor & power control PWM
  - Complementary PWM output
  - Dead time insert, Output shift
  - Duty cut, period cut
  - Synchronous ADC trigger
- 2 sets of CAN FD (KM1M7AF5/6)
- 1 set of SM Bus (LQFP 128/144)
- Up to 20 sets of 16-bit timer
- Up to 7 sets of UART
- 1 set of I^{2}C
- Up to 3 sets of SPI
- Up to 123 GPIO (LQFP144)

Security

- Memory ECC
- Memory protection
- Clock monitoring
- ADC error detection
- Power supply voltage detection

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Power Supply

Features

- Control primary PFC (AC/DC) & secondary LLC (DC/DC) with one MCU
- No need for PFC IC, cost-effective
- High speed and high accurate feedback control with high speed ADC (2 Msps) and high resolution PWM (208 ps)
- Model based design support (simulation tool)
- Reference system for totem pole PFC with high efficiency over 99%.
- Reference system for matrix converter with high power density
- Noise suppression

Application

- Digital power control applications
  Power supply unit, Power storage, Power conditioner, High speed EV charger, Base station, etc.

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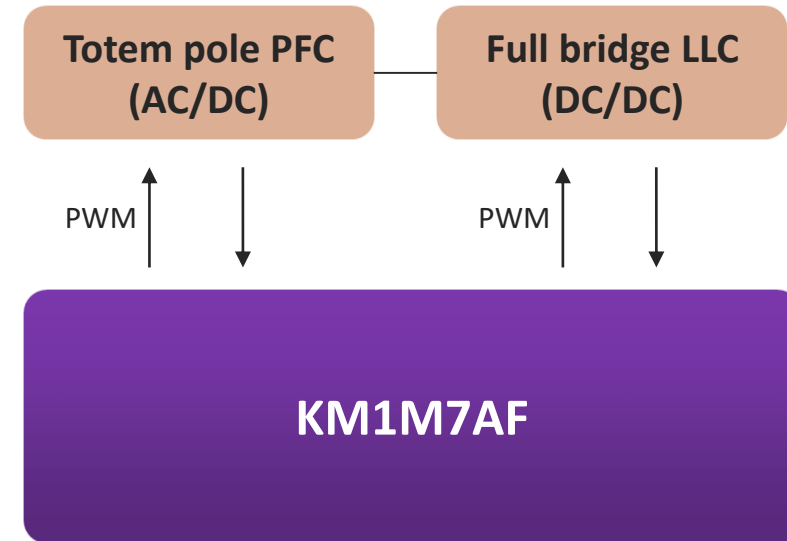
Heat Pump

Features

- Control up to 2 motors & 3 phase interleave PFC (power factor correction) simultaneously

- No need for PFC IC, cost-effective

- Motor parameter identification tool

- Model based design support (simulation tool)

- Reference system (Motor Kit) for high voltage motor control with 3 phase interleave PFC (AV 220V input)

Application

- BLDC motor control applications
  Heat pump, Commercial air conditioner, Washing machine, etc.

3 phase interleave PFC circuit (PFC-IC less)

PWM

KM1M7BF

PWM → IPM — **Compressor Motor**

PWM → IPM — **Fan Motor**

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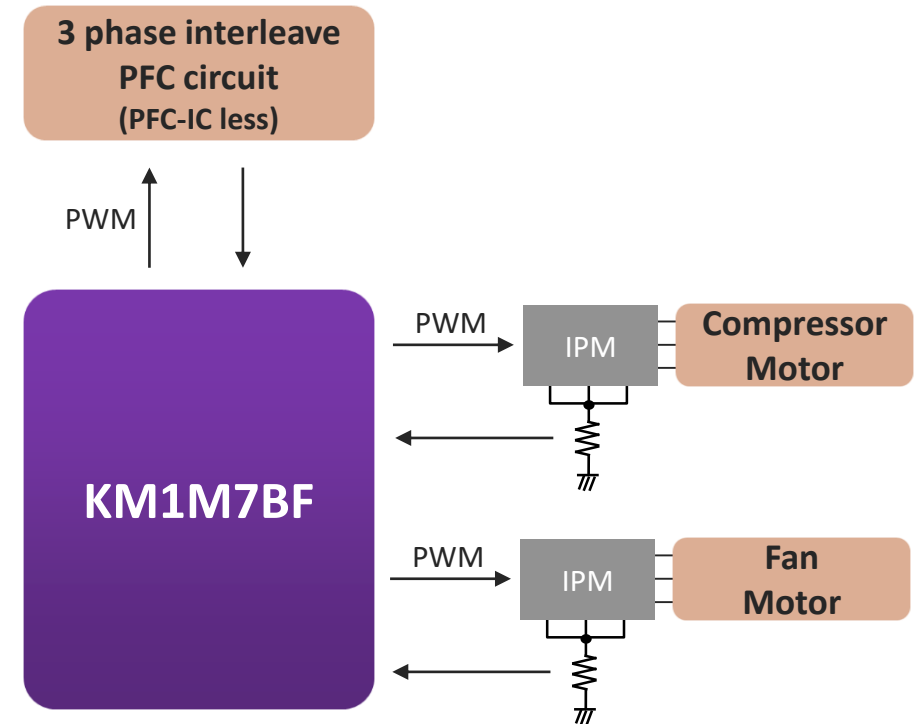
PSG – KM1M7AF Series MCU

| Part No. | Core speed (MHz) | Flash (KB) | SRAM (KB) | Data Flash | I-RAM (KB) | I/O | Timer (16-bit) | Power control PWM | Connectivity | | | | | | ADC(12-bit) | | DAC (8-bit) | DAC (10-bit) | Comparator | VGA | Flash/SRAM ECC | CRC | Package |
									Clock synchronous	UART	SPI	I²C	SM-Bus	CAN	Channel	Unit							
KM1M7AF52N	160	512	64	64	64	82	20	10	7	6	3	2	-	2	23	3	10	2	5	5	v	v	HQFP100 (14x14)
KM1M7AF50N	160	512	64	64	64	123	20	12	8	7	3	2	1	2	32	3	10	2	5	5	v	v	HQFP144 (20x20)

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PSG – KM1M7BF Series MCU

Part No.	Core speed (MHz)	Flash (KB)	SRAM (KB)	Data Flash	I-RAM (KB)	I/O	Timer (16-bit)	Power control PWM	Connectivity					ADC(12-bit)		DAC (8-bit)	DAC (10-bit)	Comparator	VGA	Flash/SRAM ECC	CRC	Package
									Clock synchronous	UART	SPI	I²C	SM-Bus	Channel	Unit							
KM1M7BF02K	160	256	32	64	64	82	20	10	7	6	3	2	-	23	3	10	2	5	5	v	v	HQFP100 (14x14)
KM1M7BF02M	160	384	48	64	64	82	20	10	7	6	3	2	-	23	3	10	2	5	5	v	v	HQFP100 (14x14)
KM1M7BF02N	160	512	64	64	64	82	20	10	7	6	3	2	-	23	3	10	2	5	5	v	v	HQFP100 (14x14)
KM1M7BF00K	160	256	32	64	64	123	20	12	8	7	3	2	1	32	3	10	2	5	5	v	v	HQFP144 (20x20)
KM1M7BF00M	160	384	48	64	64	123	20	12	8	7	3	2	1	32	3	10	2	5	5	v	v	HQFP144 (20x20)
KM1M7BF00N	160	512	64	64	64	123	20	12	8	7	3	2	1	32	3	10	2	5	5	v	v	HQFP144 (20x20)

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KM1M7CF Series MCU

Flash Memory/ SRAM (Kbytes)

	QFN32 (4 x 4 mm) Pitch 0.4 mm	TQFP48 (7 x 7 mm) Pitch 0.5 mm	TQFP64 (10 x 10 mm) Pitch 0.5 mm	TQFP80 (12 x 12 mm) Pitch 0.5 mm
512 / 128	KM1M7CF06N KM1M7CF16N	KM1M7CF05N KM1M7CF15N	KM1M7CF04N KM1M7CF14N	KM1M7CF03N KM1M7CF13N
256 / 128	KM1M7CF06K KM1M7CF16K	KM1M7CF05K KM1M7CF15K	KM1M7CF04K KM1M7CF14K	KM1M7CF03K KM1M7CF13K
Package				

- **Arm® Cortex®-M7 core**
- **Runs up to 160 MHz**
- **Operating voltage:** 2.6V ~ 3.6V

Features:
- Converter & Inverter control : High resolution PWM, Synchronous control ADC, Duty cut / Period cut function, Duty adjustment, Dead time auto-adjustment
- High speed ADC (5 Msps)
- CAN FD
- Read While Write (RWW) on Flash
- Security functions : Secure Boot, Cryptography (KM1M7CF1x)
- Safety functions
  - Memory ECC
  - Clock error detection
  - ADC failure diagnosis
  - Power supply voltage detection

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KM1M7CF Series Features
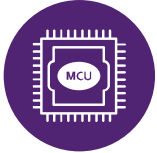
System

- Arm® Cortex®-M7 core
- Runs up to 160 MHz
- Up to 512 KB Flash Memory for instruction
- Up to 32 KB Flash Memory for data
- Up to 128 KB SRAM
- Operating voltage: 2.6V ~ 3.6V
- Operating temperature: Ta=-40°C ~ +125°C
- 16-channel DMA
- ESD HBM 2kV

Peripherals

- Up to 8 sets of motor & power control PWM
    - Complementary PWM output
    - Dead time insert, Output shift
    - Duty cut, period cut
    - Synchronous ADC trigger
- 1 set of CAN FD
- 1 set of SMBus
- Up to 14 sets of 16-bit timer
- Up to 7 sets of UART
- 2 set of I^{2}C
- Up to 7 sets of SPI
- Up to 68 GPIO (TQFP80)

Analog

- 3 sets of 12-bit 5 Msps ADC, up to 26-channel
- Up to 12 sets of 12-bit DAC
- Up to 12 sets of comparator

Security

- Memory ECC
- Memory protection
- Clock monitoring
- ADC error detection
- Power supply voltage detection

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Power Supply

Features

- Control primary PFC (AC/DC) & secondary LLC (DC/DC)
- High speed and high accurate feedback control with high speed ADC (5 Msps) and high resolution PWM (208 ps)
- Live firmware update support (dual bank flash memory)
- Security function inside (Secure Boot, Cryptographic)
- Model based design support (simulation tool)
- Reference system for totem pole PFC with high efficiency over 99%.
- Reference system for LLC with 3kW high power
- Noise suppression

Application

- Digital power control applications
  Power supply unit, Power storage, Power conditioner,
  High speed EV charger, Base station, etc.

Totem pole PFC (AC/DC)	Full bridge LLC (DC/DC)
PWM	PWM
KM1M7CF	**KM1M7CF**

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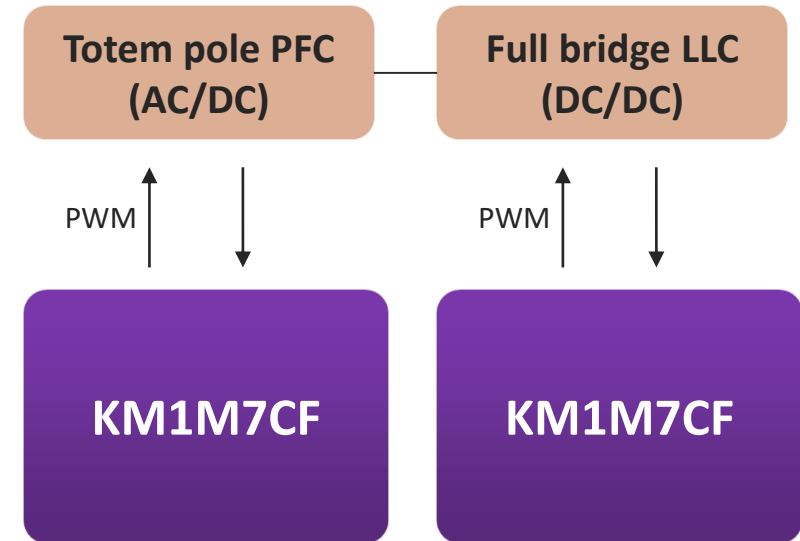
NuMicro® Development Platform

Evaluation Board / BSP / IDE / Software Tool / Debugger & Programmer

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nuvoton.com
Product Information / Documents / Selection

- **Online Support**: NuForum / Sales Support Mailbox / Online Chat
- **Social Media & Knowledge Base**: LinkedIn / Facebook / Twitter / WeChat
- **Video Platform**: YouTube / bilibili
- **Open Resource**: Github / Gitlab / Gitee

Online buy
- Nuvoton Direct
- Tmall
- TechDesign
- DigiKey

Digital Platform

Development Platform

arm KEIL   IAR Embedded Workbench   NuEclipse

IDE

Nu-Link2-Pro/Nu-Link2-Me
Nu-Link-Gang

Debugger & Programmer

NuMaker Series /
???

Evaluation Board

MCU BSP (API Compatible) / Linux BSP/ Peripheral Driver / Library / Rich Sample Code Third party resource

BSP & Example Code

CodeGenerator
PinView / PinConfig
/ ClockConfig
/ ICP/ISP Programming
/ Nu-Link Command
/ USB to Serial Port / Motor parameter identification tool

Software Tool(NuTool)

Platform

HMI Platform
AppWizard   SEGGER The Embedded Experts
SQUARELINE   LVGL
Qt

IoT Device and Gateway
arm PELION   amazon web services   Alibaba Cloud   Microsoft Azure   Allxon
arm MBED   AliOS   Azure RTOS   RT-Thread   RTOS   Linux   OpenWrt
WiFi   LTE   NB-IoT   LoRa   Bluetooth

DALI 2 Solutions
Supports all control gear and control/ input device certified library protocol.

102	103
202	303
206	304
207	
208	
209	

Reference Design Platform

BMS	LCD Touch Key	Cold Chain	Thermostat	Motor Kit
Lighting Control	HDMI2.1	USB Type-C PD3.1	AR & VR	Digital Power

8051 / M0 / M23 / M4 / M7 / Arm9 / A35 based Microcontroller

NuMicro® Microcontroller Platform

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Support Menu

Development TAT reduction	Software quality improvement	rework minimization	Quick support
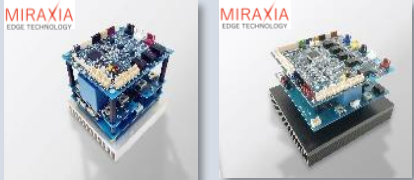
- ✓ Control MCU
- ✓ MCU Evaluation Board
- ✓ Reference Evaluation Board

- ✓ Motor Control Application Note
- ✓ Power Control Application Note
- ✓ Reference control software
- ✓ Sample of Driver Layer
- ✓ IEC60730, etc.

hardware   **software**

Development Tools   **Support**
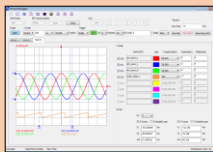
- ✓ IDE
- ✓ Support Tools
- ✓ Model-based development environment
- ✓ Provisioning tool

- ✓ Consign Development
- ✓ Technical Support (On-site, QA, Seminars)

Q&A is in operation with primary response within 1 business day

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Reference Board for Motor Control

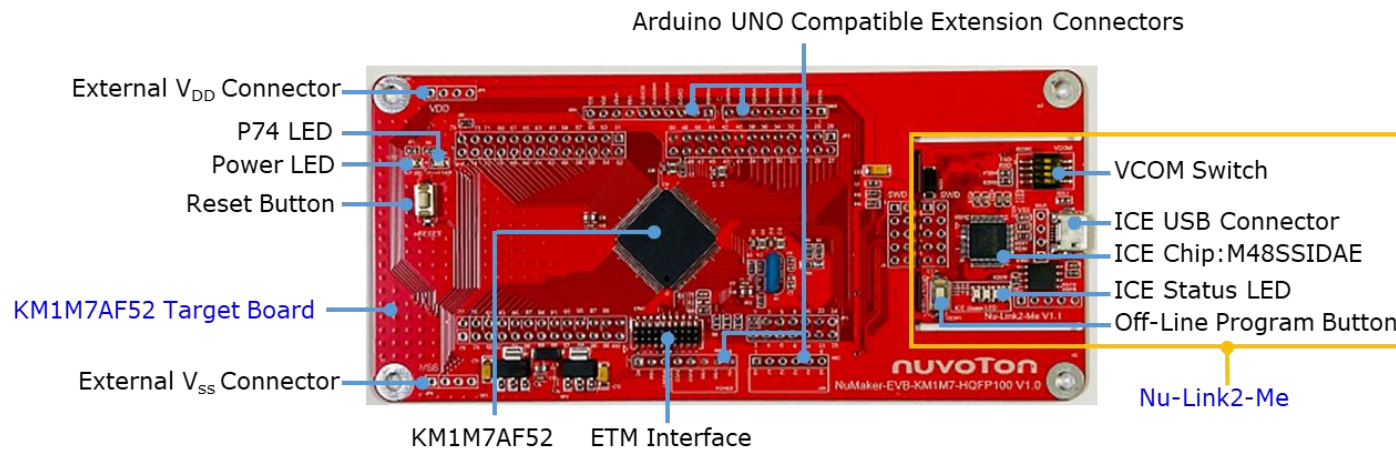| Solution		Target.	Input Power	Structure	deliverables	Status
Low voltage motor EVA board MCU:KM103HFD KM1M7A/M4B		Air purifiers Power tools One axis slider	134W	BLDC motor x 1	Hard Ref Soft IP	under development (2023/01)
High voltage motor EVA board MCU:KM103HFD KM1M7A/M4B		Air conditioner (Compressor and Fan) Washing machine Refrigerator	2kW	BLDC motor x 2 Single phase PFC	Hard Ref Soft IP	under development (2023/01)
3-phase interleaved PFC EVA board MCU:KM1M7B		Air conditioner	3.5kW	BLDC motor x 2 3-phase PFC	Hard Ref Soft IP	Available

Reference Board for Digital Power Control

	controller board	~ 1kW	~ 1kW	1kW	1.5kW	3kW	10kW ~
inverter DCAC	Cortex®-M7 (with FPU) PWM output port for gate (max. 4ch) Insulation voltage sensor (3ch) 24V power supply for cooling fan			PC Apps	1kW~3kW compatible Bidirectional inverter (Grid-connected)		
converter DCDC	Cortex®-M7 (with FPU) PWM output port for gate (max. 16ch) Insulation voltage sensor (5ch) 24V power supply for cooling fan			PC Apps	1kW~3kW compatible Bidirectional converter LiB control	3kW compatible LLC Converter	
ACDC		400W TP-PFC + LLC (GaN)	Power supplies for wireless power transmission (Storage Battery Control)	Power supplies for wireless power transmission (Storage Battery Control)	Power supplies for wireless power transmission (Storage Battery Control)	high efficiency TP-PFC (GaN)	
matrix converter ACAC	matrix converter Control Board	Cortex®-M7 (with FPU) PWM output port for gate (12ch) Equipped with a flow diversion control system					15 kW Matrix converter (EV quick charge)

Starter Kit NuMaker

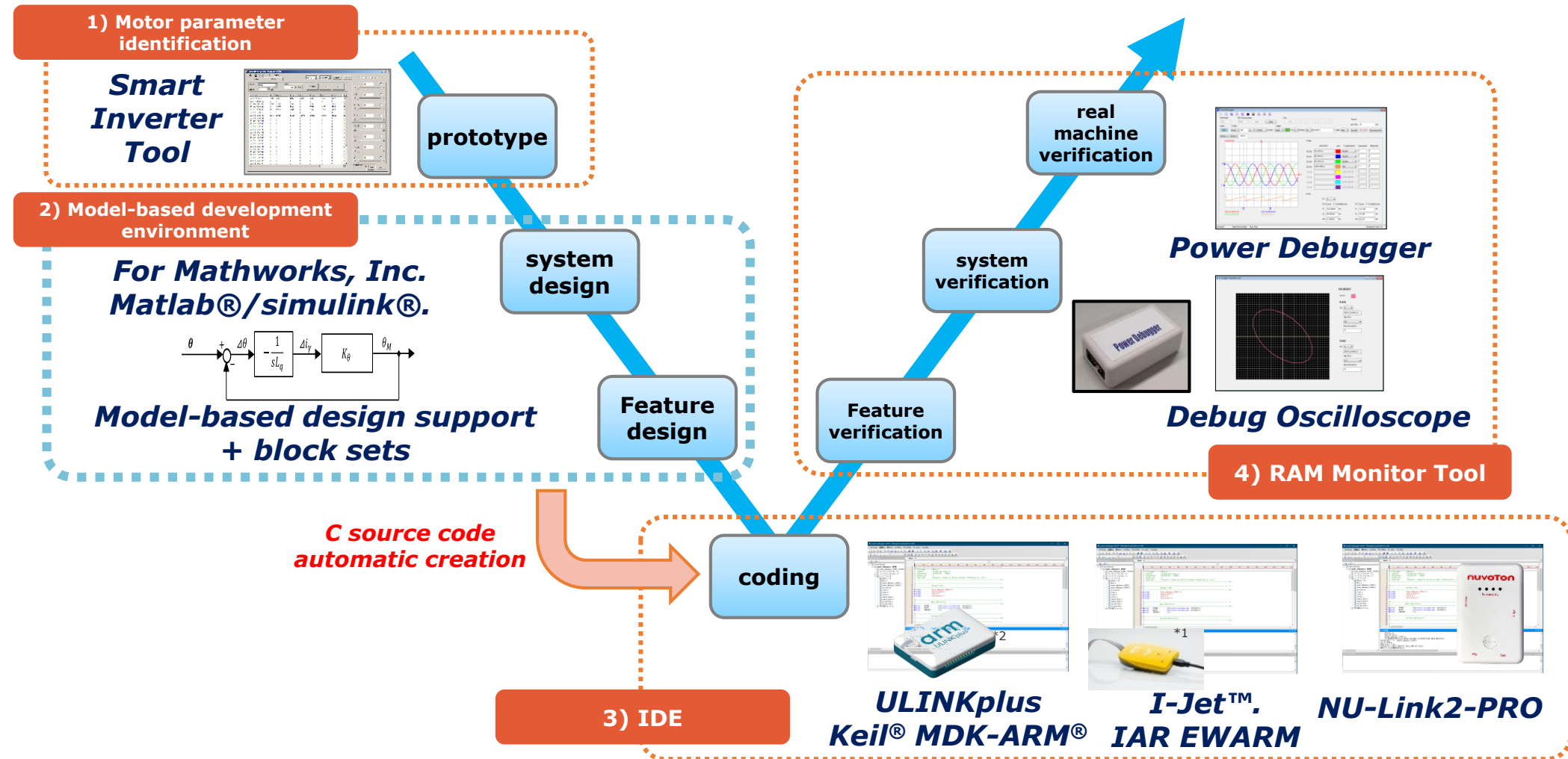## Provides a starter kit ideal for initial MCU evaluation with connectors on all pins

External V$_{DD}$ Connector
P74 LED
Power LED
Reset Button
KM1M7AF52 Target Board
External V$_{SS}$ Connector
KM1M7AF52
ETM Interface
Arduino UNO Compatible Extension Connectors
VCOM Switch
ICE USB Connector
ICE Chip:M48SSIDAE
ICE Status LED
Off-Line Program Button
Nu-Link2-Me

Special Features

◎KM1M7AF52 Connector for all terminals
◎Arduino® UNO compatible expansion terminals
◎ Supports flexible board power supplies:
 - External VDD supply terminal
 - Arduino® UNO compatible Vin pin
 - USB connector on Nu-Link2-Me
◎ On-board Nu-Link2-Me debugger and programmer support
 - Debugging through SWD
 - Online/Offline Programming
 - Virtual COM port function
Embedded Trace Macrocell (ETM) function support

Supported IDEs

◎Keil®.
◎IAR SYSTEMS®.
◎NuEclipse

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Development Support Tools

1) Motor parameter identification

Smart Inverter Tool

2) Model-based development environment

For Mathworks, Inc. Matlab®/simulink®.

$$\theta \xrightarrow{+} \Delta\theta \rightarrow \boxed{-\frac{1}{sL_q}} \xrightarrow{\Delta i_\gamma} \boxed{K_\theta} \xrightarrow{\theta_M}$$

Model-based design support + block sets

prototype

system design

Feature design

C source code automatic creation

coding

real machine verification

system verification

Feature verification

Power Debugger

Debug Oscilloscope

4) RAM Monitor Tool

3) IDE

ULINKplus Keil® MDK-ARM® *2

I-Jet™. IAR EWARM *1

NU-Link2-PRO

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1) Motor parameter identification tool

Quick set up to start motors at the prototype stage

SmartInverterTool

Motor parameter identification error within ±8%*. ➡ **Enables stable motor control with parameter identification algorithm**

*Results from our evaluation environment, substrate, and motor

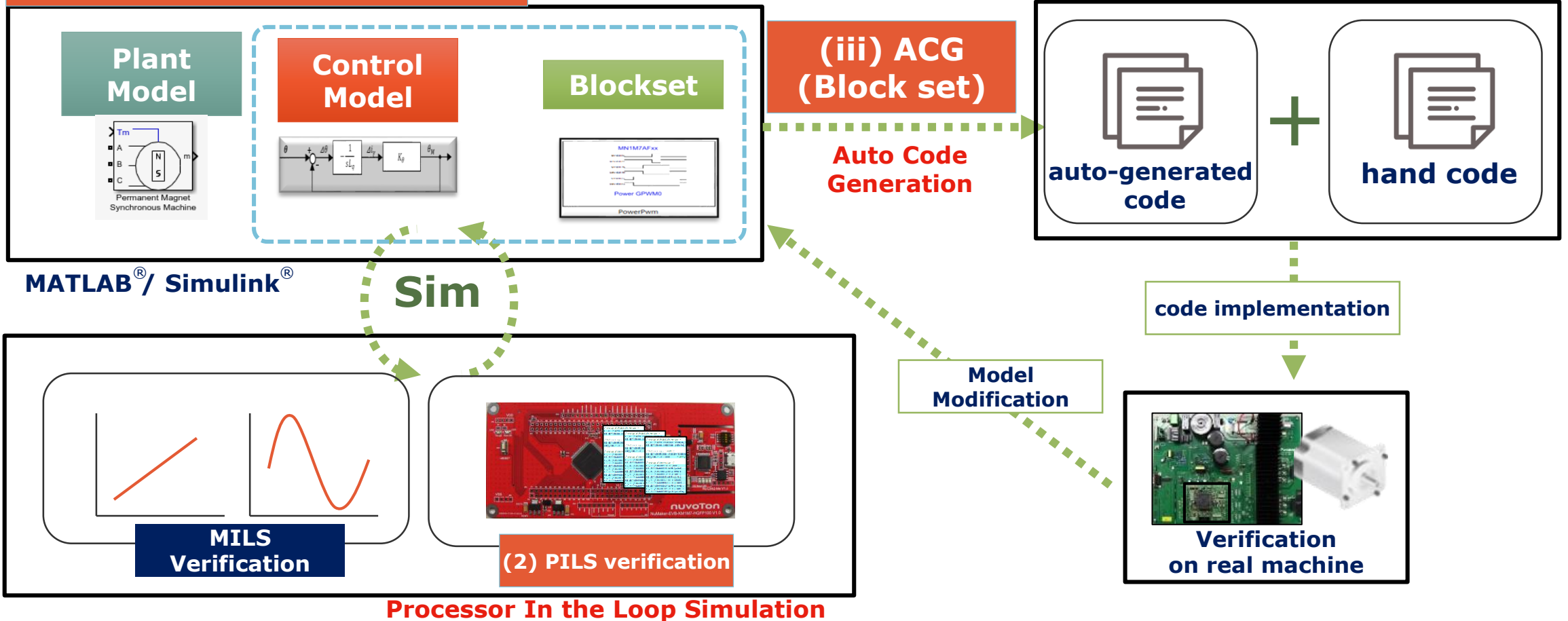| STEP 1	STEP2	STEP 3
Identification can be done in about 1 minute with only 4 inputs (1) Pole pair (up to 5 pole pairs) (2) Carrier frequency (fixed at 4 kHz) (3) Rated current Overcurrent limit	**Automatic calculation of control gain with 1 click** identified in STEP 1. From the motor parameter values Automatic calculation of various control gains	**Operation can be checked and fine-tuned with tools** Control gain calculated in STEP2 Confirmation of motor operation with Various control gains on the GUI Fine-tuning possible

High-speed identification in approx. 1 min. waiting time, motor can be driven immediately

Motor ID GUI

Tuning GUI

PC Tools

parameter identification Program

3shunt

Motor to be identified

USB to SPI conversion Module (sold separately)

Inverter board (provided by us)
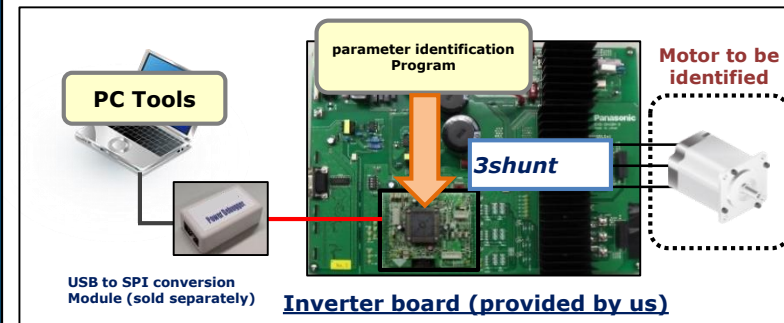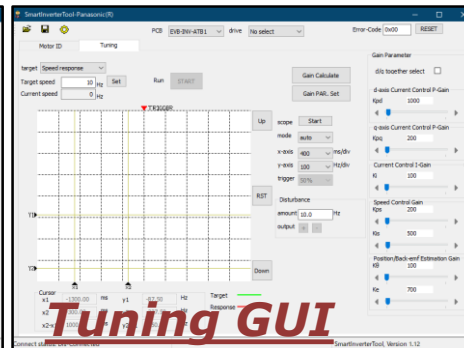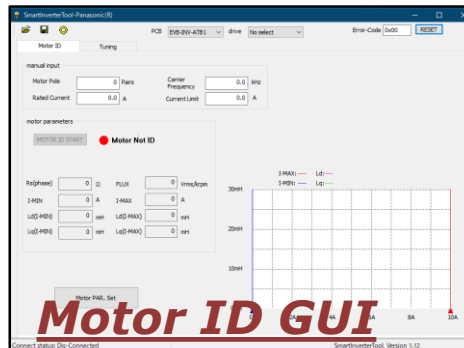
2) Model-based development environment

(1) MILS (Simulation Model)   Model In the Loop Simulation

Plant Model

Control Model

Blockset

Permanent Magnet Synchronous Machine

MATLAB® / Simulink®

Sim

(iii) ACG (Block set)

Auto Code Generation

auto-generated code   **+**   hand code

code implementation

Model Modification

Verification on real machine

MILS Verification

(2) PILS verification

Processor In the Loop Simulation

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3) Integrated Development Environment

IDE		IAR Embedded Workbench®		Keil® MDK-ARM® (Methylmethacrylate-ARM®)		NuEclipse
compiler	Support CPU	Arm® Cortex®-M Series		Arm® Cortex®-M Series		Arm® Cortex®-M Series
	type	IAR compiler (EWARM)		Arm® compiler(µVision®)		GCC C/C++
	OS Environment	Windows		Windows		Windows/Linux
	library	Included in EWARM		Included in µVision®.		Included in GCC
	functional safety	available (e.g. software)		available (e.g. software)		--
debugger	hardware (esp. computer)	Nu-LINK2-PRO *1	I-JET™. *2	Nu-LINK2-PRO	ULINK2 / ULINKpro ULINKplus *3	Nu-LINK2-PRO
	Software (Version)	EWARM(7.70.2 or later)		µVision® (5.16a or later)		NuEclipse(v1.01.019 or later)
	Debug I/F	SWD 10/20 pin connector		SWD 10/20 pin connector		SWD 10/20 pin connector
	Source.	IAR SYSTEMS		Arm Limited		Nuvoton Technology
remarks		https://www.iar.com/jp/		https://www2.keil.com/mdk5/		https://www.nuvoton.com/

*1 Source: https://store.developer.arm.com/store/debug-probes/ulinkpro-debug-adapter?_ga=2.145815538.719634597.1632873814-1854199051. 1610951068/
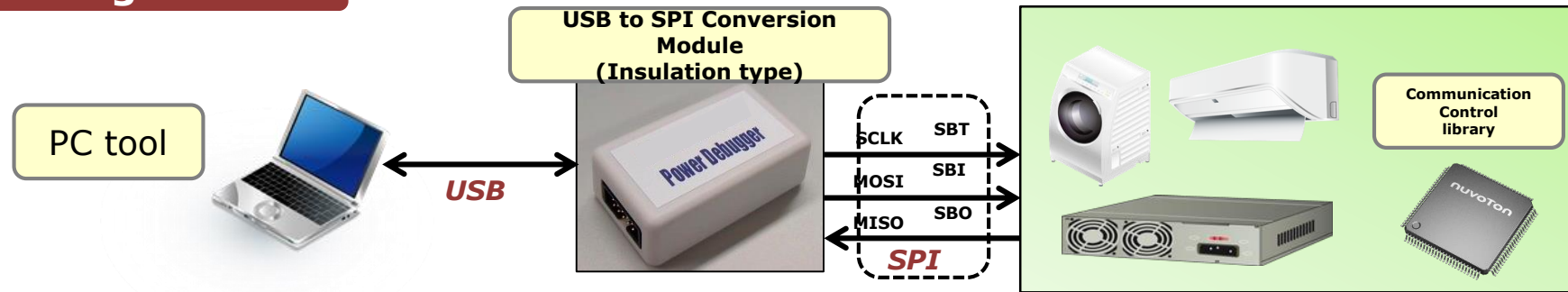*2 Source: https://www.iar.com/jp/products/architectures/arm/i-jet/
*3 Source: https://www2.keil.com/mdk5/ulink
Arm®, Cortex®, Keil®, MDK-ARM®, and µVision® are registered trademarks of Arm Limited or its subsidiaries in the EU and other countries.
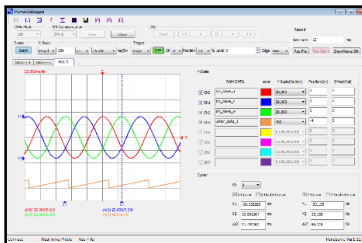IAR Embedded Workbench® and I-JET™ are registered trademarks of IAR SYSTEMS.

4) RAM monitor tool

Configuration

PC tool

USB

USB to SPI Conversion Module (Insulation type)

Power Debugger

SCLK — SBT
MOSI — SBI
MISO — SBO

SPI

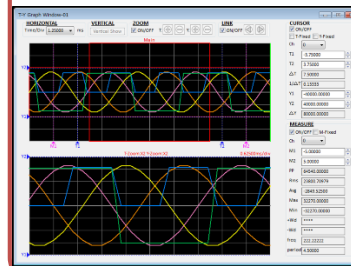**Communication Control library**

Power Debugger

Debugging and analysis with real-time waveform display

Minimum 50usec cycle @ 2ch
 Real-time waveform display, trigger function
Save and read log files (CSV)
Arbitrary RAM data up to 24 Ch
 Read/Write

Debug Oscilloscope

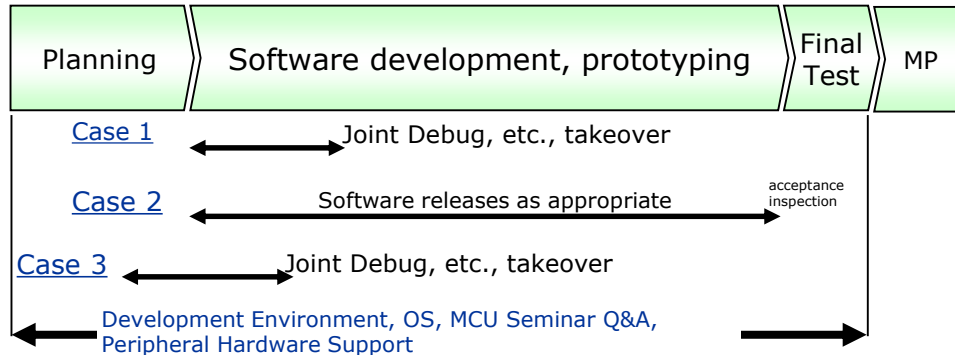**Detailed debugging and analysis with high-speed sampling**

Minimum 10 usec cycle @ 16ch
 Graph waveform display (T-Y/X-Y), trigger function
Save and read log files (CSV)
PowerDebugger log readable

Offerings

✓ **Communication module （Communication module, board connection cable, USB cable)**
✓ **PC tools, communication control library**
✓ **Documentation (tool handling manuals, library installation manuals)**

Development support

■Image of Support Contents

Planning	Software development, prototyping	Final Test	MP

Case 1 — Joint Debug, etc., takeover

Case 2 — Software releases as appropriate — acceptance inspection

Case 3 — Joint Debug, etc., takeover

Development Environment, OS, MCU Seminar Q&A, Peripheral Hardware Support

Case 1: Software Replacement Support
Replacing software from other companies' MCU with NTCJ MCU

Case 2: Software consign development
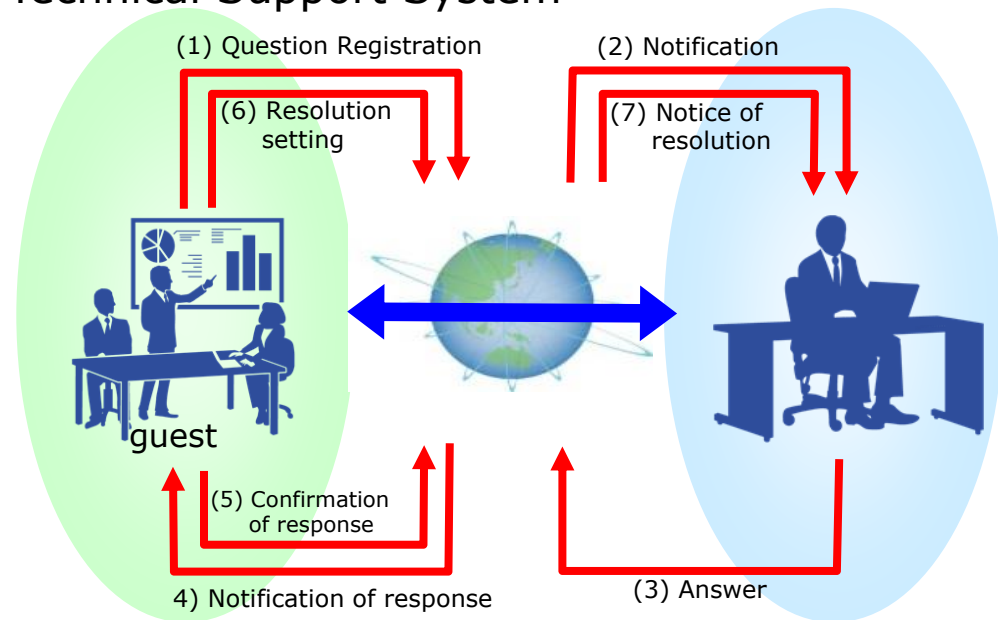Developed by NTCJ based on software specifications

Case 3: Providing Solutions
Release NTCJ development solutions and develop them in your company

■ **Inquiries can be made through NTCJ's technical support website.**
https://nuvoton.co.jp/semi-spt/

■ **Regardless of the hardware, software, or tool, when you enter a query, a developer will respond within 24 hours**

Technical Support System

(1) Question Registration

(2) Notification

(6) Resolution setting

(7) Notice of resolution

guest

(5) Confirmation of response

4) Notification of response

(3) Answer

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Thank You
Danke
Merci
ありがとう
Gracias
Kiitos
감사합니다
धन्यवाद
شكرا لك
תודה