Arm® Cortex®-M4F
32-bit Microcontroller

NuMicro® Family
M48XXGCAE
(256 KB Flash)
Product Brief

For additional information or questions, please contact: Nuvoton Technology Corporation.

www.nuvoton.com

1 GENERAL DESCRIPTION

The NuMicro® M480 series microcontroller is powered by Arm® Cortex®-M4 with DSP and FPU and runs up to 192 MHz. The dynamic power consumption is around 130 µA/MHz and the standby current can be down to 500 nA. This M480 series consists of three sub-series according to the characteristics and applications and provides 256 KB embedded Flash and 128 KB embedded SRAM.

This M480 series supports Secure Boot functionality to protect firmware integrity and authenticity as well as the AES and TRNG for data security. In addition, this M480 series supports dual 12-bit 5 MSPS SAR ADC for simultaneous sampling, camera interface for image capture, up to 3 sets of Bosch CAN bus 2.0B for data transmission in industrial control and dual Quad-SPI for siginal generation.

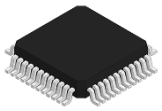
The NuMicro® M480 series comprises three sub-series:

- NuMicro® M481 Base series: high performance, low power consumption, dual ADC, versatile high speed UART/SPI/I2C/PWM peripherals, eligible for motor control and data collector.
- NuMicro® M482 USB FS OTG series: Integrated USB 2.0 full speed interface with on-chip OTG PHY, crystal-less USB in device mode, eligible for gaming or PC accessories.
- NuMicro® M483 CAN series: Integrated 3 sets of CAN 2.0B interfaces, dual ADC and 8 sets of UART interfaces, eligible for IoV and industrial control

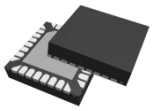
Series	USB Full Speed	USB High Speed	CAN 2.0B	Cryptography	Ethernet
M481					
M482	√				
M483	√		√		

2 FEATURES

* **Core**
  - Up to 192 MHz ARM® Cortex®-M4F delivering 1.25 DMIPS per MHz
  - DSP instruction set
  - Memory Protection Unit (MPU)
* **Memories**
  - 256 KB zero-wait state flash memory support 4 eXecute-Only-Memory (XOM) regions
  - 128 KB SRAM
  - 2 KB One-Time-Programmable ROM
* **Cyclic Redundancy Calculation Unit**
* **16-channel Peripheral DMA Controller**
* **External Bus Interface**
  - LCD parallel interface, i80 mode
* **Clock**
  - 4 to 24 MHz crystal oscillator
  - 32 kHz crystal oscillator for RTC
  - Internal 48 MHz RC oscillator (X-less USB)
  - Internal 12 MHz RC oscillator
  - Internal 10 kHz RC oscillator
  - Internal PLL up to 480 MHz
* **RTC**
  - Independent V_{BAT} power pin
  - 20 bytes of battery-powered backup registers
  - Up to six temper detection pins
* **Power Management**
  - Active: 130 µA/MHz at 25°C/3.3V (peripheral off)
  - Deep power-down: <1 µA
  - V_{BAT} for RTC: < 500 nA
* **Timer & PWM**
  - Four 32-bit timers, each supports up to 2 PWM (Total 8 PWM)
  - Twelve Enhanced PWM with twelve 16-bit timers
  - Twelve Basic PWM with two 16-bit timers
  - One 24-bit count-down SysTick timer
  - One watchdog timer
  - One window watchdog timer
* **Analog Peripheral**
  - Two 12-bit, up to 24-ch 5MSPS SAR ADC
  - One 12-bit, 1MSPS DAC
  - Two rail-to-rail comparators
  - Built-in internal reference voltage
* **Cryptography Accelerator**
  - ECC-256
  - AES-256
  - SHA-256 / HMAC
  - True Random number generator



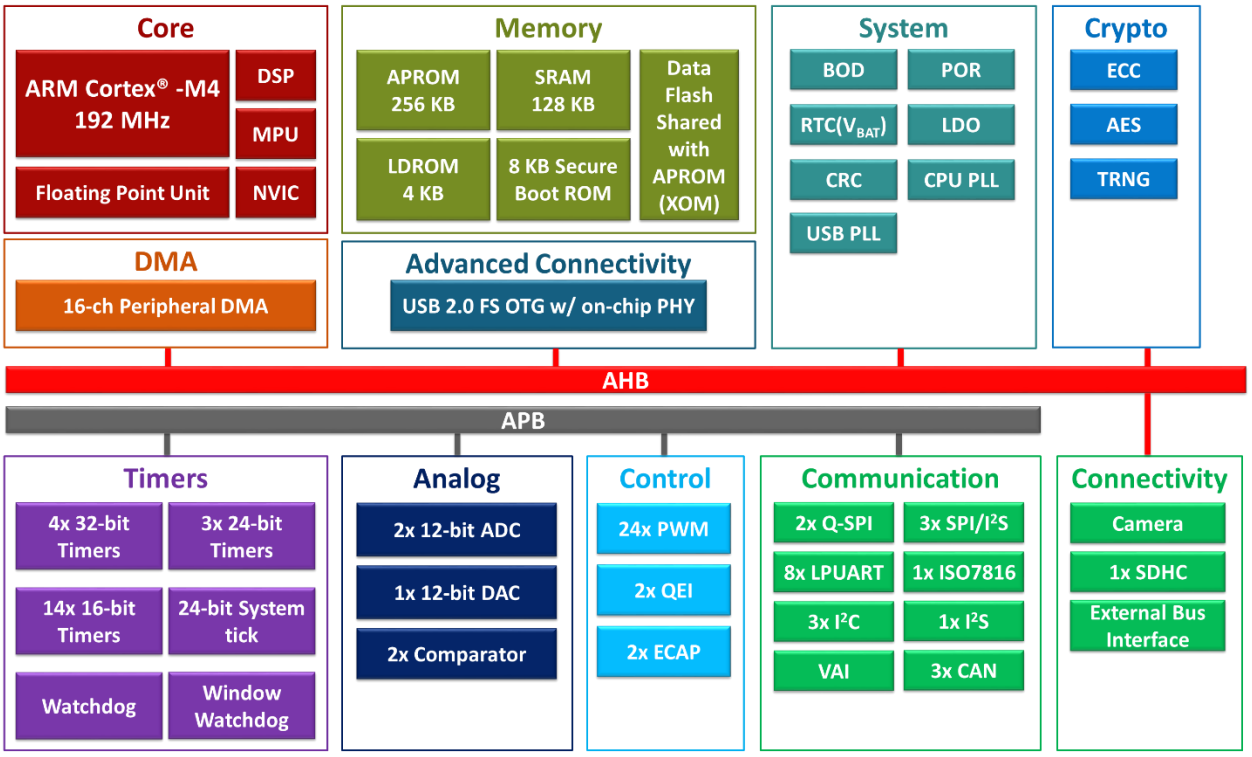
LQFP48 (7x7 mm)
LQFP64 (7x7 mm)
LQFP128 (14x14 mm)



QFN33 (5x5 mm)

* **Communication Interface**
  - Up to 8 UART interfaces, including LIN and IrDA interfaces
  - One ISO-816-3 interface, which supports full duplex UART mode
  - Three I^2C interfaces with SMBus/PMBus (Up to 3.4 Mbps)
  - Two Quad-SPI interface (Up to 48 MB/s)
  - Up to 3 SPI/I^2S interfaces (SPI up to 96 Mbps, I^2S up to 6 Mbps)
  - One I^2S interface (Up to 12 Mbps)
  - Up to three CAN 2.0B interfaces (Up to 1 Mbps)
  - One Secure Digital Host Controllers (Up to 48 Mbps)
* **Control Interface**
  - Up to two quadrature encoder interfaces
  - Two 24-bit, 3-ch input capture timer/counter units
* **Digital Camera Interface**
  - CCIR601/CCIR656 camera interface
* **Advanced Connectivity**
  - USB 2.0 full speed device/host/OTG controller with on-chip PHY, which supports crystal-less in device mode
* **Operating Characteristic**
  - Voltage range: 1.8V to 3.6V
  - Temperature range: -40°C to +105°C
  - ESD HBM 4KV
* **Voltage Adjustable Interface**
  - Up to six I/O ports support VAI with supply V_{DDIO} from 1.8V to 3.6V
* **Up to 100 I/O pins with interrupt capability**
  - Up to 62 5V-tolerant I/O pins
* **96-bit Unique ID (UID)**
* **128-bit Unique Customer ID (UCID)**
* **IEC-60730 Class B Compliance**

3 BLOCK DIAGRAM



4 PARTS INFORMATION

4.1 Package Type

Part No.	QFN33	LQFP48	LQFP64	LQFP128	LQFP144
M481	M481ZGCAE	M481LGCAE	M481SGCAE M481SGCAE2A		
M482	M482ZGCAE	M482LGCAE	M482SGCAE	M482KGCAE	
M483			M483SGCAE M483SGCAE2A	M483KGCAE M483KGCAE2A	

4.2 M481 Base Series

PART NUMBER		M481			
		ZGCAE	LGCAE	SGCAE	SGCAE2A
Flash (KB)		256 (Support XOM)			
SRAM (KB)		128			
ISP Loader ROM (KB)		4			
I/O		26	41	52	52
32-bit Timer		4			
Peripheral DMA		16			
Tamper		-	-	1	1
Connectivity	LPUART	8			
	ISO-7816	1			
	SPI Master	-			
	Quad SPI	2			
	SPI/I^2S	2	3	3	3
	I^2S	1			
	I^2C	3			
	USCI	-			
	CAN	-			
	LIN	2			
	SDHC	1			
16-bit PWM		24			
QEI		1	2	2	2
ECAP		-	1	1	1
USB 2.0 FS OTG		-			
USB 2.0 HS OTG		-			
12-bit ADC		10	12	16	**8+8**
12-bit DAC		1			
Analog Comparator		2			
Operational Amplifier		-			
Ethernet		-			
Cryptography		AES-256			
TRNG		√			
External Bus Interface		-	√	√	√
Camera Interface		-	-	√	√
Package		QFN33	LQFP 48	LQFP 64	LQFP 64

* M481SGCAE2A supports dual ADC.

4.3 M482 USB FS OTG Series

PART NUMBER		M482			
		ZGCAE	LGCAE	SGCAE	KGCAE
Flash (KB)		256 (Support XOM)			
SRAM (KB)		128			
ISP Loader ROM (KB)		4			
I/O		26	41	52	100
32-bit Timer		4			
Peripheral DMA		16			
Tamper		-	-	1	6
Connectivity	LPUART	8			
	ISO-7816	1			
	SPI Master	-			
	Quad SPI	2			
	SPI/I^{2}S	2	3	3	3
	I^{2}S	1			
	I^{2}C	3			
	USCI	-			
	CAN	-			
	LIN	2			
	SDHC	1			
16-bit PWM		24			
QEI		1	2	2	2
ECAP		-	1	1	2
USB 2.0 FS OTG		√ (Crystal-less)			
USB 2.0 HS OTG		-			
12-bit ADC		10	12	16	16
12-bit DAC		1			
Analog Comparator		2			
Operational Amplifier		-			
Ethernet		-			
Cryptography		AES-256			
TRNG		√			
External Bus Interface		-	√	√	√
Camera Interface		-	-	√	√
Package		QFN33	LQFP 48	LQFP 64	LQFP 128

4.4 M483 CAN Series

PART NUMBER		M483			
		SGCAE	SGCAE2A	KGCAE	KGCAE2A
Flash (KB)		256 (Support XOM)			
SRAM (KB)		128			
ISP Loader ROM (KB)		4			
I/O		52	52	100	
32-bit Timer		4			
Peripheral DMA		16			
Tamper		1	1	6	
Connectivity	LPUART	8			
	ISO-7816	1			
	SPI Master	-			
	Quad SPI	2			
	SPI/I^{2}S	3			
	I^{2}S	1			
	I^{2}C	3			
	USCI	-			
	CAN	2	2	3	
	LIN	2			
	SDHC	1			
16-bit PWM		24			
QEI		2			
ECAP		1	1	2	
USB 2.0 FS OTG		√ (Crystal-less)			
USB 2.0 HS OTG		-			
12-bit ADC		16	**8+8**	16	**16+8**
12-bit DAC		1			
Analog Comparator		2			
Operational Amplifier		-			
Ethernet		-			
Cryptography		AES-256			
TRNG		√			
External Bus Interface		√			
Camera Interface		√			
Package		LQFP 64	LQFP 64	LQFP 128	

* M483SGCAE2A and M483KGCAE2A support dual ADC.

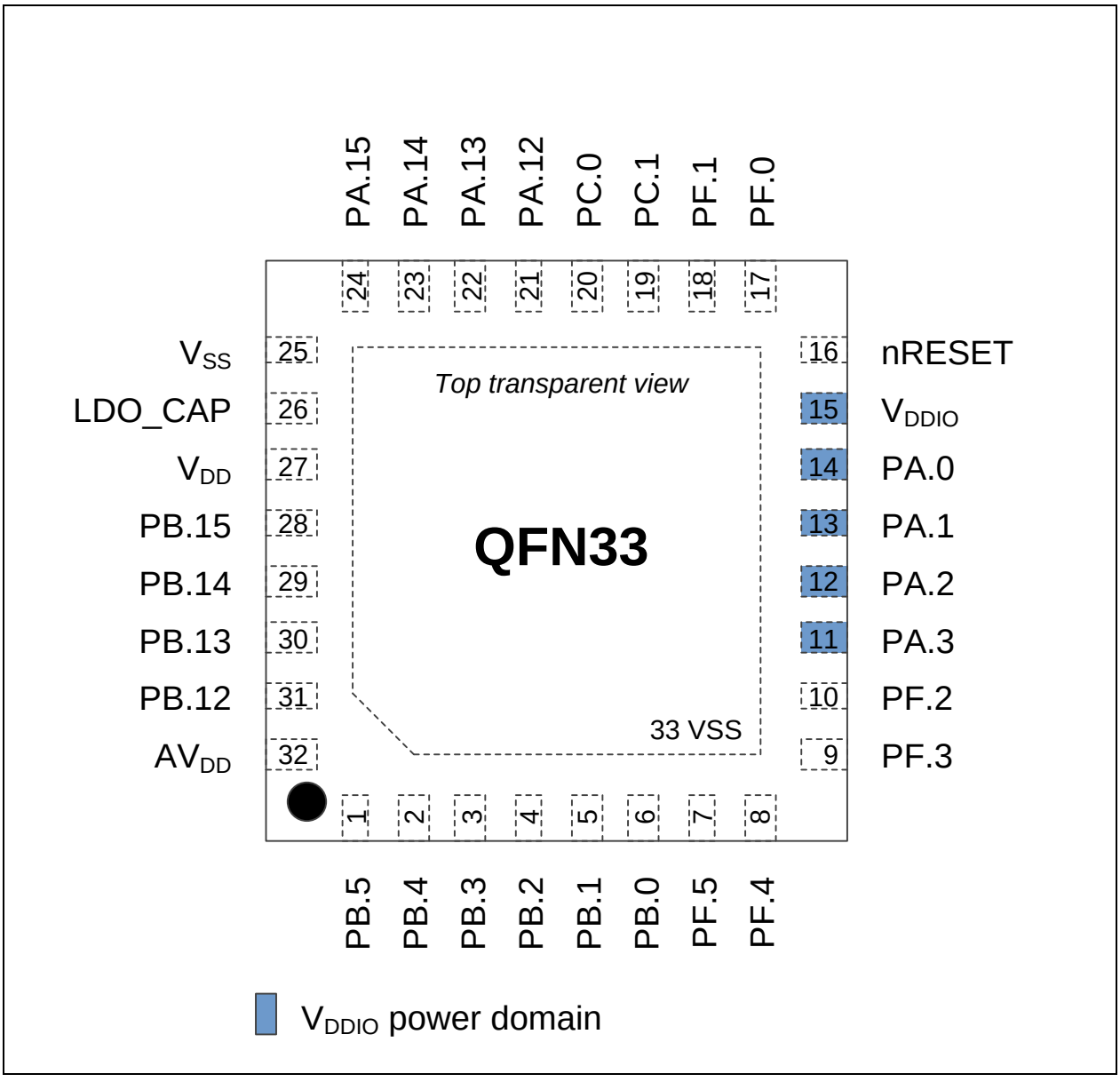
4.5 Naming Rule

M4	81	Z	G	D	A	E
Core	**Series**	**Package**	**Flash Size**	**SRAM Size**	**Revision**	**Temperature**
Cortex®-M4F	81: Base 82: USB FS 83: CAN 84: USB HS 85: Crypto 87: Ethernet	Z: QFN33 (5x5 mm) L: LQFP48 (7x7 mm) C: WLCSP S: LQFP64 (7x7 mm) O: QFN88 (10x10 mm) V: LQFP100 (14x14 mm) K: LQFP128 (14x14 mm) J: LQFP144 (20x20 mm)	A: 8 KB B: 16 KB C: 32 KB D: 64 KB E: 128 KB F: 192 KB G: 256 KB H: 384 KB I: 512 KB	1: 4 KB 2: 8 KB 3: 16 KB 4: 20 KB 5: 24 KB 6: 32 KB 7: 48 KB 8: 64 KB 9: 80 KB A: 96 KB B: 112 KB C: 128 KB D: 160 KB		E:-40˚C ~ 105˚C

5 PIN CONFIGURATION

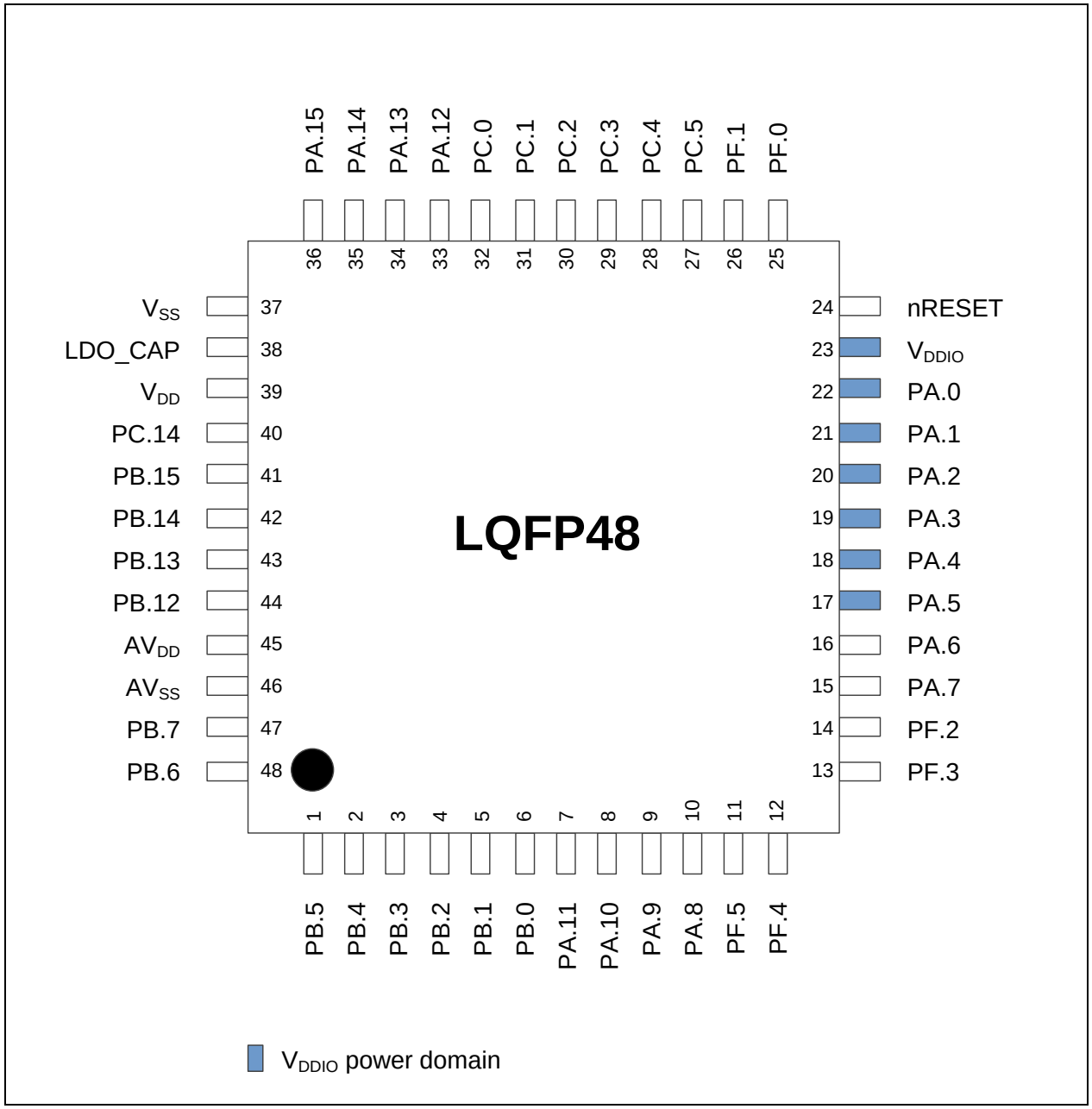
5.1 QFN-33 Pin Diagram

Corresponding Part Number: M481ZGCAE, M482ZGCAE



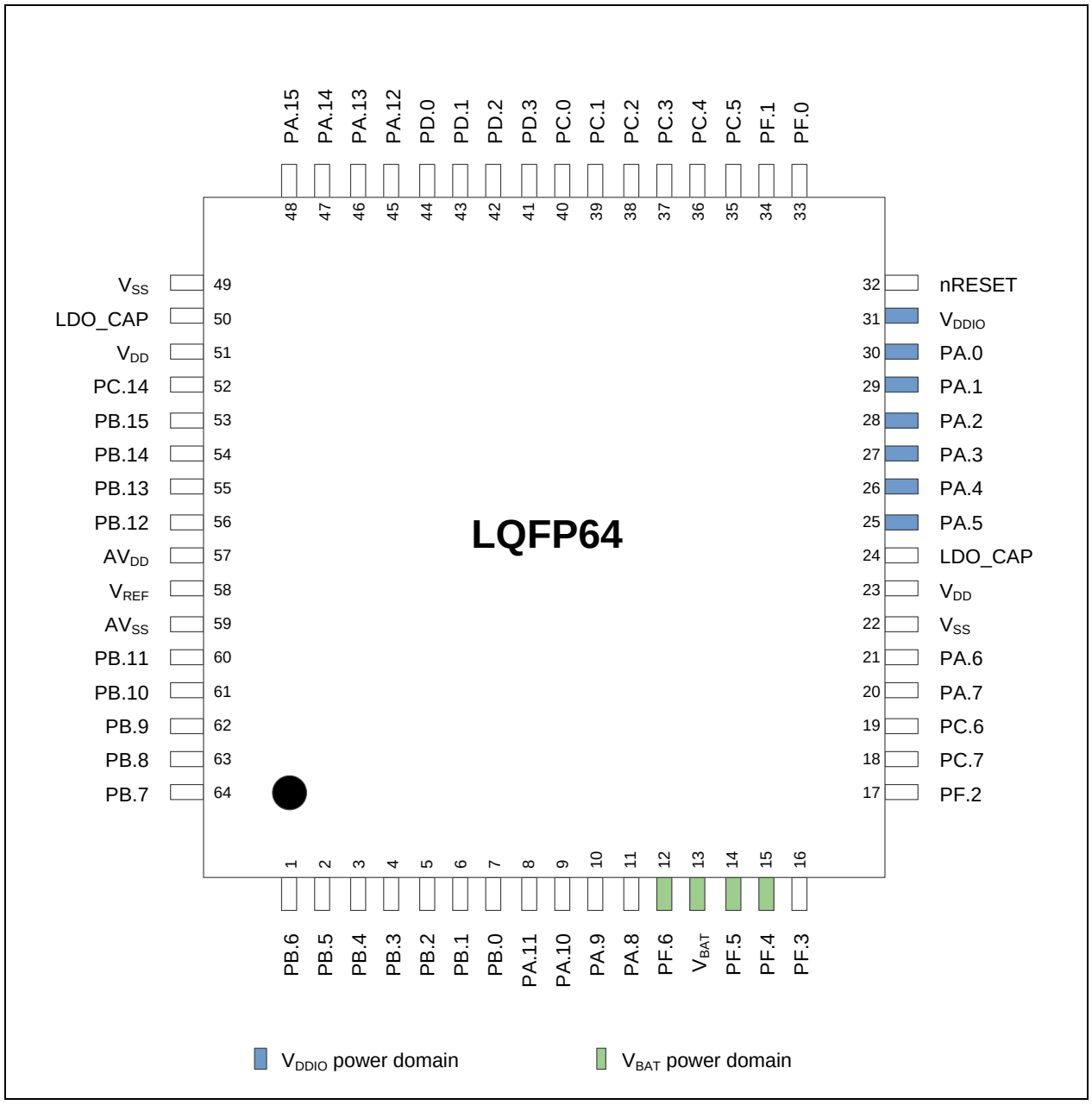
5.2 LQFP-48 Pin Diagram (0/1 USB FS)

Corresponding Part Number: M481LGCAE, M482LGCAE



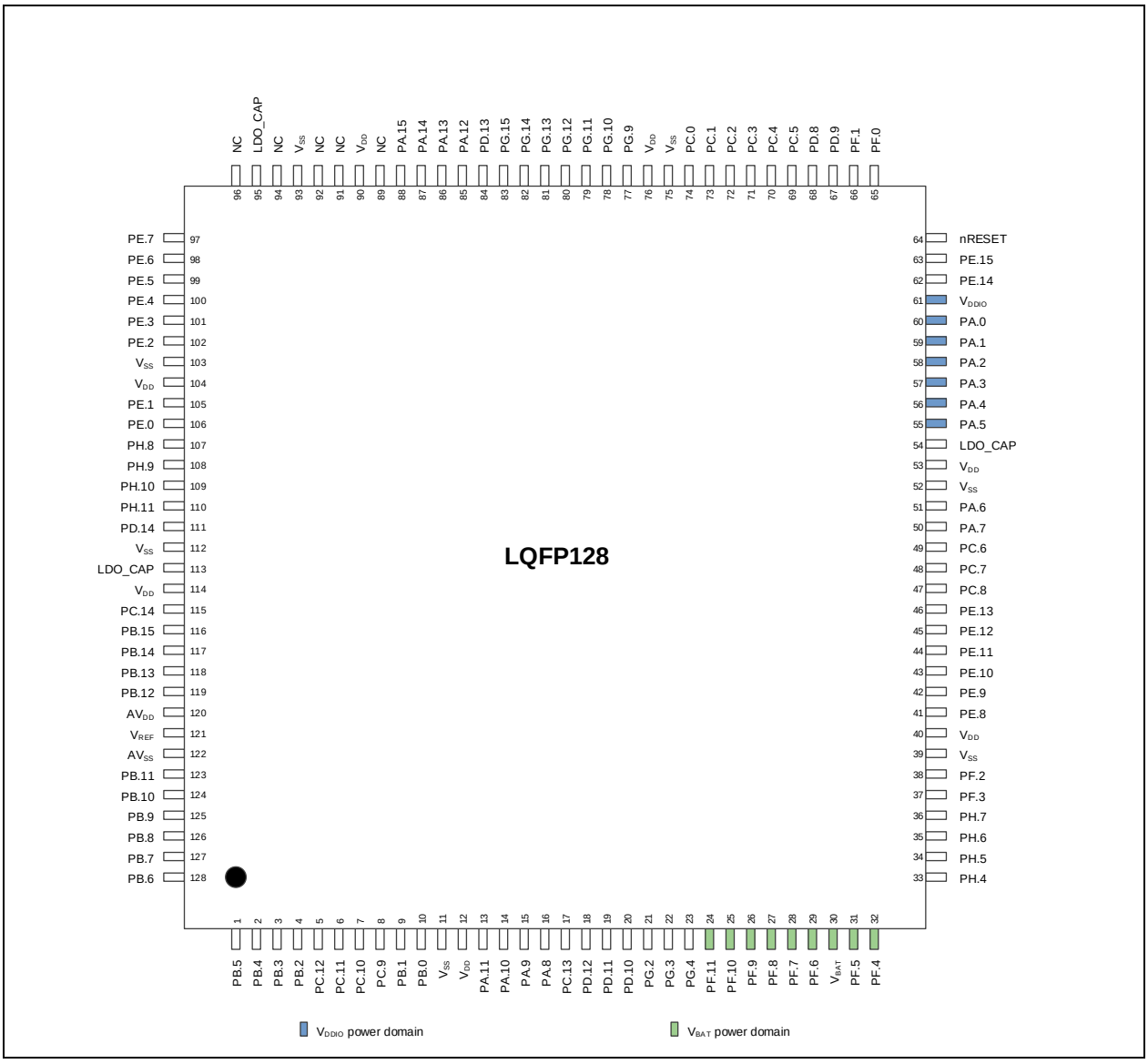
5.3 LQFP-64 Pin Diagram (0/1 USB FS)

Corresponding Part Number: M481SGCAE, M481SGCAE2A, M482SGCAE, M483SGCAE, M483SGCAE2A



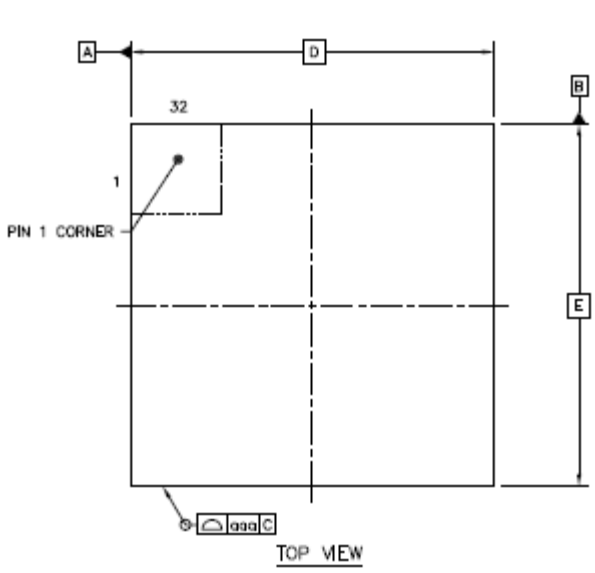
5.4 LQFP-128 Pin Diagram (1 USB FS)

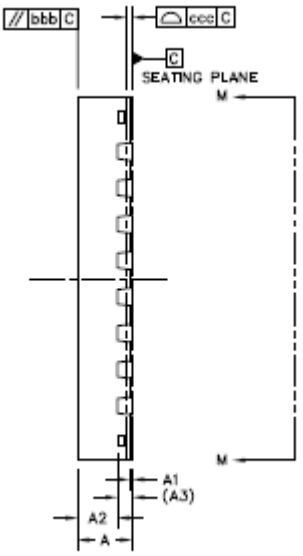
Corresponding Part Number: M482KGCAE, M483KGCAE, K483KGCAE2A

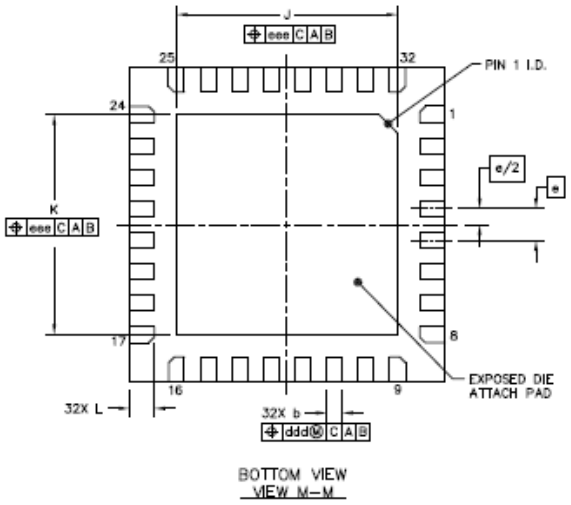


6 PACKAGE DIMENSIONS

6.1 QFN 33L (5x5x0.8 mm^3 Pitch 0.5 mm)

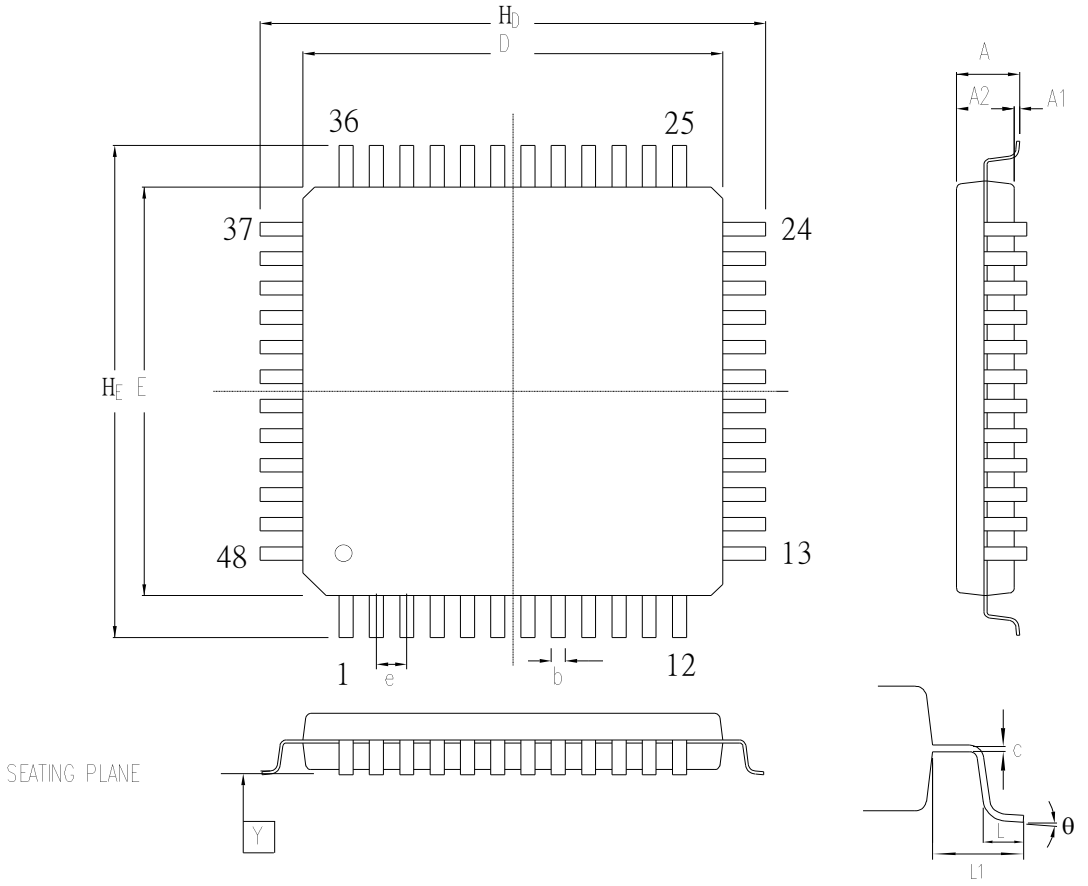






		SYMBOL	MIN	NOM	MAX
TOTAL THICKNESS		A	0.7	0.75	0.8
STAND OFF		A1	0	0.035	0.05
MOLD THICKNESS		A2	---	0.55	0.57
L/F THICKNESS		A3		0.203 REF	
LEAD WIDTH		b	0.2	0.25	0.3
BODY SIZE	X	D		5 BSC	
	Y	E		5 BSC	
LEAD PITCH		e		0.5 BSC	
EP SIZE	X	J	3.4	3.5	3.6
	Y	K	3.4	3.5	3.6
LEAD LENGTH		L	0.35	0.4	0.45
PACKAGE EDGE TOLERANCE		aaa		0.1	
MOLD FLATNESS		bbb		0.1	
COPLANARITY		ccc		0.08	
LEAD OFFSET		ddd		0.1	
EXPOSED PAD OFFSET		eee		0.1	

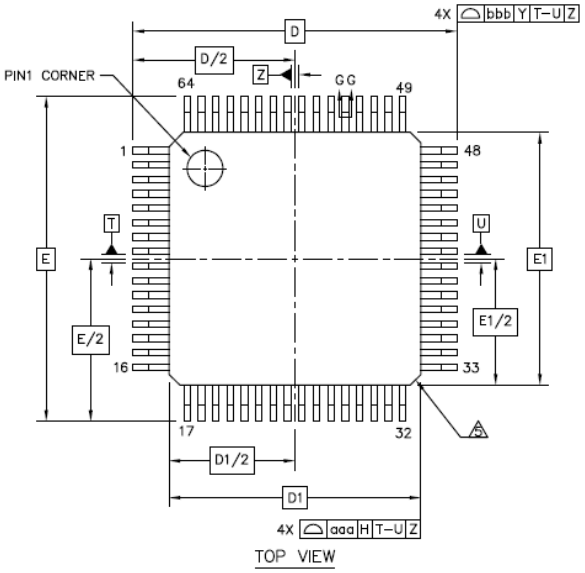
6.2 LQFP 48L (7x7x1.4 mm^3 Footprint 2.0mm)



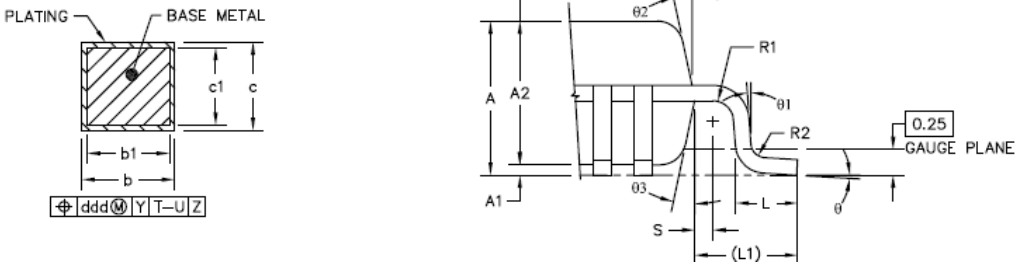
Controlling dimension : Millimeters

Symbol	Dimension in inch			Dimension in mm		
	Min	Nom	Max	Min	Nom	Max
A	—	—	—	—	—	—
A_1	0.002	0.004	0.006	0.05	0.10	0.15
A_2	0.053	0.055	0.057	1.35	1.40	1.45
b	0.006	0.008	0.010	0.15	0.20	0.25
c	0.004	0.006	0.008	0.10	0.15	0.20
D	0.272	0.276	0.280	6.90	7.00	7.10
E	0.272	0.276	0.280	6.90	7.00	7.10
e	0.014	0.020	0.026	0.35	0.50	0.65
H_D	0.350	0.354	0.358	8.90	9.00	9.10
H_E	0.350	0.354	0.358	8.90	9.00	9.10
L	0.018	0.024	0.030	0.45	0.60	0.75
L_1	—	0.039	—	—	1.00	—
Y	—	—	0.004	—	—	0.10
θ	0	—	7	0	—	7

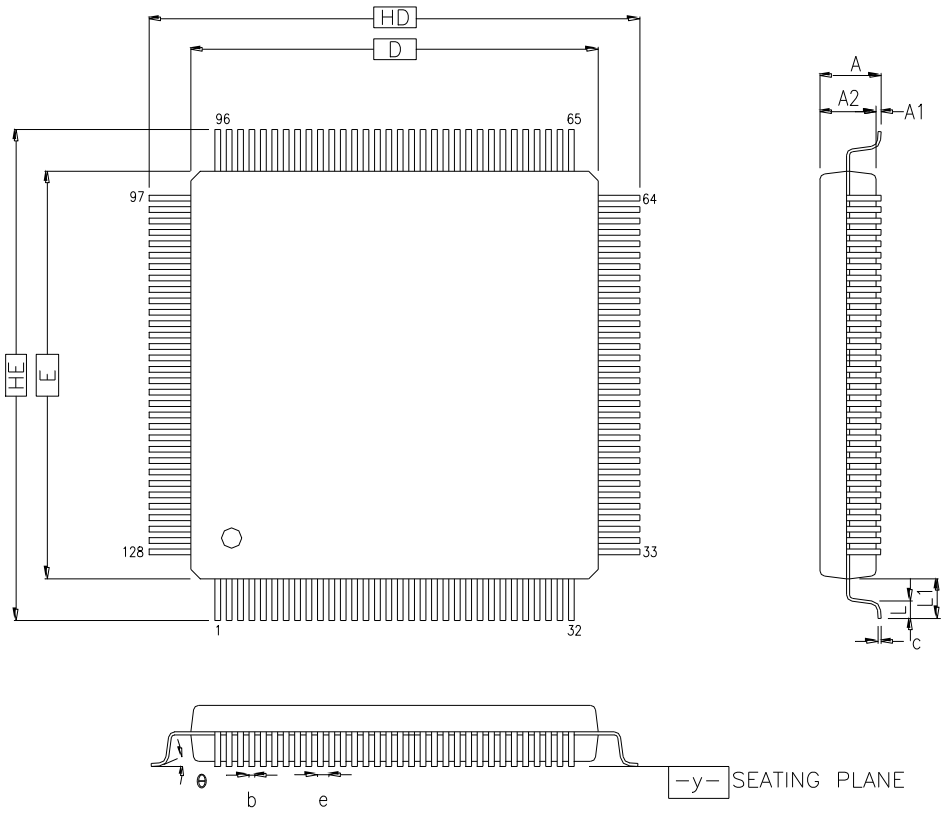
6.3 LQFP 64L (7x7x1.4 mm^3 footprint 2.0 mm)



		SYMBOL	MIN	NOM	MAX
TOTAL THICKNESS		A	---	---	1.6
STAND OFF		A1	0.05	---	0.15
MOLD THICKNESS		A2	1.35	1.4	1.45
LEAD WIDTH(PLATING)		b	0.13	0.18	0.23
LEAD WIDTH		b1	0.13	0.16	0.19
L/F THICKNESS(PLATING)		c	0.09	---	0.2
L/F THICKNESS		c1	0.09	---	0.16
	X	D	9 BSC		
	Y	E	9 BSC		
BODY SIZE	X	D1	7 BSC		
	Y	E1	7 BSC		
LEAD PITCH		e	0.4 BSC		
		L	0.45	0.6	0.75
FOOTPRINT		L1	1 REF		
		θ	0°	3.5°	7°
		θ1	0°	---	---
		θ2	11°	12°	13°
		θ3	11°	12°	13°
		R1	0.08	---	---
		R2	0.08	---	0.2
		S	0.2	---	---
PACKAGE EDGE TOLERANCE		aaa	0.2		
LEAD EDGE TOLERANCE		bbb	0.2		
COPLANARITY		ccc	0.08		
LEAD OFFSET		ddd	0.07		
MOLD FLATNESS		eee	0.05		



6.4 LQFP 128L (14x14x1.4 mm^3 footprint 2.0 mm)



COTROL DIMENSIONS ARE IN MILLIMETERS.

SYMBOL	MILLIMETER			INCH		
	MIN.	NOM.	MAX.	MIN.	NOM.	MAX.
A	—	—	1.60	—	—	0.063
A_1	0.05	—	0.15	0.002	—	0.006
A_2	1.35	1.40	1.45	0.053	0.055	0.057
HD		16.00 BSC.			0.630 BSC.	
D		14.00 BSC.			0.551 BSC.	
HE		16.00 BSC.			0.630 BSC.	
E		14.00 BSC.			0.551 BSC.	
b	0.13	0.16	0.23	0.005	0.006	0.009
e		0.40 BSC.			0.016 BSC.	
θ	0°	3.5°	7°	0°	3.5°	7°
c	0.09	—	0.20	0.004	—	0.008
L	0.45	0.60	0.75	0.018	0.024	0.030
L_1		1.00 REF			0.039 REF	
y	–	–	0.1	–	–	0.004

7 UTILITIES

7.1 Programmer and Debugger

Nu-Link	Basic hardware programmer/debugger
Nu-Link-Pro	Advance hardware programmer/debugger with programming counter
Nu-Link2	Multi-functional hardware programmer/debugger which support high-speed USB 2.0
Nu-Trace	Nu-Trace supports all of Nu-Link2's features plus ETM trace function (4-bit data).
Nu-Link-Gang	Standalone hardware programmer which supports up to four chips programming in mass production.
ISP Tool	Software programming tool for In-System Programming. Supported interface includes UART and USB https://www.nuvoton.com/hq/support/tool-and-software/software/programmer/
ICP Tool	Software programming tool for In-Chip Programming, supported Nu-LinkX hardware programmer. https://www.nuvoton.com/hq/support/tool-and-software/software/programmer/

7.2 Development Environment

https://www.nuvoton.com/hq/support/tool-and-software/software/development-tool/

Supported IDE	Keil® MDK, IAR Embedded Workbench, NuEclipse (GCC) https://www.nuvoton.com/hq/support/tool-and-software/software/
Software Package	Board Support Package (BSP), Sample Code
Configure Software	NuTool PinConfig, NuTool PinView, NuTool ClockConfig, NuConsole, GUI Builder https://www.nuvoton.com/hq/support/tool-and-software/software/development-tool/
Real Time OS	Arm® Mbed® OS, FreeRTOS, Amazon FreeRTOS, AliOS Things
Graphic Library	emWin (embedded graphics library)

7.3 Development Board

Part No.	**Description**
NK-M483KG	Development board of NuMicro® M480 series.

8 REVISION HISTORY

Date	Revision	Description
2019.10.07	2.00	Preliminary version.