

ARM Cortex™-M0
32-BIT MICROCONTROLLER

NuMicro™ Family
NUC130 Product Brief

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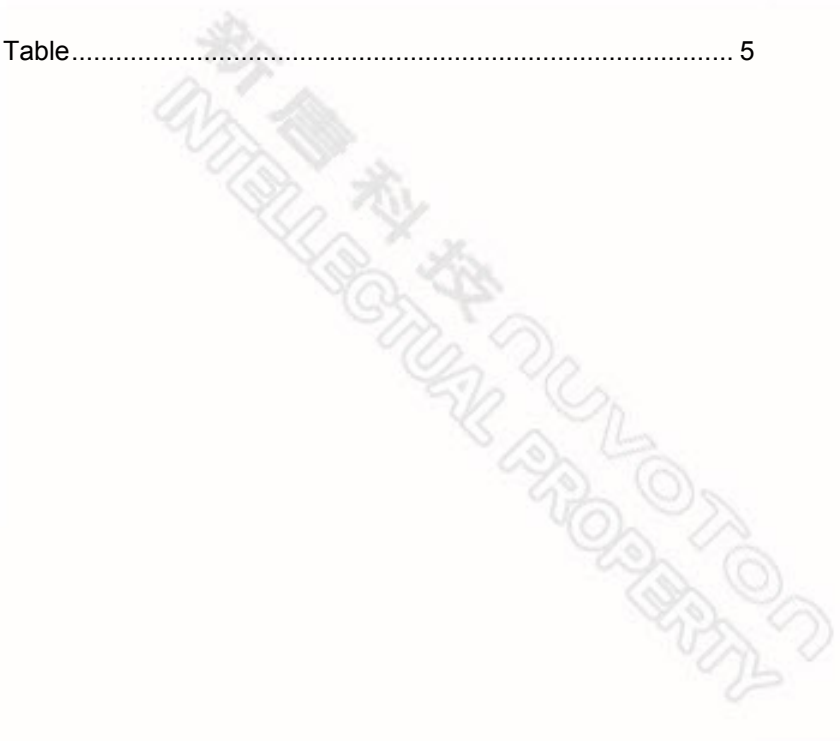
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1 GENERAL DESCRIPTION

The NuMicro™ NUC100 Series is 32-bit microcontrollers with embedded ARM® Cortex™-M0 core for industrial control and applications which need rich communication interfaces. The Cortex™-M0 is the newest ARM® embedded processor with 32-bit performance and at a cost equivalent to traditional 8-bit microcontroller. NuMicro™ NUC100 Series includes NUC100, NUC120, NUC130 and NUC140 product line.

The NuMicro™ NUC130 Automotive Line with CAN function embeds Cortex™-M0 core running up to 50 MHz with 32K/64K/128K-byte embedded flash, 4K/8K/16K-byte embedded SRAM, and 4K-byte loader ROM for the ISP. It also equips with plenty of peripheral devices, such as Timers, Watchdog Timer, RTC, PDMA, UART, SPI, I²C, I²S, PWM Timer, GPIO, LIN, CAN, PS/2, 12-bit ADC, Analog Comparator, Low Voltage Reset Controller and Brown-out Detector.

Product Line	UART	SPI	I ² C	USB	LIN	CAN	PS/2	I ² S
NUC100	•	•	•				•	•
NUC120	•	•	•	•			•	•
NUC130	•	•	•		•	•	•	•
NUC140	•	•	•	•	•	•	•	•

Table 1-1 Connectivity Supported Table

2 FEATURES

The equipped features are dependent on the product line and their sub products.

2.1 NuMicro™ NUC130 Features – Automotive Line

- Core
 - ARM® Cortex™-M0 core runs up to 50 MHz
 - One 24-bit system timer
 - Supports low power sleep mode
 - Single-cycle 32-bit hardware multiplier
 - NVIC for the 32 interrupt inputs, each with 4-levels of priority
 - Serial Wire Debug supports with 2 watchpoints/4 breakpoints
- Build-in LDO for wide operating voltage ranges from 2.5 V to 5.5 V
- Flash Memory
 - 32K/64K/128K bytes Flash for program code
 - 4KB flash for ISP loader
 - Support In-system program (ISP) application code update
 - 512 byte page erase for flash
 - Configurable data flash address and size for 128KB system, fixed 4KB data flash for the 32KB and 64KB system
 - Support 2 wire ICP update through SWD/ICE interface
 - Support fast parallel programming mode by external programmer
- SRAM Memory
 - 4K/8K/16K bytes embedded SRAM
 - Support PDMA mode
- PDMA (Peripheral DMA)
 - Support 9 channels PDMA for automatic data transfer between SRAM and peripherals
- Clock Control
 - Flexible selection for different applications
 - Built-in 22.1184 MHz high speed OSC for system operation
 - ◆ Trimmed to $\pm 1\%$ at $+25\text{ }^\circ\text{C}$ and $V_{DD} = 5\text{ V}$
 - ◆ Trimmed to $\pm 3\%$ at $-40\text{ }^\circ\text{C} \sim +85\text{ }^\circ\text{C}$ and $V_{DD} = 2.5\text{ V} \sim 5.5\text{ V}$
 - Built-in 10 kHz low speed OSC for Watchdog Timer and Wake-up operation
 - Support one PLL, up to 50 MHz, for high performance system operation
 - External 4~24 MHz high speed crystal input for precise timing operation
 - External 32.768 kHz low speed crystal input for RTC function and low power system operation
- GPIO
 - Four I/O modes:
 - ◆ Quasi bi-direction
 - ◆ Push-Pull output
 - ◆ Open-Drain output
 - ◆ Input only with high impedance
 - TTL/Schmitt trigger input selectable
 - I/O pin can be configured as interrupt source with edge/level setting
 - High driver and high sink IO mode support



- Timer
 - Support 4 sets of 32-bit timers with 24-bit up-timer and one 8-bit pre-scale counter
 - Independent clock source for each timer
 - Provides one-shot, periodic, toggle and continuous counting operation modes
 - Support event counting function
 - Support input capture function
- Watchdog Timer
 - Multiple clock sources
 - 8 selectable time out period from 1.6ms ~ 26.0sec (depends on clock source)
 - WDT can wake-up from power down or idle mode
 - Interrupt or reset selectable on watchdog time-out
- RTC
 - Support software compensation by setting frequency compensate register (FCR)
 - Support RTC counter (second, minute, hour) and calendar counter (day, month, year)
 - Support Alarm registers (second, minute, hour, day, month, year)
 - Selectable 12-hour or 24-hour mode
 - Automatic leap year recognition
 - Support periodic time tick interrupt with 8 period options 1/128, 1/64, 1/32, 1/16, 1/8, 1/4, 1/2 and 1 second
 - Support wake-up function
- PWM/Capture
 - Built-in up to four 16-bit PWM generators provide eight PWM outputs or four complementary paired PWM outputs
 - Each PWM generator equipped with one clock source selector, one clock divider, one 8-bit prescaler and one Dead-Zone generator for complementary paired PWM
 - Up to eight 16-bit digital Capture timers (shared with PWM timers) provide eight rising/falling capture inputs
 - Support Capture interrupt
- UART
 - Up to three UART controllers
 - UART ports with flow control (TXD, RXD, CTS and RTS)
 - UART0 with 64-byte FIFO is for high speed
 - UART1/2(optional) with 16-byte FIFO for standard device
 - Support IrDA (SIR) and LIN function
 - Support RS-485 9-bit mode and direction control.
 - Programmable baud-rate generator up to 1/16 system clock
 - Support PDMA mode
- SPI
 - Up to four sets of SPI controller
 - Master up to 32 MHz, and Slave up to 10 MHz (chip working @ 5V)
 - Support SPI master/slave mode
 - Full duplex synchronous serial data transfer
 - Variable length of transfer data from 1 to 32 bits
 - MSB or LSB first data transfer
 - Rx and Tx on both rising or falling edge of serial clock independently
 - 2 slave/device select lines when it is as the master, and 1 slave/device select line when it is as the slave
 - Support byte suspend mode in 32-bit transmission
 - Support PDMA mode
 - Support three wire, no slave select signal, bi-direction interface

- I²C

- Up to two sets of I²C device
- Master/Slave mode
- Bidirectional data transfer between masters and slaves
- Multi-master bus (no central master)
- Arbitration between simultaneously transmitting masters without corruption of serial data on the bus
- Serial clock synchronization allows devices with different bit rates to communicate via one serial bus
- Serial clock synchronization can be used as a handshake mechanism to suspend and resume serial transfer
- Programmable clocks allow versatile rate control
- Support multiple address recognition (four slave address with mask option)

- I²S

- Interface with external audio CODEC
- Operate as either master or slave mode
- Capable of handling 8-, 16-, 24- and 32-bit word sizes
- Mono and stereo audio data supported
- I²S and MSB justified data format supported
- Two 8 word FIFO data buffers are provided, one for transmit and one for receive
- Generates interrupt requests when buffer levels cross a programmable boundary
- Support two DMA requests, one for transmit and one for receive

- PS/2 Device Controller

- Host communication inhibit and request to send detection
- Reception frame error detection
- Programmable 1 to 16 bytes transmit buffer to reduce CPU intervention
- Double buffer for data reception
- S/W override bus

- CAN 2.0

- Supports CAN protocol version 2.0 part A and B
- Bit rates up to 1M bit/s
- 32 Message Objects
- Each Message Object has its own identifier mask
- Programmable FIFO mode (concatenation of Message Object)
- Maskable interrupt
- Disabled Automatic Re-transmission mode for Time Triggered CAN applications
- Support power down wake-up function

- EBI (External bus interface) support (100-pin and 64-pin Package Only)

- Accessible space: 64KB in 8-bit mode or 128KB in 16-bit mode
- Support 8-/16-bit data width
- Support byte write in 16-bit data width mode

- ADC

- 12-bit SAR ADC with 700K SPS
- Up to 8-ch single-end input or 4-ch differential input
- Single scan/single cycle scan/continuous scan
- Each channel with individual result register
- Scan on enabled channels
- Threshold voltage detection
- Conversion start by software programming or external input

- Support PDMA mode
- Analog Comparator
 - Up to two analog comparator
 - External input or internal bandgap voltage selectable at negative node
 - Interrupt when compare result change
 - Power down wake-up
- One built-in temperature sensor with 1°C resolution
- Brown-Out detector
 - With 4 levels: 4.5 V/3.8 V/2.7 V/2.2 V
 - Support Brown-Out Interrupt and Reset option
- Low Voltage Reset
 - Threshold voltage levels: 2.0 V
- Operating Temperature: -40°C~85°C
- Packages:
 - All Green package (RoHS)
 - LQFP 100-pin / 64-pin / 48-pin

3 PARTS INFORMATION LIST AND PIN CONFIGURATION

3.1 NuMicro™ NUC130 Products Selection Guide

3.1.1 NuMicro™ NUC130 Automotive Line Selection Guide

Part number	APROM	RAM	Data Flash	ISP Loader ROM	I/O	Timer	Connectivity					i ² S	Comp.	PWM	ADC	RTC	EBI	ISP ICP	Package	
							UART	SPI	I ² C	USB	LIN									CAN
NUC130LC1CN	32 KB	4 KB	4 KB	4 KB	up to 35	4x32-bit	3	1	2	-	2	1	1	1	4	8x12-bit	v	-	v	LQFP48
NUC130LD2CN	64 KB	8 KB	4 KB	4 KB	up to 35	4x32-bit	3	1	2	-	2	1	1	1	4	8x12-bit	v	-	v	LQFP48
NUC130LE3CN	128 KB	16 KB	Definable	4 KB	up to 35	4x32-bit	3	1	2	-	2	1	1	1	4	8x12-bit	v	-	v	LQFP48
NUC130RC1CN	32 KB	4 KB	4 KB	4 KB	up to 49	4x32-bit	3	2	2	-	2	1	1	2	6	8x12-bit	v	v	v	LQFP64
NUC130RD2CN	64 KB	8 KB	4 KB	4 KB	up to 49	4x32-bit	3	2	2	-	2	1	1	2	6	8x12-bit	v	v	v	LQFP64
NUC130RD3CN	128 KB	16 KB	Definable	4 KB	up to 49	4x32-bit	3	2	2	-	2	1	1	2	6	8x12-bit	v	v	v	LQFP64
NUC130VE3CN	128 KB	16 KB	Definable	4 KB	up to 80	4x32-bit	3	4	2	-	2	1	1	2	8	8x12-bit	v	v	v	LQFP100

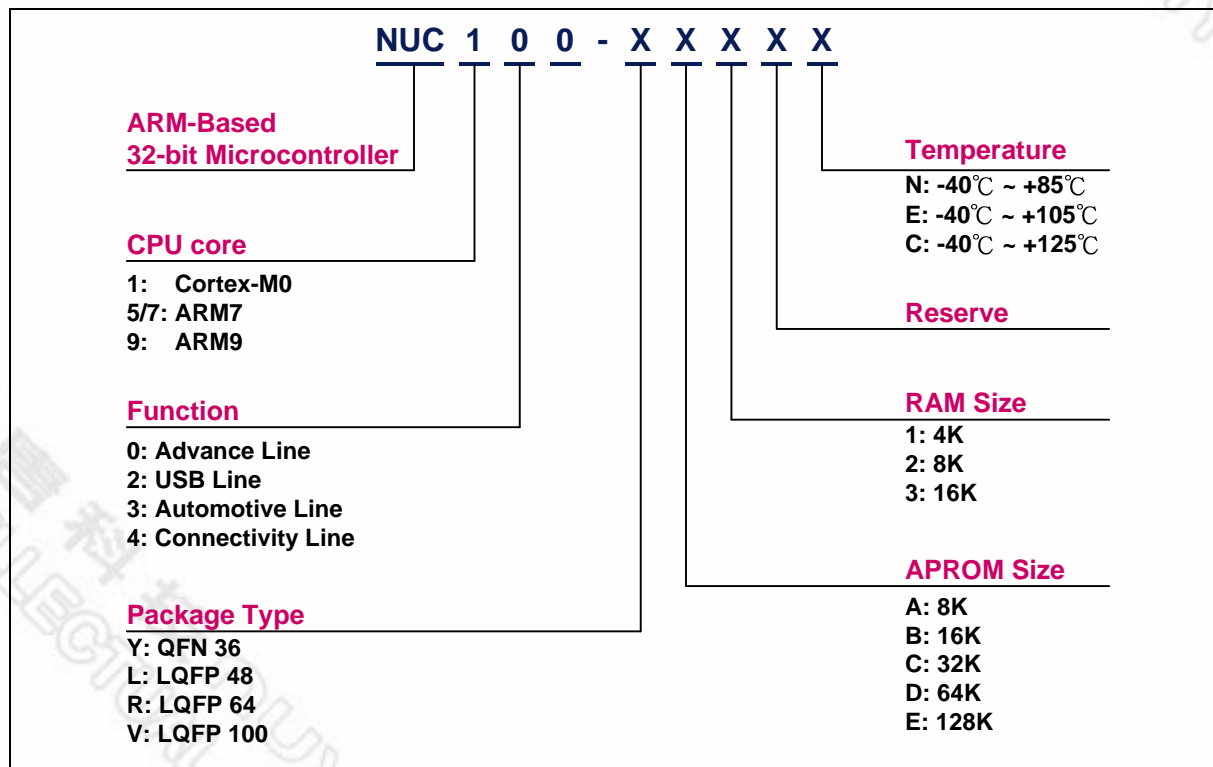


Figure 3-1 NuMicro™ NUC100 Series selection code

3.2 Pin Configuration

3.2.1 NuMicro™ NUC130/NUC140 Pin Diagram

3.2.1.1 NuMicro™ NUC130 LQFP 100 pin

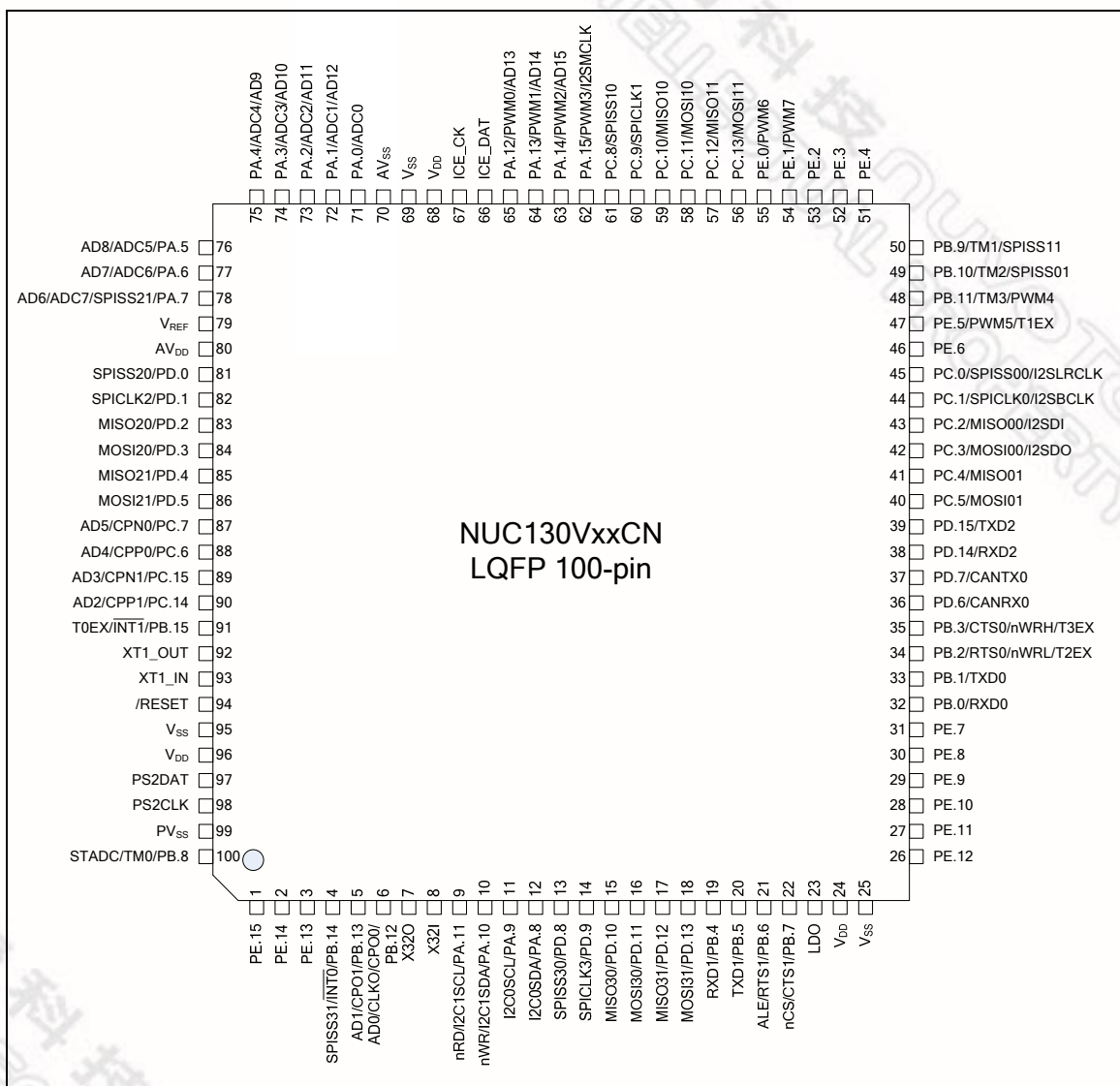


Figure 3-2 NuMicro™ NUC130 LQFP 100-pin Pin Diagram

3.2.1.2 NuMicro™ NUC130 LQFP 64 pin

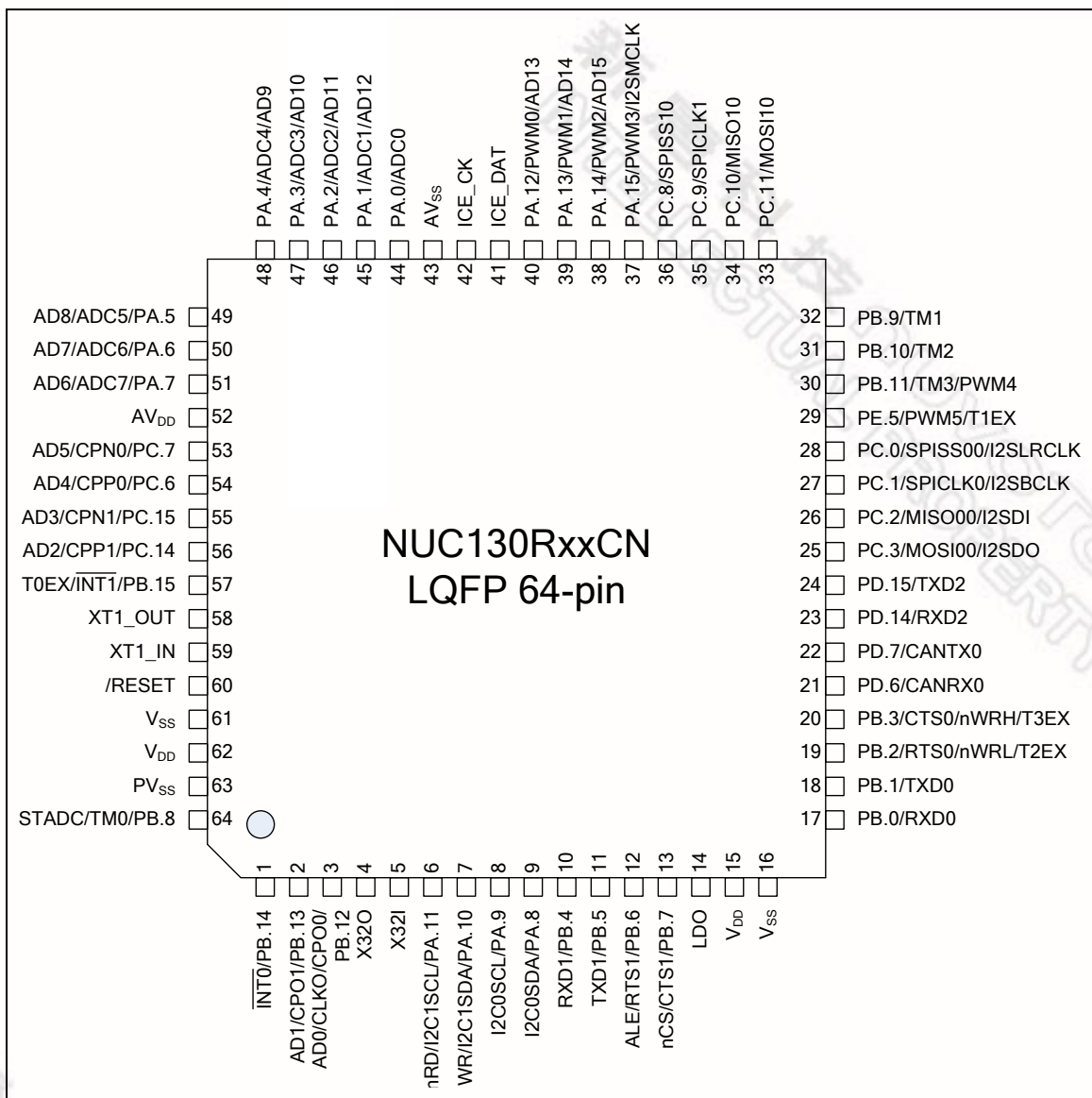


Figure 3-3 NuMicro™ NUC130 LQFP 64-pin Pin Diagram

3.2.1.3 NuMicro™ NUC130 LQFP 48 pin

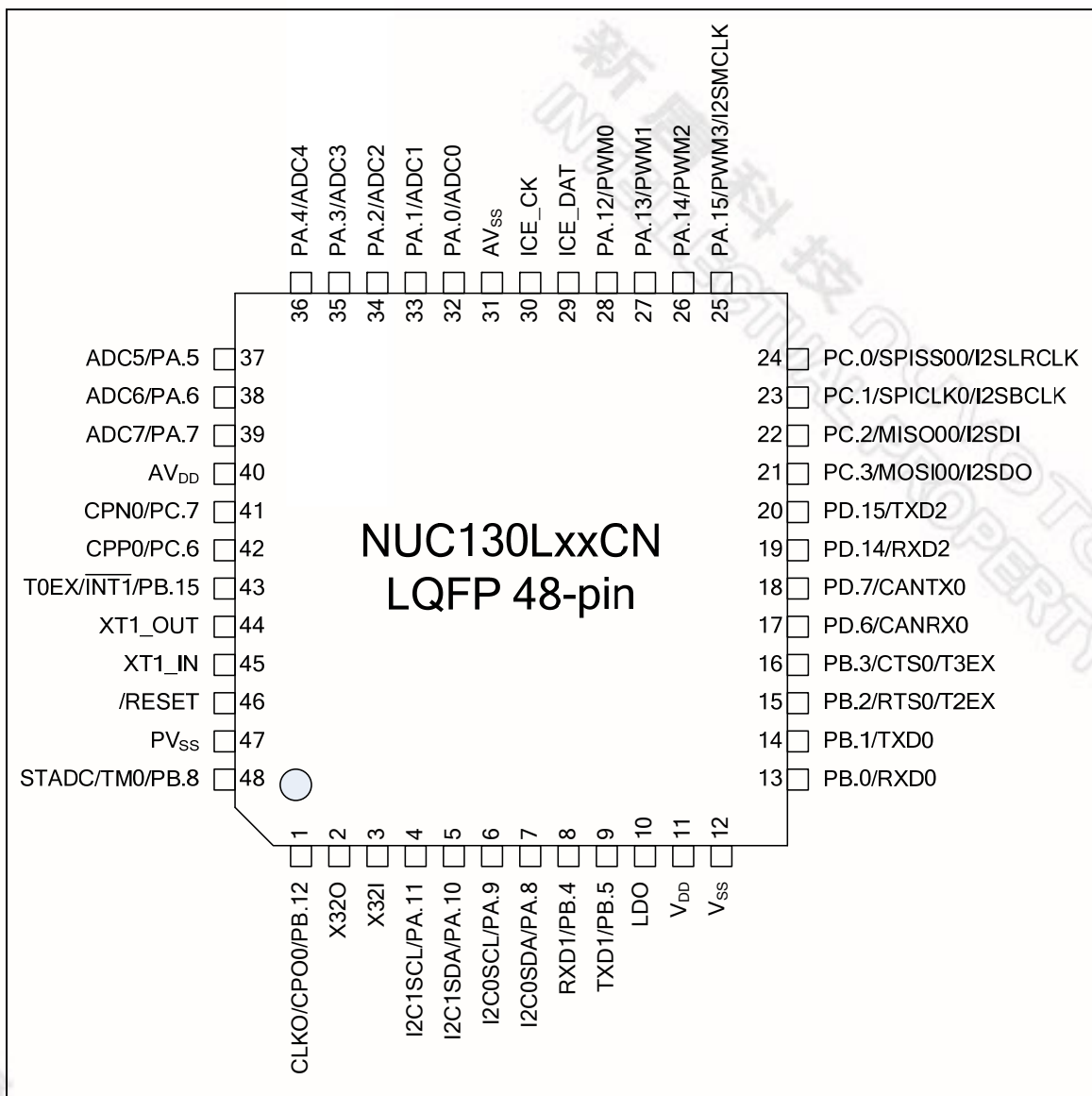


Figure 3-4 NuMicro™ NUC130 LQFP 48-pin Pin Diagram

4 BLOCK DIAGRAM

4.1 NuMicro™ NUC130 Block Diagram

4.1.1 NuMicro™ NUC130 Block Diagram

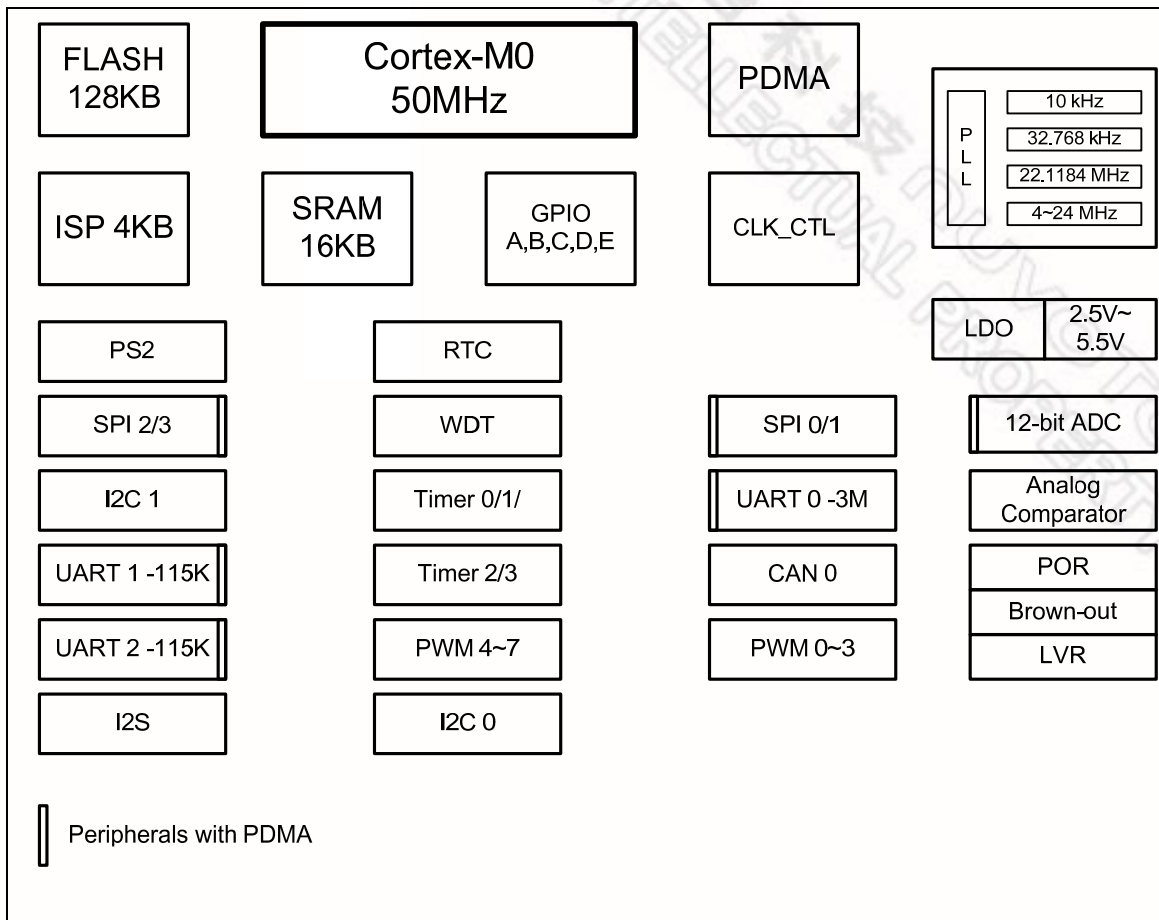


Figure 4-1 NuMicro™ NUC130 Block Diagram

5 ELECTRICAL CHARACTERISTICS

5.1 Absolute Maximum Ratings

PARAMETER	SYMBOL	MIN.	MAX	UNIT
DC Power Supply	$V_{DD}-V_{SS}$	-0.3	+7.0	V
Input Voltage	V_{IN}	$V_{SS}-0.3$	$V_{DD}+0.3$	V
Oscillator Frequency	$1/t_{CLCL}$	4	24	MHz
Operating Temperature	TA	-40	+85	°C
Storage Temperature	TST	-55	+150	°C
Maximum Current into V_{DD}		-	120	mA
Maximum Current out of V_{SS}			120	mA
Maximum Current sunk by a I/O pin			35	mA
Maximum Current sourced by a I/O pin			35	mA
Maximum Current sunk by total I/O pins			100	mA
Maximum Current sourced by total I/O pins			100	mA

Note: Exposure to conditions beyond those listed under absolute maximum ratings may adversely affects the lift and reliability of the device.



5.2 DC Electrical Characteristics

5.2.1 NuMicro™ NUC130/NUC140 DC Electrical Characteristics

($V_{DD}-V_{SS}=3.3$ V, $T_A = 25^\circ\text{C}$, FOSC = 50 MHz unless otherwise specified.)

PARAMETER	SYM.	SPECIFICATION				TEST CONDITIONS
		MIN.	TYP.	MAX.	UNIT	
Operation voltage	V_{DD}	2.5		5.5	V	$V_{DD} = 2.5$ V ~ 5.5 V up to 50 MHz
Power Ground	V_{SS} AV_{SS}	-0.3			V	
LDO Output Voltage	V_{LDO}	-10%	2.5	+10%	V	$V_{DD} > 2.7$ V
Analog Operating Voltage	AV_{DD}	0		V_{DD}	V	
Analog Reference Voltage	Vref	0		AV_{DD}	V	
Operating Current Normal Run Mode @ 50 MHz	I_{DD1}		51		mA	$V_{DD} = 5.5$ V@50 MHz, enable all IP and PLL, XTAL=12 MHz
	I_{DD2}		25		mA	$V_{DD} = 5.5$ V@50 MHz, disable all IP and enable PLL, XTAL=12 MHz
	I_{DD3}		48		mA	$V_{DD} = 3$ V@50 MHz, enable all IP and PLL, XTAL=12 MHz
	I_{DD4}		23		mA	$V_{DD} = 3$ V@50 MHz, disable all IP and enable PLL, XTAL=12 MHz
Operating Current Normal Run Mode @ 12 MHz	I_{DD5}		19		mA	$V_{DD} = 5.5$ V@12 MHz, enable all IP and disable PLL, XTAL=12 MHz
	I_{DD6}		7		mA	$V_{DD} = 5.5$ V@12 MHz, disable all IP and disable PLL, XTAL=12 MHz
	I_{DD7}		17		mA	$V_{DD} = 3$ V@12 MHz, enable all IP and disable PLL, XTAL=12 MHz



PARAMETER	SYM.	SPECIFICATION				TEST CONDITIONS
		MIN.	TYP.	MAX.	UNIT	
	I _{DD8}		6		mA	V _{DD} = 3 V@12 MHz, disable all IP and disable PLL, XTAL=12 MHz
Operating Current Normal Run Mode @ 4 MHz	I _{DD9}		11		mA	V _{DD} = 5 V@4 MHz, enable all IP and disable PLL, XTAL=4 MHz
	I _{DD10}		3		mA	V _{DD} = 5 V@4 MHz, disable all IP and disable PLL, XTAL=4 MHz
	I _{DD11}		10		mA	V _{DD} = 3 V@4 MHz, enable all IP and disable PLL, XTAL=4 MHz
	I _{DD12}		2.5		mA	V _{DD} = 3 V@4 MHz, disable all IP and disable PLL, XTAL=4 MHz
Operating Current Idle Mode @ 50 MHz	I _{IDLE1}		35		mA	V _{DD} = 5.5 V@50 MHz, enable all IP and PLL, XTAL=12 MHz
	I _{IDLE2}		15		mA	V _{DD} =5.5 V@50 MHz, disable all IP and enable PLL, XTAL=12 MHz
	I _{IDLE3}		33		mA	V _{DD} = 3 V@50 MHz, enable all IP and PLL, XTAL=12 MHz
	I _{IDLE4}		13		mA	V _{DD} = 3 V@50 MHz, disable all IP and enable PLL, XTAL=12 MHz
Operating Current Idle Mode @ 12 MHz	I _{IDLE5}		10		mA	V _{DD} = 5.5 V@12 MHz, enable all IP and disable PLL, XTAL=12 MHz
	I _{IDLE6}		4.5		mA	V _{DD} = 5.5 V@12 MHz, disable all IP and disable PLL, XTAL=12 MHz
	I _{IDLE7}		9		mA	V _{DD} = 3 V@12 MHz, enable all IP and disable PLL, XTAL=12 MHz



PARAMETER	SYM.	SPECIFICATION				TEST CONDITIONS
		MIN.	TYP.	MAX.	UNIT	
	I _{IDLE8}		3.5		mA	V _{DD} = 3 V@12 MHz, disable all IP and disable PLL, XTAL=12 MHz
Operating Current Idle Mode @ 4 MHz	I _{IDLE9}		4		mA	V _{DD} = 5 V@4 MHz, enable all IP and disable PLL, XTAL=4 MHz
	I _{IDLE10}		2.5		mA	V _{DD} = 5 V@4 MHz, disable all IP and disable PLL, XTAL=4 MHz
	I _{IDLE11}		3.5		mA	V _{DD} = 3 V@4 MHz, enable all IP and disable PLL, XTAL=4 MHz
	I _{IDLE12}		1.5		mA	V _{DD} = 3 V@4 MHz, disable all IP and disable PLL, XTAL=4 MHz
Standby Current Power down Mode	I _{PWD1}		12		μA	V _{DD} = 5.5 V, RTC OFF, No load @ Disable BOV function
	I _{PWD2}		9		μA	V _{DD} = 3.3 V, RTC OFF, No load @ Disable BOV function
	I _{PWD3}				μA	V _{DD} = 5.5 V, RTC run , No load @ Disable BOV function
	I _{PWD4}				μA	V _{DD} = 3.3 V, RTC run , No load @ Disable BOV function
Input Current PA, PB, PC, PD, PE (Quasi-bidirectional mode)	I _{IN1}		-50	-60	μA	V _{DD} = 5.5 V, V _{IN} = 0 V or V _{IN} =V _{DD}
Input Current at /RESET ^[1]	I _{IN2}	-55	-45	-30	μA	V _{DD} = 3.3 V, V _{IN} = 0.45 V
Input Leakage Current PA, PB, PC, PD, PE	I _{LK}	-2	-	+2	μA	V _{DD} = 5.5 V, 0<V _{IN} <V _{DD}
Logic 1 to 0 Transition Current PA~PE (Quasi-bidirectional mode)	I _{TL} ^[3]	-650	-	-200	μA	V _{DD} = 5.5 V, V _{IN} <2.0 V
Input Low Voltage PA, PB, PC, PD, PE (TTL input)	V _{IL1}	-0.3	-	0.8	V	V _{DD} = 4.5 V
		-0.3	-	0.6		V _{DD} = 2.5 V
Input High Voltage PA, PB, PC, PD, PE (TTL input)	V _{IH1}	2.0	-	V _{DD} +0.2	V	V _{DD} = 5.5 V
		1.5	-	V _{DD} +0.2		V _{DD} =3.0 V
Input Low Voltage PA, PB, PC, PD, PE (Schmitt input)	V _{IL2}	-0.5	-	0.3 V _{DD}	V	

PARAMETER	SYM.	SPECIFICATION				TEST CONDITIONS
		MIN.	TYP.	MAX.	UNIT	
Input High Voltage PA, PB, PC, PD, PE (Schmitt input)	V _{IH2}	0.7 V _{DD}	-	V _{DD} +0.5	V	
Hysteresis voltage of PA~PE (Schmitt input)	V _{HY}		0.2 V _{DD}		V	
Input Low Voltage XT1 ^[*2]	V _{IL3}	0	-	0.8	V	V _{DD} = 4.5 V
		0	-	0.4		V _{DD} = 3.0 V
Input High Voltage XT1 ^[*2]	V _{IH3}	3.5	-	V _{DD} +0.2	V	V _{DD} = 5.5 V
		2.4	-	V _{DD} +0.2		V _{DD} = 3.0 V
Input Low Voltage X32I ^[*2]	V _{IL4}	0	-	0.4	v	
Input High Voltage X32I ^[*2]	V _{IH4}	1.7		2.5	V	
Negative going threshold (Schmitt input), /RESET	V _{ILS}	-0.5	-	0.3 V _{DD}	V	
Positive going threshold (Schmitt input), /RESET	V _{IHS}	0.7 V _{DD}	-	V _{DD} +0.5	V	
Source Current PA, PB, PC, PD, PE (Quasi-bidirectional Mode)	I _{SR11}	-300	-370	-450	μA	V _{DD} = 4.5 V, V _S = 2.4 V
	I _{SR12}	-50	-70	-90	μA	V _{DD} = 2.7 V, V _S = 2.2 V
	I _{SR13}	-40	-60	-80	μA	V _{DD} = 2.5 V, V _S = 2.0 V
Source Current PA, PB, PC, PD, PE (Push-pull Mode)	I _{SR21}	-20	-24	-28	mA	V _{DD} = 4.5 V, V _S = 2.4 V
	I _{SR22}	-4	-6	-8	mA	V _{DD} = 2.7 V, V _S = 2.2 V
	I _{SR23}	-3	-5	-7	mA	V _{DD} = 2.5 V, V _S = 2.0 V
Sink Current PA, PB, PC, PD, PE (Quasi-bidirectional and Push-pull Mode)	I _{SK11}	10	16	20	mA	V _{DD} = 4.5 V, V _S = 0.45 V
	I _{SK12}	7	10	13	mA	V _{DD} = 2.7 V, V _S = 0.45 V
	I _{SK13}	6	9	12	mA	V _{DD} = 2.5 V, V _S = 0.45 V
Brown-Out voltage with BOV_VL [1:0] =00b	V _{BO2.2}	2.1	2.2	2.3	V	
Brown-Out voltage with BOV_VL [1:0] =01b	V _{BO2.7}	2.6	2.7	2.8	V	
Brown-Out voltage with BOV_VL [1:0] =10b	V _{BO3.8}	3.6	3.8	4.0	V	
Brown-Out voltage with BOV_VL [1:0] =11b	V _{BO4.5}	4.3	4.5	4.7	V	
Hysteresis range of BOD voltage	V _{BH}	30	-	150	mV	V _{DD} = 2.5 V~5.5 V



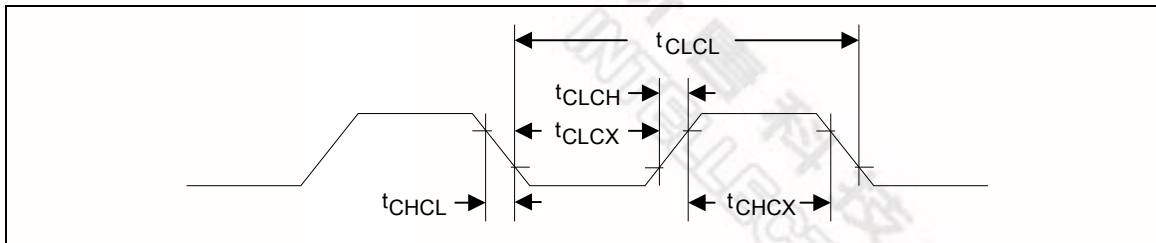
PARAMETER	SYM.	SPECIFICATION				TEST CONDITIONS
		MIN.	TYP.	MAX.	UNIT	
Bandgap voltage	V _{BG}	1.20	1.26	1.32	V	V _{DD} = 2.5 V~5.5 V

Note:

1. /RESET pin is a Schmitt trigger input.
2. Crystal Input is a CMOS input.
3. Pins of PA, PB, PC, PD and PE can source a transition current when they are being externally driven from 1 to 0. In the condition of V_{DD}=5.5 V, the transition current reaches its maximum value when V_{IN} approximates to 2 V.

5.3 AC Electrical Characteristics

5.3.1 External 4~24 MHz High Speed Oscillator



Note: Duty cycle is 50%.

SYMBOL	PARAMETER	CONDITION	MIN.	TYP.	MAX.	UNIT
t _{CHCX}	Clock High Time		20	-	-	nS
t _{CLCX}	Clock Low Time		20	-	-	nS
t _{CLCH}	Clock Rise Time		-	-	10	nS
t _{CHCL}	Clock Fall Time		-	-	10	nS

5.3.2 External 4~24 MHz High Speed Crystal

PARAMETER	CONDITION	MIN.	TYP.	MAX.	UNIT
Input clock frequency	External crystal	4	12	24	MHz
Temperature	-	-40	-	85	°C
V _{DD}	-	2.5	5	5.5	V
Operating current	12 MHz@ V _{DD} = 5V	-	1	-	mA

5.3.2.1 Typical Crystal Application Circuits

CRYSTAL	C1	C2	R
4 MHz ~ 24 MHz	without	without	without

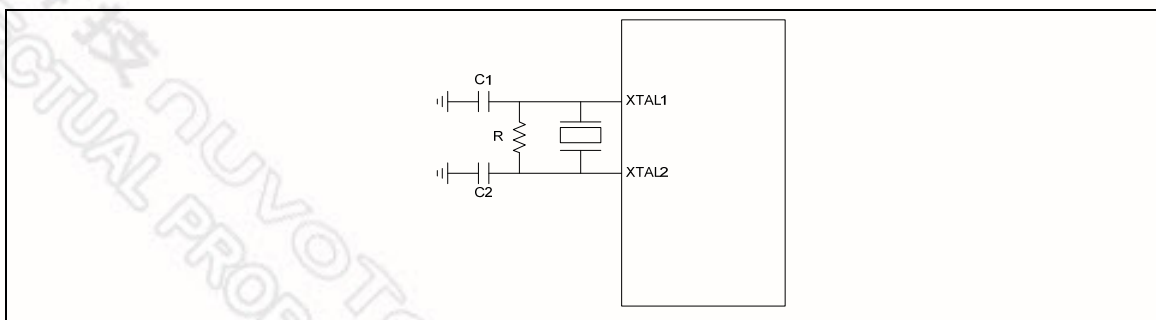


Figure 5-1 Typical Crystal Application Circuit

5.3.3 External 32.768 kHz Low Speed Crystal

PARAMETER	CONDITION	MIN.	TYP.	MAX.	UNIT
Input clock frequency	External crystal	-	32.768	-	kHz
Temperature	-	-40	-	85	°C
V _{DD}	-	2.5	-	5.5	V

5.3.4 Internal 22.1184 MHz High Speed Oscillator

PARAMETER	CONDITION	MIN.	TYP.	MAX.	UNIT
Supply voltage ^[1]	-	2.5	-	5.5	V
Center Frequency	-	-	22.1184	-	MHz
Calibrated Internal Oscillator Frequency	+25°C; V _{DD} =5 V	-1	-	+1	%
	-40°C~+85°C; V _{DD} =2.5 V~5.5 V	-3	-	+3	%
Operation Current	V _{DD} =5 V	-	500	-	uA

5.3.5 Internal 10 kHz Low Speed Oscillator

PARAMETER	CONDITION	MIN.	TYP.	MAX.	UNIT
Supply voltage ^[1]	-	2.5	-	5.5	V
Center Frequency	-	-	10	-	kHz
Calibrated Internal Oscillator Frequency	+25°C; V _{DD} =5 V	-30	-	+30	%
	-40°C~+85°C; V _{DD} =2.5 V~5.5 V	-50	-	+50	%

Note: Internal operation voltage comes from LDO.

5.4 Analog Characteristics

5.4.1 Specification of 12-bit SARADC

SYMBOL	PARAMETER	MIN.	TYP.	MAX.	UNIT
-	Resolution	-	-	12	Bit
DNL	Differential nonlinearity error	-	±3	-	LSB
INL	Integral nonlinearity error	-	±4	-	LSB
EO	Offset error	-	±1	10	LSB
EG	Gain error (Transfer gain)	-	1	1.005	-
-	Monotonic	Guaranteed			
FADC	ADC clock frequency (AV _{DD} =5V/3V)	-	-	16/8	MHz
FS	Sample rate	-	-	700	K SPS
V _{DDA}	Supply voltage	3	-	5.5	V
I _{DD}	Supply current (Avg.)	-	0.5	-	mA
I _{DDA}		-	1.5	-	mA
V _{REF}	Reference voltage	-	V _{DDA}	-	V
I _{REF}	Reference current (Avg.)	-	1	-	mA
V _{IN}	Input voltage	0	-	V _{REF}	V

5.4.2 Specification of LDO and Power management

PARAMETER	MIN.	TYP.	MAX.	UNIT	NOTE
Input Voltage	2.7	5	5.5	V	V _{DD} input voltage
Output Voltage	-10%	2.5	+10%	V	V _{DD} > 2.7 V
Temperature	-40	25	85	°C	
Cbp	-	1	-	uF	Resr=1ohm

Note:

1. It is recommended that a 10uF or higher capacitor and a 100nF bypass capacitor are connected between V_{DD} and the closest V_{SS} pin of the device.

2. For ensuring power stability, a 1uF or higher capacitor must be connected between LDO pin and the closest V_{SS} pin of the device.

5.4.3 Specification of Low Voltage Reset

PARAMETER	CONDITION	MIN.	TYP.	MAX.	UNIT
Operation voltage	-	1.7	-	5.5	V
Quiescent current	V _{DD} =5.5 V	-	-	5	μA
Temperature	-	-40	25	85	°C
Threshold voltage	Temperature=25°C	1.7	2.0	2.3	V
	Temperature=-40°C	-	2.4	-	V
	Temperature=85°C	-	1.6	-	V
Hysteresis	-	0	0	0	V

5.4.4 Specification of Brown-Out Detector

PARAMETER	CONDITION	MIN.	TYP.	MAX.	UNIT
Operation voltage	-	2.5	-	5.5	V
Quiescent current	AV _{DD} =5.5 V	-	-	125	μA
Temperature	-	-40	25	85	°C
Brown-out voltage	BOV_VL[1:0]=11	4.3	4.5	4.7	V
	BOV_VL [1:0]=10	3.6	3.8	4.0	V
	BOV_VL [1:0]=01	2.6	2.7	2.8	V
	BOV_VL [1:0]=00	2.1	2.2	2.3	V
Hysteresis	-	30	-	150	mV

5.4.5 Specification of Power-On Reset (5 V)

PARAMETER	CONDITION	MIN.	TYP.	MAX.	UNIT
Temperature	-	-40	25	85	°C
Reset voltage	V+	-	2	-	V
Quiescent current	V _{in} >reset voltage	-	1	-	nA

5.4.6 Specification of Temperature Sensor

PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Supply voltage ^[1]		2.5	-	5.5	V
Temperature		-40	-	125	°C
Current consumption		6.4	-	10.5	uA
Gain			-1.76		mV/°C
Offset	Temp=0 °C		720		mV

Note: Internal operation voltage comes from LDO.

5.4.7 Specification of Comparator

PARAMETER	CONDITION	MIN.	TYP.	MAX.	UNIT
Temperature	-	-40	25	85	°C
V _{DD}	-	2.4	3	5.5	V
V _{DD} current	20 uA@V _{DD} =3 V	-	20	40	uA
Input offset voltage	-	-	5	15	mV
Output swing	-	0.1	-	V _{DD} -0.1	V
Input common mode range	-	0.1	-	V _{DD} -1.2	V
DC gain	-	-	70	-	dB
Propagation delay	@V _{CM} =1.2 V and V _{DIFF} =0.1 V	-	200	-	ns
Comparison voltage	20 mV@V _{CM} =1 V 50 mV@V _{CM} =0.1 V 50 mV@V _{CM} =V _{DD} -1.2 @10 mV for non-hysteresis	10	20	-	mV
Hysteresis	One bit control W/O and W. hysteresis @V _{CM} =0.4 V ~ V _{DD} -1.2 V	-	±10	-	mV
Wake-up time	@C _{INP} =1.3 V C _{INN} =1.2 V	-	-	2	us

5.5 Flash DC Electrical Characteristics

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
N _{Endu}	Endurance		10000			cycles ^[1]
T _{ret}	Retention time	Temp=25 °C	100			year
T _{erase}	Page erase time		20		40	ms
T _{mass}	Mass erase time		40	50	60	ms
T _{prog}	Program time		35	40	55	us
V _{dd}	Supply voltage		2.25	2.5	2.75	V ^[2]
I _{dd1}	Read current				14	mA
I _{dd2}	Program/Erase current				7	mA
I _{pd}	Power down current				10	uA

1. Number of program/erase cycles.
2. V_{dd} is source from chip LDO output voltage.
3. This table is guaranteed by design, not test in production.

5.6 SPI Dynamic Characteristics

SYMBOL	PARAMETER	MIN.	TYP.	MAX.	UNIT
SPI master mode ($V_{DD} = 4.5V \sim 5.5V$, 30pF loading Capacitor)					
t_{DS}	Data setup time	4	2	-	ns
t_{DH}	Data hold time	0	-	-	ns
t_V	Data output valid time	-	7	11	ns
SPI master mode ($V_{DD} = 3.0V \sim 3.6V$, 30pF loading Capacitor)					
t_{DS}	Data setup time	5	3	-	ns
t_{DH}	Data hold time	0	-	-	ns
t_V	Data output valid time	-	13	18	ns
SPI slave mode ($V_{DD} = 4.5V \sim 5.5V$, 30pF loading Capacitor)					
t_{DS}	Data setup time	0	-	-	ns
t_{DH}	Data hold time	$2 \cdot PCLK + 4$	-	-	ns
t_V	Data output valid time	-	$2 \cdot PCLK + 11$	$2 \cdot PCLK + 19$	ns
SPI slave mode ($V_{DD} = 3.0V \sim 3.6V$, 30pF loading Capacitor)					
t_{DS}	Data setup time	0	-	-	ns
t_{DH}	Data hold time	$2 \cdot PCLK + 6$	-	-	ns
t_V	Data output valid time	-	$2 \cdot PCLK + 19$	$2 \cdot PCLK + 25$	ns

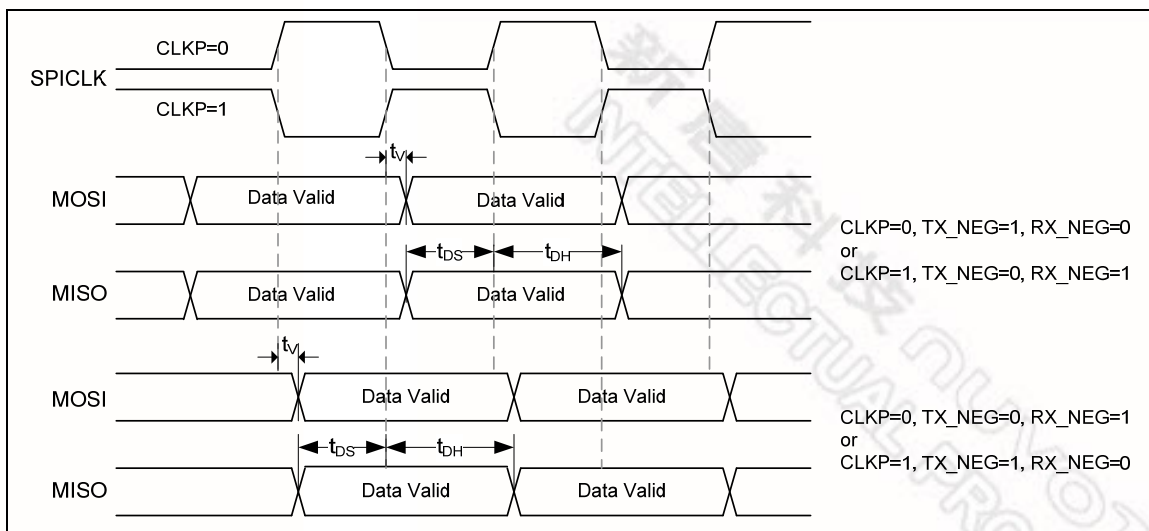


Figure 5-2 SPI Master dynamic characteristics timing

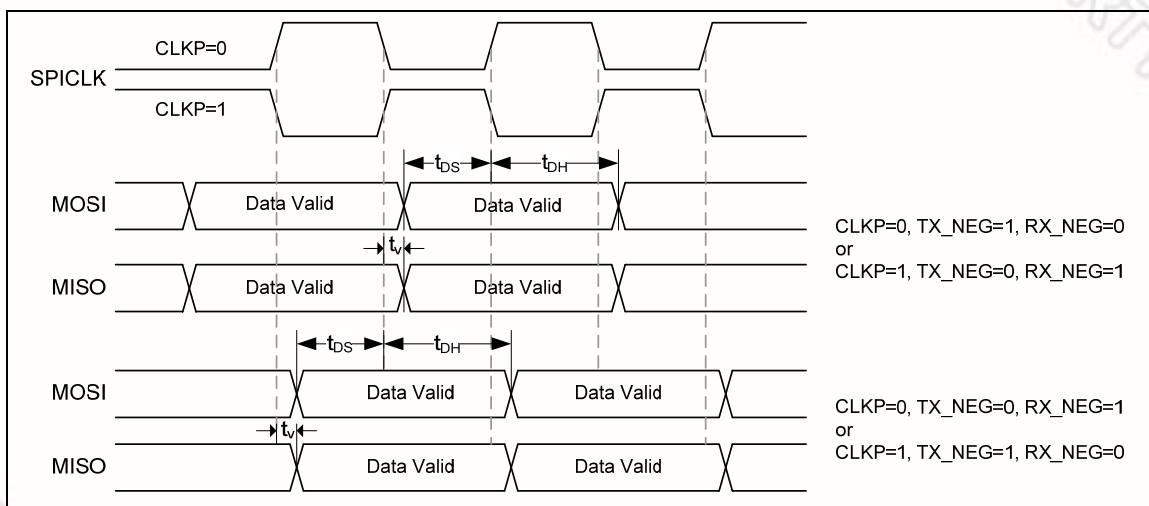
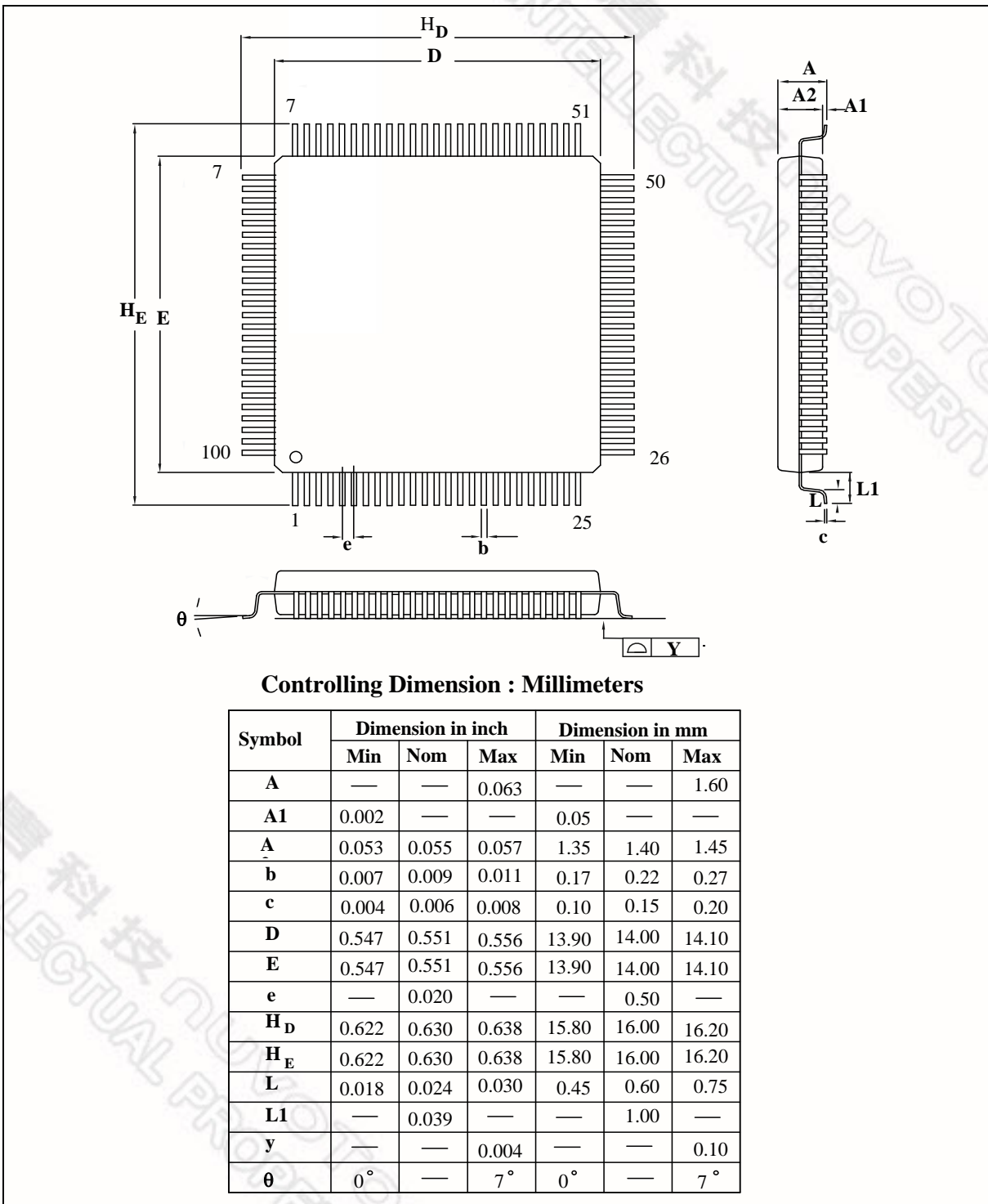


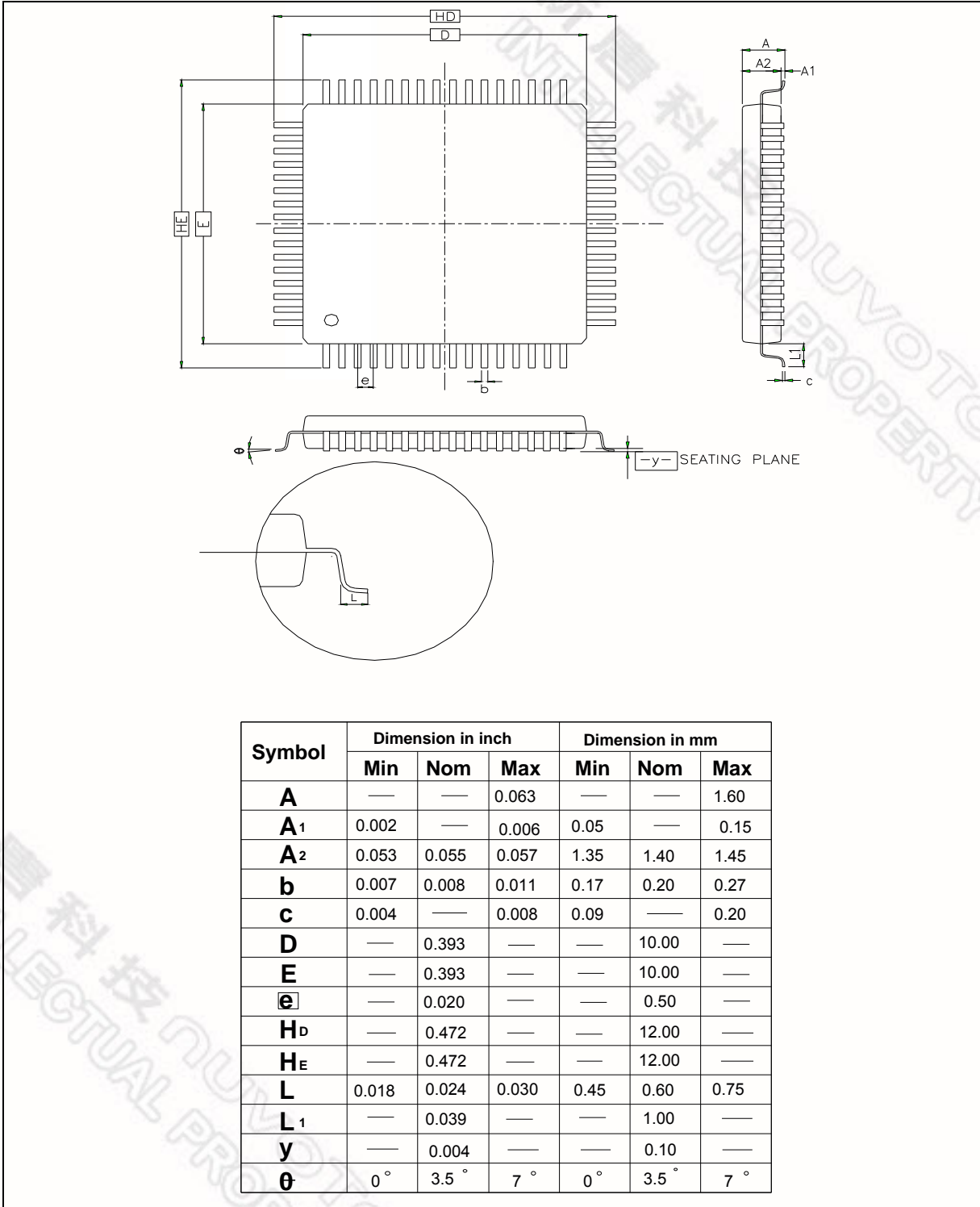
Figure 5-3 SPI Slave dynamic characteristics timing

6 PACKAGE DIMENSIONS

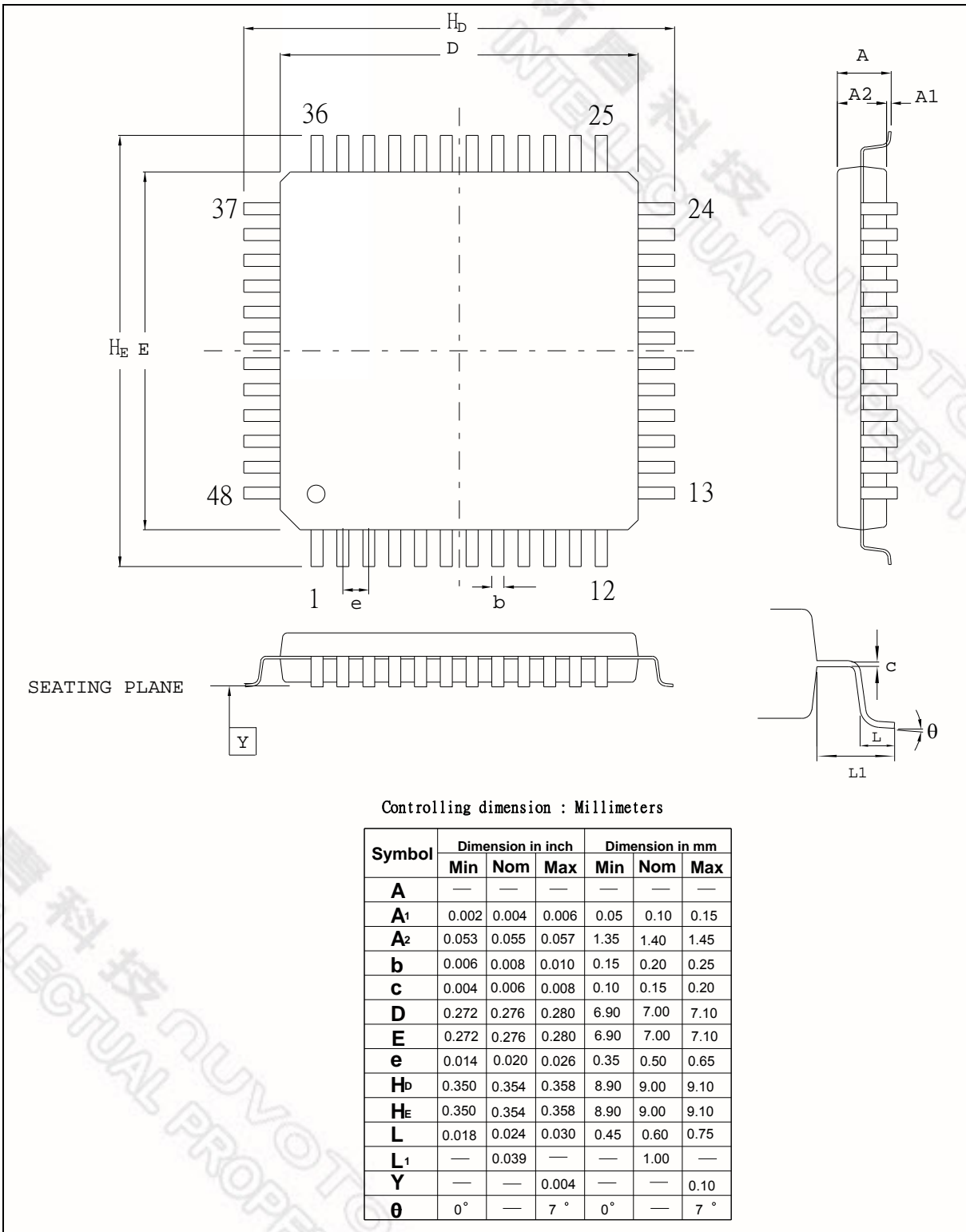
6.1 100L LQFP (14x14x1.4 mm footprint 2.0mm)



6.2 64L LQFP (10x10x1.4mm footprint 2.0 mm)



6.3 48L LQFP (7x7x1.4mm footprint 2.0mm)



7 REVISION HISTORY

VERSION	DATE	PAGE/ CHAP.	DESCRIPTION
V1.00	March 1, 2010	-	Preliminary version initial issued
V1.01	April 9, 2010	Ch4	Modify the block diagram
V1.02	May 31, 2010	7.2	Add operation current of DC characteristics
V1.03	Aug. 23, 2010	7.2	Modify operation current of DC characteristics
V2.00	Nov. 11, 2010	-	Update low density and selection table
V3.00	May 6, 2011	All	Revise from NUC130XXXAN or NUC130XXXBN to NUC130XXXCN Revise NUC130 selection guide Revise DC Electrical Characteristics
V3.01	June 22, 2011	-	modify temperature sensor spec Revise Pin description position for multi-function T2EX, T3EX, nRD, nWR update title of SPI Dynamic Characteristics update BOD spec
V3.02	Jan. 2, 2012	-	1. Modify ADC analog characteristic spec 2. Remove SPI FIFO mode

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