



九齊科技股份有限公司  
Nyquest Technology Co., Ltd.

DATA SHEET

## **NX11M2xA Series**

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**Up to 30-min Voice Prompt IC in a small  
SOP-8 / SOP-16 package**

**Version 1.5**

**Nov. 24, 2023**

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## Revision History

<b>Version</b>	<b>Date</b>	<b>Description</b>	<b>Modified Page</b>
1.0	2019/05/10	Formal release.	-
1.1	2019/11/22	<ol style="list-style-type: none"><li>1. Add duration column for line-up.</li><li>2. Add 4.5Kbps for SBC.</li></ol>	4, 7 5, 8
1.2	2020/06/02	Rename programming pin names to avoid confusion.	10, 20
1.3	2021/12/24	Revise I <sub>HALT</sub> with typical values.	4, 7, 16
1.4	2022/4/27	<ol style="list-style-type: none"><li>1. Quality upgraded to Industrial Grade: -40 ~ 85°C.</li><li>2. Add DAC output for using external power amplifier.</li><li>3. Revise DAC characteristics with test conditions.</li></ol>	16, 17, 20
1.5	2023/11/24	<ol style="list-style-type: none"><li>1. Update operating voltage range.</li></ol>	4, 7

## 1. 概述

NX11M2xA 系列是基於 32位元 CPU 的高品質 Speech/MIDI 處理器，特別設計成小巧的SOP-8 / SOP-16多晶片封裝，將SPI Flash堆疊在MCP內部。內嵌OTP作為量產晶片，完全不需要掩膜費用，並且擁有OTP產品在MOQ和交期的優勢。

CPU內建 ILM/DLM 本地匯流排，提供每兆赫高達 1.57 DMIPS 的優異表現，當在32MHz最高系統頻率時，更可達到 50+ DMIPS。雙頻率設計則可讓使用者在高速與低速頻率之間切換以求最佳的功耗/效能比。

NX11M2xA 系列包含數個產品，由內部堆疊SPI Flash記憶體大小、I/O數目、以及封裝型態來區分。NX11M2xA 採用記憶體映射架構，可以定址到16MB，包含記憶體(OTP/RAM)、週邊、以及SPI Flash的儲存空間(支援指令/資料模式)。由於DSP演算法以及硬體規格的提升，NX11M2xA 支援SBC (Sub-Band Coding, 子帶編碼)，相較于傳統式的ADPCM演算法，除了更高的壓縮率之外，在音質上也大幅超越傳統的語音水準！藉由32位元MCU軟體的高性能運算，可用來實現16和弦MIDI。所有的資料，包括SBC / MIDI 檔案、音色波表(Wavetable)、XIP 程式、一般使用者資料，都可以從SPI Flash取得。

NX11M2xA 涵蓋了大量實用的功能：2組16位元的計時器(Timer)；14位元的數位類比轉換器(DAC)加上1.3瓦的推挽式功放可直接驅動喇叭；每根 I/O 管腳獨立控制、可作為多功能用途的 GPIO；支援 38KHz/57KHz/125KHz/500KHz載波傳輸的紅外發射(IR TX)或QFID應用；SPI0用來控制堆疊在MCP內部的SPI Flash，可選擇內建的 3.3V LDO來供電，並支援 Single/Dual/Quad I/O模式以及 XIP (eXecute In Place, 在地執行程式) 功能。

NX11M2xA 系列除了可用 C 語言在 *NYIDE* 環境下開發，提供客戶更多的控制度來滿足較高複雜度的產品開發。更將高階的 *Q-Code* 語言移植到32位元MCU，不僅提供簡單易用和高生產力的開發環境，更把握了產品構想及時實現的重要性。藉由 *NX\_Programmer* 硬體多功能USB轉串列適配器，使用者可以方便地完成以下諸多事項：當作 *NX1\_ICE* 進行程式除錯；以 *NX1\_FDB* (Flash Demo Board) 完成原型的演示；以及使用多晶片的SOP封裝來量產。*NX\_Programmer* 還提供 ICP (In-Circuit Programming) 燒寫量產板上 SPI Flash 的功能，方便客戶先組裝PCBA模組再進行燒錄。

NX11M2xA 系列採用堆疊式封裝，將SPI Flash集成在小型的SOP-8 / SOP-16 多晶片封裝 (MCP, Multi-Chip Package) 之中，用以滿足各式多樣化的應用。

## 2. 功能

- 寬廣的工作電壓：2.2V ~ 5.5V
  - SPI0 上的 SPI Flash 由內建 3.3V LDO 供電。
  - CPU 最高速度 32MHz 運行時，最低工作電壓為 3.0V；最低速度 12MHz 運行時，最低工作電壓為 2.2V。
- 32 位元 CPU 內核
  - Andes N705-S，性能相當於 ARM Cortex-M0+。
  - 最高 CPU 頻率：32MHz，搭配零等待狀態(wait-state) 的高速 OTP，可達 50+ DMIPS。
  - 單一指令週期快速乘法器。
- 共有 8 個母體，SPI Flash 容量為 4Mb 到 32Mb。

P/N	RAM	OTP	I/O	Flash (Mb)	Duration (Second, SBC)		SPI0	16-bit Timer	Push-Pull	Package
					7.2Kbps	16Kbps				
NX11M22AS8	4KB	32KB	4	4	583	263	v	2	v	SOP-8, 150mil
NX11M22AS16	4KB	32KB	12	4	583	263	v	2	v	SOP-16, 150mil
NX11M23AS8	4KB	32KB	4	8	1,166	525	v	2	v	SOP-8, 150mil
NX11M23AS16	4KB	32KB	12	8	1,166	525	v	2	v	SOP-16, 150mil
NX11M24AS8	4KB	32KB	4	16	2,331	1,049	v	2	v	SOP-8, 150mil
NX11M24AS16	4KB	32KB	12	16	2,331	1,049	v	2	v	SOP-16, 150mil
NX11M25AS8	4KB	32KB	4	32	4,661	2,098	v	2	v	SOP-8, 150mil
NX11M25AS16	4KB	32KB	12	32	4,661	2,098	v	2	v	SOP-16, 150mil

Table 1 Product Line-Up of NX11M2xA Series

- 雙時脈操作，內建 HI\_CLK(32MHz)和 LO\_CLK(32.768KHz) 振盪器。(精準度：HI\_CLK @ +/-0.5%，LO\_CLK @ +/-1.5%)
- 四種工作模式可隨系統需求調整電流消耗：正常 (Normal) / 慢速 (Slow) / 待機 (Standby) / 睡眠 (Halt)，在睡眠模式下，典型耗電流 @ 1uA。
- 內建 6 階低電壓檢測器 (LVD)：3.6V, 3.4V, 3.2V, 2.6V, 2.4V, 2.2V。
- 內建低壓復位功能 (LVR)：使用者可以自行設定，預設值為 2.7V @ 32MHz, 2.4V @ 24MHz, 2.0V @ 16MHz, 1.8V @ 12MHz。
- 二組 16 位下數計時器 (Timer0 / Timer1)。
- 內建 14 位元 DAC(數位類比轉換器) 以及 1.3 瓦推挽式功放
- 最多 12 根 I/O 管腳，除了上拉電阻(以 byte 為單位)以外，每根管腳可由暫存器個別位元控制。
- 支援主模式 SPI (Master)以連接 SPI Flash 並堆疊於 MCP 封裝內部
  - 高達 32MHz 時脈。
  - 支援數據模式以及 XIP 模式 (在地執行程式)。
  - 支援 x1 / x2 / x4 I/O 數據模式 (Single / Dual / Quad)。

- 內建 IR 傳輸介面。
- 支援實時時鐘(RTC)：16KHz / 1KHz / 64Hz / 2Hz 中斷。
- 支援看門狗(WDT)計時：可選 188ms / 750ms 重置。
- 多晶片封裝 (MCP, Multi-Chip Package)
  - SPI Flash 堆疊在 SOP-8 / SOP-16 封裝內部
  - 支持 4Mb / 8Mb / 16Mb / 32Mb SPI Flash
  - SPI0 介面在封裝內部邦定，使小型封裝具備更多的 GPIO 管腳
  - 內置推挽式功放、直推喇叭
  - 最大 GPIO 管腳數：4 @ SOP-8，12 @ SOP-16
  - 可作 Master 或 Slave 操作
- 支援 OTP 安全鎖防讀寫。
- 簡易開發環境
  - 高階易用的 *Q-Code* 程式。
  - 進階的 *NYIDE C* 語言程式。
  - 多用途 NX\_Programmer™ 搭配 NX1\_FDB 以及 NX11M2xA 系列。
- 基於軟件的語音/MIDI 編解碼器以及各式演算法
  - ADPCM 編解碼：每採樣點 4 位元 / 5 位元。
  - SBC 編解碼：4.5K ~ 32K 比特率，最高頻寬 16KHz。
  - CELP 解碼：4.8K 比特率(8KHz 採樣率)，僅限人聲。
  - MIDI 解碼：最多 16 通道(32KHz 輸出採樣率)。
- 支援 4 倍頻超採樣濾波器。
- 出貨形態
  - 多晶片 MCP 封裝：SOP-8 / SOP-16。

## 1. GENERAL DESCRIPTION

The NX11M2xA series is a 32-bit MCU based high-quality speech/MIDI processor, which is specially designed in a small SOP-8 / SOP-16 package with SPI Flash stacked inside the MCP. It is embedded with OTP (One Time PROM) for mass production, such that no mask is required while MOQ / Lead Time are kept minimized.

With Instruction / Data Local Memory bus (ILM/DLM) built in CPU, the NX11M2xA can run 1.57 DMIPS per MHz and up to 50+ DMIPS @ 32MHz. In addition, the dual clock design let customers switch between fast / slow clocks for achieving the best power consumption and performance ratio.

The NX11M2xA series consists of several derivatives with respect to the memory size of stacked SPI Flash, I/O and package type. With memory-mapped architecture, the NX11M2xA can address up to 16MB space that includes memory, register files, peripheral and SPI Flash storage (including instruction / data modes). SBC (Sub-Band Coding) is achieved with greatly enhanced quality & much less memory size compared against traditional ADPCM coding due to the incorporation of efficient DSP algorithms as well as the upgrade of H/W spec. Via the high performance of 32-bit MCU, the S/W-based MIDI synthesizer can reach more than 16-ch polyphonic channels. All data including SBC / MIDI files, wavetable timbres, XIP codes and general user data, can be accessed from the SPI Flash stacked inside the MCP.

There are various useful features inside the NX11M2xA series: Two sets of 16-bit Timers; 14-bit DAC + 1.3-watt Push-Pull power amplifier to drive speaker directly; independently configurable GPIO per pin with alternate functions; IR TX that supports 38KHz / 57KHz / 125KHz / 500KHz carrier for Infrared or QFID applications; SPI0 for the control of the stacked SPI Flash, powered by embedded 3.3V LDO, which supports single/dual/quad I/O mode with XIP (**eX**ecute **I**n **P**lace) capability.

Project development can be handled by C language at *NYIDE* environment, which provides customers with more controllability over complicated projects. Moreover, The NX11M2xA series brings *Q-Code* (High-level programming) to 32-bit MCU, which provides customers with an easy-to-use, highly productive development environment to cope with the importance of in-time product concept realization. The multi-purpose NX\_Programmer (USB-2-Serial adaptor) H/W provides customers with various functionalities: program code debugging @ ICE, prototype demo @ NX1\_FDB (Flash Demo Board) and mass production @ MCP with OTP embedded. Besides, NX\_Programmer can also provide ICP (In-Circuit Programming) function to program SPI Flash for customers to fabricate PCBA in advance.

The NX11M2xA series adopts stacked MCP technology, which integrates SPI Flash into the small SOP-8 / SOP-16 package, to meet various kinds of long-duration synthesis applications.

## 2. FEATURES

- Wide Operating Voltage: 2.2V ~ 5.5V
  - SPI Flash @ SPI0 powered by embedded 3.3V LDO.
  - Min. operating voltage is 3.0V @ 32MHz maximum CPU clock, and 2.2V @ 12MHz minimum CPU clock.
- 32-bit CPU core
  - Andes N705-S, like ARM Cortex-M0+.
  - Max. CPU clock: 32MHz, up to 50+ DMIPS cooperated with zero wait-state high speed OTP.
  - 1-cycle fast multiplier.
- There are 8 bodies in the NX11M2xA series. The SPI Flash size ranges from 4Mb to 32Mb.

P/N	RAM	OTP	I/O	Flash (Mb)	Duration (Second, SBC)		SPI0	16-bit Timer	Push-Pull	Package
					7.2Kbps	16Kbps				
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NX11M25AS16	4KB	32KB	12	32	4,661	2,098	v	2	v	SOP-16, 150mil

Table 1 Product Line-Up of NX11M2xA Series

- Dual Clock Operation. Built-in oscillators for HI\_CLK (32MHz) and LO\_CLK (32.768KHz), accuracy trimmed to +/-0.5% for HI\_CLK and +/-1.5% for LO\_CLK.
- Power management to support 4 operating modes: Normal / Slow / Standby / Halt mode. At Halt mode, the typical consumption current is 1uA.
- LVD (Low Voltage Detection): Total 6-level options: 3.6V, 3.4V, 3.2V, 2.6V, 2.4V, 2.2V.
- LVR (Low Voltage Reset): User-configurable, default values are 2.7V @ 32MHz, 2.4V @ 24MHz, 2.0V @ 16MHz, 1.8V @ 12MHz.
- Timers (Timer0 / Timer1): Each Timer consists of divider and 16-bit down-counter with various clock sources.
- Built-in 14-bit DAC + 1.3-Watt Push-Pull power amplifier
- Up to 12 pins GPIO. Bit configurability for every I/O pin by register control, except pull-up value by byte.
- SPI master supported to connect with the SPI Flash stacked inside MCP
  - Up to 32MHz clock speed.
  - Support Data mode and XIP mode (eXecute In Place).

- Support Single / Dual / Quad I/O mode of SPI Flash.
- IR TX supported.
- RTC with 16KHz / 1KHz / 64Hz / 2Hz interrupts.
- WDT (Watch-Dog Timer) supported with optional 188ms / 750ms Reset.
- MCP (Multi-Chip Package)
  - SPI Flash stacked inside SOP-8 / SOP-16 packages
  - Support 4Mb / 8Mb / 16Mb / 32Mb SPI Flash density
  - SPI0 interface bonded inside the package, leaving more GPIO pins available
  - Built-in Push-Pull PA to drive speaker directly
  - Max. GPIO pins: 4 @ SOP-8, 12 @ SOP-16
  - Master or Slave operation
- Support OTP Security Lock to prevent OTP data from being read.
- Easy-to-use Development Environment
  - High-level *Q-Code* programming.
  - *NYIDE* for advanced programming with C language.
  - Multi-purpose NX\_Programmer™ to work with NX1\_FDB and NX11M2xA series.
- S/W-based Speech/MIDI Codec & various algorithms
  - ADPCM Codec (Adaptive Differential PCM): 4-bit / 5-bit per sample.
  - SBC Codec (Sub-Band Coding): 4.5K ~ 32Kbps with maximum 16KHz bandwidth.
  - CELP Decoder (Code-Excitation Linear Prediction): 4.8Kbps @ 8KHz SR for human voice only.
  - MIDI: Up to 16-channel MIDI @ 32KHz Output Sample Rate.
- Noise filter @ 4x Up-Sampling.
- Shipping Form
  - MCP (Multi-Chip Package): SOP-8 / SOP-16.



3. BLOCK DIAGRAM

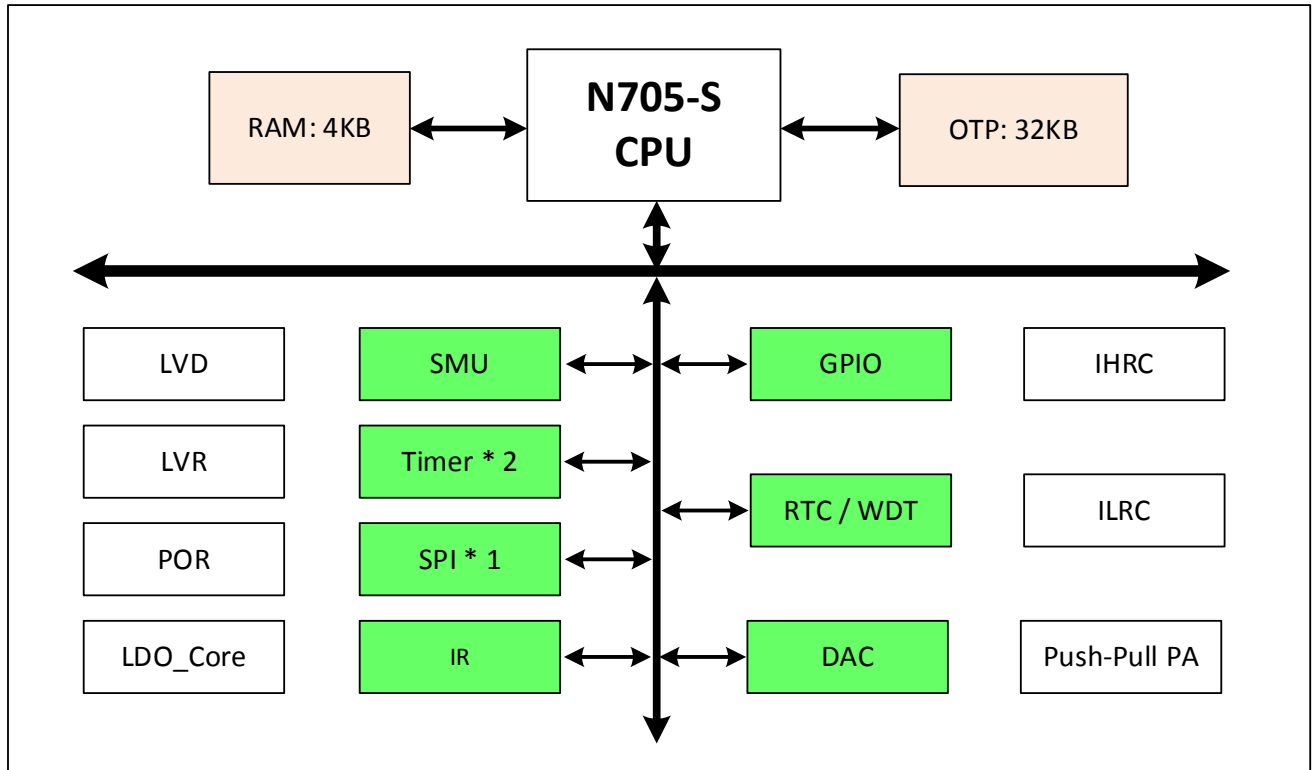


Figure 1 Block Diagram of NX11M2xA Series

**4. PAD DESCRIPTION**

Name	ALT 1	Type	Description
<b>Power &amp; Ground</b>			
VDD	-	P, I	Power input
VSS	-	P, I	Ground
<b>PP / DAC</b>			
PP1	DAC0	AO	Push-Pull PA output 1 or DAC0
PP2	-	AO	Push-Pull PA output 2
<b>Port A</b>			
PA0	-	I/O	PA0 or Analog input 0
PA1	-	I/O	PA1 or Analog input 1
PA2/Vpp	RSTb	I/O I/P	PA2/Vpp (only for OTP / SPI Flash programming), or RSTb pin
PA3/SCK	-	I/O	PA3/Programming Clock
PA4/MOSI	TM0	I/O, I	PA4/Programming Input, or Timer input 0
PA5/MISO	IR	I/O, O	PA5/Programming Output, or IR output
PA6	-	I/O, O	PA6
PA7	-	I/O, I	PA7
PA8	-	I/O	PA8
PA9	-	I/O	PA9
PA10	-	I/O	PA10
PA11	-	I/O	PA11
<b>Port B (specifically for SPI Flash stacked inside MCP)</b>			
PB0	SPI0_CSb	O	SPI0's CSb
PB1	SPI0_SCK	O	SPI0's SCK
PB2	SPI0_IO0	I/O	SPI0's IO0 (MOSI)
PB3	SPI0_IO1	I/O	SPI0's IO1 (MISO)
PB4	SPI0_IO2	I/O	SPI0's IO2
PB5	SPI0_IO3	I/O	SPI0's IO3

Pad Type: P = Digital Power, I = Digital Input, O = Digital Output, AI = Analog Input, AO = Analog output, AP=Analog Power.

## 5. MEMORY ORGANIZATION

The memory map of the NX11M2xA series is depicted in Figure 2 Memory Map of the NX11M2xA Series. The OTP ROM, RAM, function registers, and interrupt vectors, are all memory mapped. The OTP size is 32KB, while the RAM size is 4KB. Total addressing space is 16MB, while SPI Flash is mapped within 0x80\_0000 ~ 0x9F\_FFFF (2MB space) for XIP and data storage purposes.

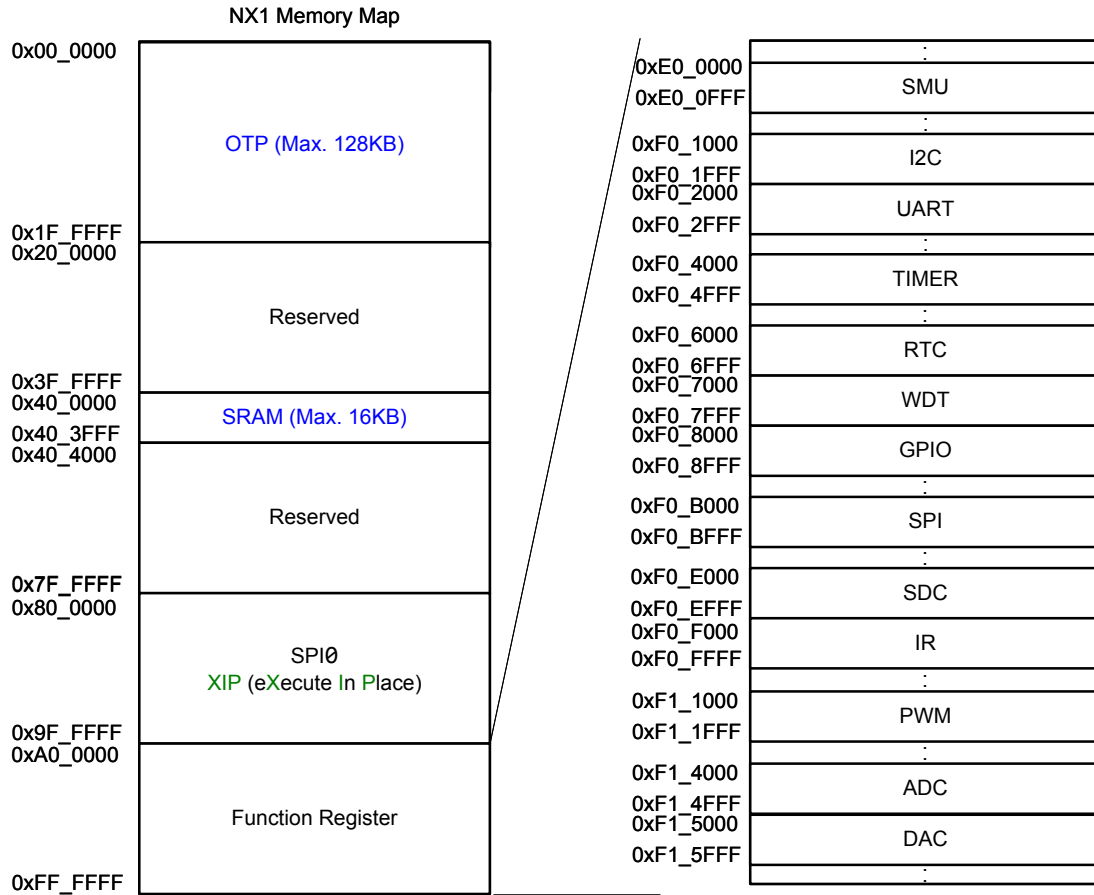


Figure 2 Memory Map of the NX11M2xA Series

## 6. CLOCK GENERATOR

The clock generator consists of 2 clock sources:

- Built-in high clock (I\_HRC): Output frequency can be 32MHz, 24MHz, 16MHz, or 12MHz by option.
- Built-in low clock (I\_LRC): Output frequency is 32,768Hz.

The internal oscillators, I\_HRC and I\_LRC, are trimmed to achieve +/-0.5% and +/-1.5% accuracy, respectively.

## 7. OPERATING MODE

The NX11M2xA series provides four kinds of operating modes to tailor for various kinds of applications while saving power consumption. These operating modes are normal mode, slow mode, standby mode and halt mode.

Normal mode is designated for high-speed, high-performance operation, while slow mode is designated for low-speed operation to save power consumption. At standby mode, the NX11M2xA series will stop almost all operations, except peripheral blocks with clock source from LO\_CLK, to wake-up periodically. At halt mode, the NX11M2xA series will stop all operations, waiting for external events to wake it up.

When the NX11M2xA is power up, there is a delay of 32mS before user's code is executed to ensure the proper operation. Besides, the SPI Flash needs another 15mS to get power stabilized after SPI0\_VDD is turned on. Therefore, there is a total of 50mS or so before any attempt to access the data stored inside the SPI Flash.

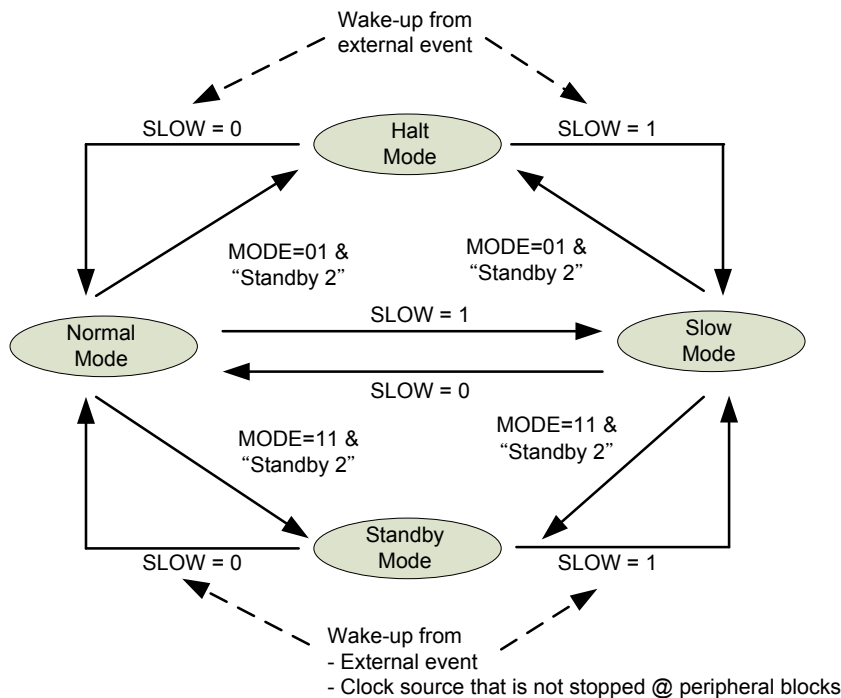


Figure 3 Four Operating Modes

## 8. INTERRUPT

Interrupt signals are directly connected to the N705-S processor. The interrupt priority is controlled by the processor. Each interrupt is assigned with 2 bits to represent 4 possible priority levels ranging from 0 (highest) to 3 (lowest). The hardware compares the priority level first: the smaller the priority level, the higher the priority. With the same priority, the lower the interrupt number, the higher the priority.

## 9. PERIPHERALS

### 9.1 I/O Port

Up to 12 \* I/O pins are available, since PB0 ~ PB5 are dedicated to interface with the stacked SPI Flash. These are shared multiple function pins under control of the alternate multiple function registers. These 12 \* I/O pins belong to Port A (PA0 ~ PA11).

Each pin can be configured as input or output, weak / strong pull-high resistor and can generate interrupt signal to CPU.

### 9.2 SPI0

The SPI0 that is dedicated for connecting with the stacked SPI Flash to store most of the data used for various applications like speech (ADPCM, SBC, or CELP), melody (including MIDI file and wavetable timbres), user's general data storage. With single/dual/quad I/O modes supported, the SPI Flash can run up to 32MHz clock. Together with the XIP capability (eXecute In Place), users can extend the program code to the SPI Flash at a descent performance for many applications.

### 9.7 IR TX

The NX11M2xA provide a 5-bit IR carrier, it can generate different IR frequency by assign different counter value.

- Support output stop at 0 or 1.
- Support 5 bits reload data to adjust IR's frequency.

## 10. TIMER

The NX11M2xA has two 16-bit timers: TIMER0 / TIMER1, which can be used as a trigger source for or as a function of time delay, clock generation, etc.

- Programmable source of timer clock
- 16-bit counter for each timer

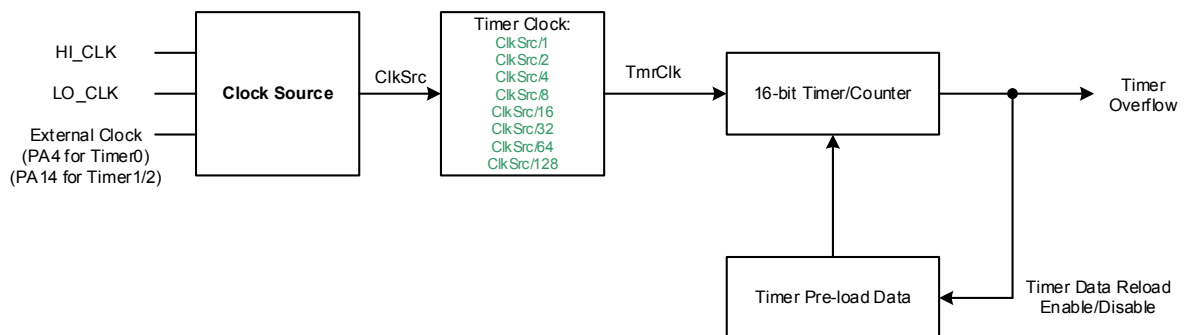


Figure 4 Timer Block Diagram

### 11. RTC

As the name implies, the RTC (Real-Time Clock) is generally used to keep the time, with the clock source from either an internal built-in I\_LRC (trimmed to 32,768Hz with +/-1.5% accuracy), or an external crystal (32,768Hz). The RTC support periodic time tick interrupts with 4 options: 16KHz, 1KHz, 64Hz, 2Hz.

### 12. WDT

The Watchdog Timer (WDT) is used to perform a system reset when the system is not responding. There are two period options for the WDT to generate a reset: 188ms / 750ms.

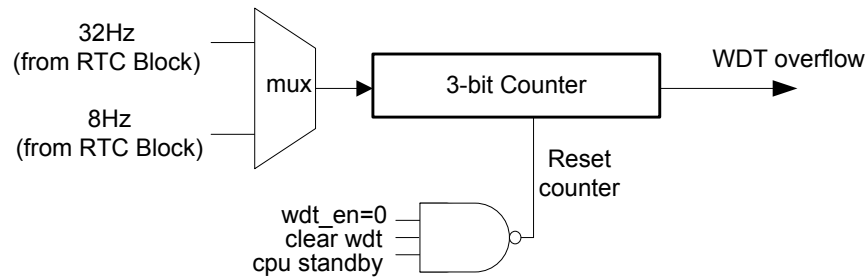


Figure 5 WDT Block Diagram

### 15. DAC & PP

The NX11M2xA provides two data buffers with 8-level FIFO each and up to two 14-bit Digital-to-Analog converters (optional) with interpolation function. It can be started by software or TIMER trigger.

- Provide 8-level FIFO per channel data buffer
- Provide hardware up-sampling (interpolation) function
- Support mixing mode for two-channel data applications

### 16. LVD

The LVD (Low Voltage Detector) is trimmed to +/-0.1V accuracy for the user to detect the battery voltage @ VDD pin. When the VDD voltage falls below the specified LVD level, the LVD\_Flag will be set as HIGH.

LVD_SEL[2:0]	Voltage
111	Reserved
110	Reserved
101	3.6V
100	3.4V
011	3.2V
010	2.6V
001	2.4V
000	2.2V

Table 2 LVD voltage select

## 17. OPTIONS

Users may select different options depending on the application requirement. There are several options that users may select for the NX11M2xA series, as shown in Table 3 User Options.

Item	Name	Options
1	High Oscillation Source	1. I_HRC 2. E_HXT
2	Low Oscillation Source	1. I_LRC 2. E_LXT
3	HI_CLK Frequency	1. 32MHz (Core LDO @ 3.3V) 2. 24MHz (Core LDO @ 2.8V) 3. 16MHz (Core LDO @ 2.5V) 4. 12MHz (Core LDO @ 2.5V)
4	VDD Voltage	1. 4.5V 2. 3.0V
5	SPI0_VDD Voltage	1. 3.3V (fixed for NX11M2xA series)
6	LVR Voltage	1. 2.9V / 2.8V / <u>2.7V</u> / 2.6V / 2.5V (HI_CLK @ 32MHz) 2. 2.6V / 2.5V / <u>2.4V</u> / 2.3V / 2.2V (HI_CLK @ 24MHz) 3. 2.2V / 2.1V / <u>2.0V</u> / 1.9V / 1.8V (HI_CLK @ 16MHz) 4. 2.0V / 1.9V / <u>1.8V</u> / 1.7V / 1.6V (HI_CLK @ 12MHz)

Table 3 User Options

**18. ELECTRICAL CHARACTERISTICS**
**18.1 Absolute Maximum Rating**

Symbol	Parameter	Rated Value	Unit
$V_{DD} - V_{SS}$	Supply voltage	-0.5 ~ +7.5	V
$V_{IN}$	Input voltage	$V_{SS} - 0.3 \sim V_{DD} + 0.3$	V
$T_{OP}$	Operating Temperature	-40 ~ +85	°C
$T_{ST}$	Storage Temperature	-25 ~ +85	°C

**18.2 DC Characteristics** ( $T_A=25^\circ\text{C}$ , unless otherwise specified)

Symbol	Parameter		$V_{DD}$	Min.	Typ.	Max.	Unit	Condition	
$V_{DD}$	Operating voltage		-	3.0	4.5	5.5	V	CPU_CLK=32MHz	
				2.7	4.5	5.5		CPU_CLK=24MHz	
				2.2	3.0	5.5		CPU_CLK=16MHz	
				2.2	3.0	5.5		CPU_CLK=12MHz	
				2.2	3.0	5.5		CPU_CLK=32.768KHz	
$I_{HALT}$	Halt Current		3		1		uA	CPU stop, all functions off	
			4.5		1				
$I_{SB}$	Standby Current		3		3		uA	CPU stop, all functions off, RTC on	
			4.5		3				
$I_{OP}$	Slow Mode	Operating Current	3		58.3		uA	CPU_CLK=32.768KHz	
			4.5		75				
	Normal Mode		3		6.1		mA		CPU_CLK = 12MHz, Core_LDO = 2.3V
			3		7.5		mA		CPU_CLK = 16MHz, Core_LDO = 2.3V
			4.5		12.0		mA		CPU_CLK = 24MHz, Core_LDO = 2.7V
4.5		19.1		mA	CPU_CLK = 32MHz, Core_LDO = 3.3V				
$I_{IL}$	Weak (1M $\Omega$ )	Input current (Internal pull-high)	3		-2.7		uA	$V_{IL} = 0V$	
			4.5		-7.2				
	Strong (100K $\Omega$ )		3		-30				
			4.5		-78				
	SDC pad (20K $\Omega$ )		3		-144				
4.5			-215						



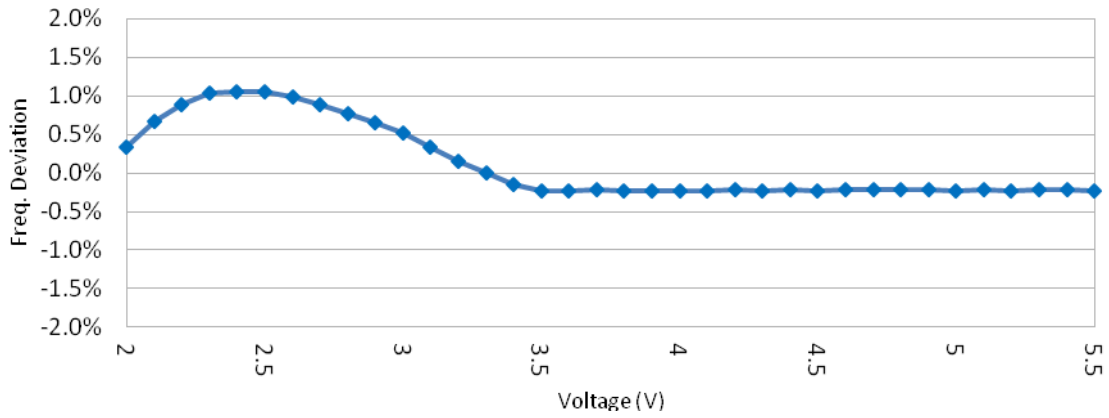
Symbol	Parameter	V <sub>DD</sub>	Min.	Typ.	Max.	Unit	Condition
I <sub>OH</sub>	Normal drive current (PA)	3		-8.7		mA	V <sub>OH</sub> = 2.0V
		4.5		-13.7			V <sub>OH</sub> = 3.5V
	Normal drive current (PB for SPI0)	3		-12.9			V <sub>OH</sub> = 2.0V
		4.5		-20.2			V <sub>OH</sub> = 3.5V
	Large drive current (PB for SPI0)	3		-24.8			V <sub>OH</sub> = 2.0V
		4.5		-38.0			V <sub>OH</sub> = 3.5V
I <sub>OL</sub>	Normal sink current	3		12.4		mA	V <sub>OL</sub> = 1.0V
		4.5		19.2			
	Large sink current	3		24.3			
		4.5		37.1			
I <sub>PP</sub>	Push-Pull Output Current	3		180		mA	<u>Load = 8 Ω</u>
		4.5		280			
ΔF/F	Frequency deviation by voltage drop (I <sub>HRC</sub> =32MHz/24MHz)	4.5		-0.5		%	$\frac{F_{osc}(4.5v) - F_{osc}(3.3v)}{F_{osc}(4.5v)}$
	Frequency deviation by voltage drop (I <sub>HRC</sub> =16MHz/12MHz)	3		-0.5			$\frac{F_{osc}(3.0v) - F_{osc}(2.4v)}{F_{osc}(3.0v)}$
		4.5		-0.5			$\frac{F_{osc}(4.5v) - F_{osc}(3.0v)}{F_{osc}(4.5v)}$
ΔF/F	Frequency deviation by lot	3	-0.5		0.5	%	$\frac{F_{osc}(3.0v) - F_{typ}(3.0v)}{F_{typ}(3.0v)}$

**18.4 DAC Characteristics** ( $V_{DD}=5V$ ,  $T_A=25^\circ C$ , unless otherwise specified)

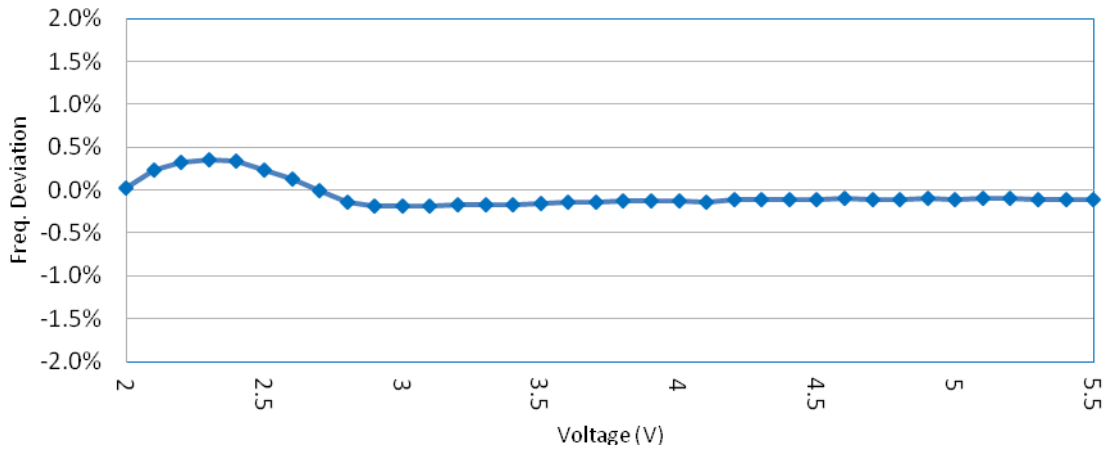
Symbol	Characteristics	Min.	Typ.	Max.	Unit	Condition
B <sub>RES</sub>	Resolution of DAC			14	Bit	-
DR	Dynamic Range (V <sub>in</sub> = -60 dBFS)		-73		dBr A	No Load
SNR	Noise at No Signal (V <sub>in</sub> = -90 dBFS)		-97		dBr A	
P <sub>O</sub>	THD+N 1%		0.7		W	4Ω Load
	THD+N 10%		1.3		W	

**18.5 Voltage vs. Frequency**

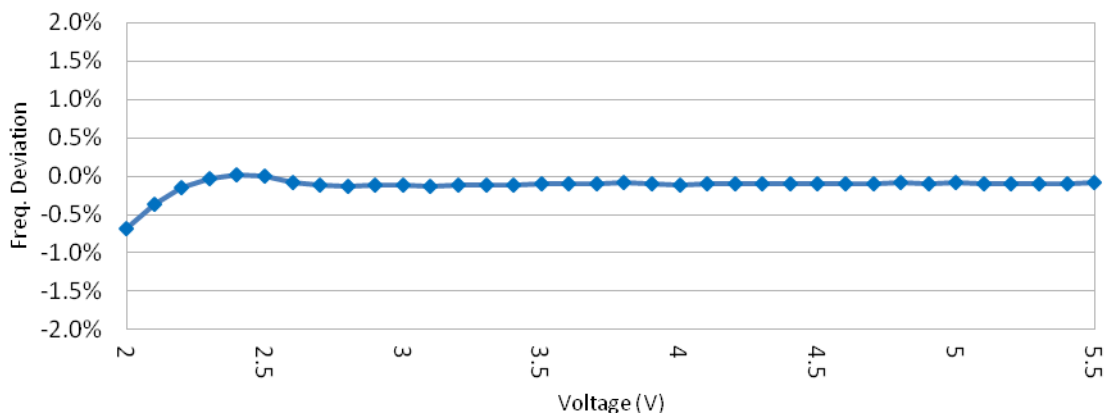
**18.5.1 I\_HRC @ 32 MHz**



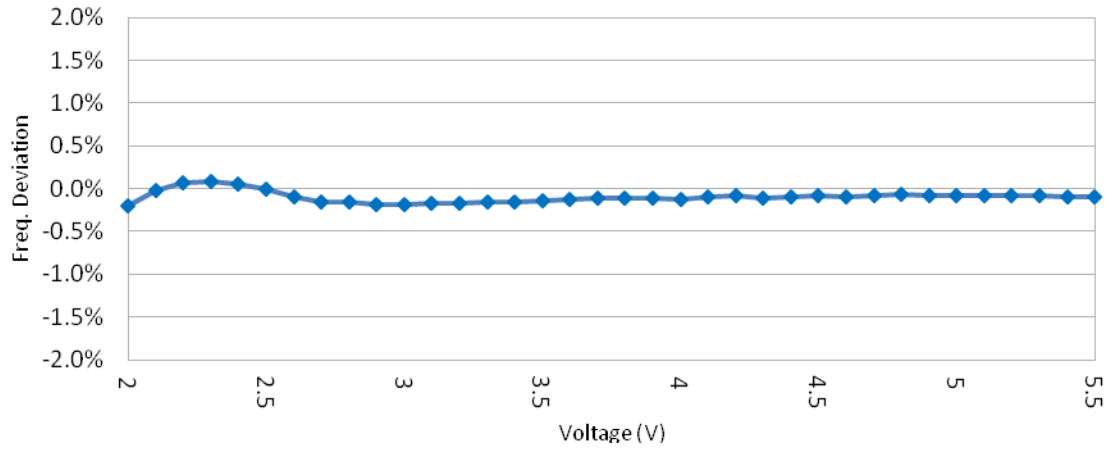
**18.5.2 I\_HRC @ 24 MHz**



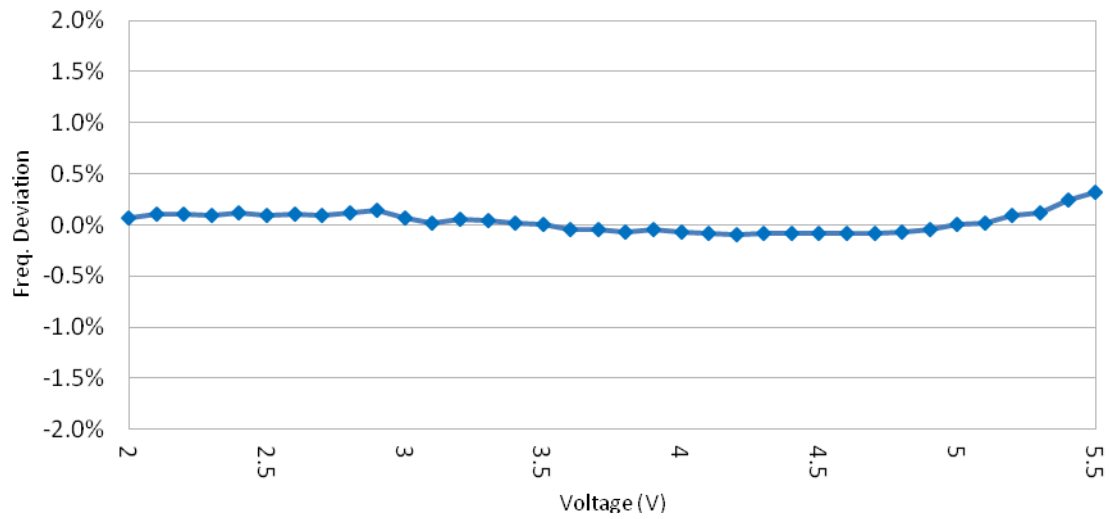
**18.5.3 I\_HRC @ 16 MHz**



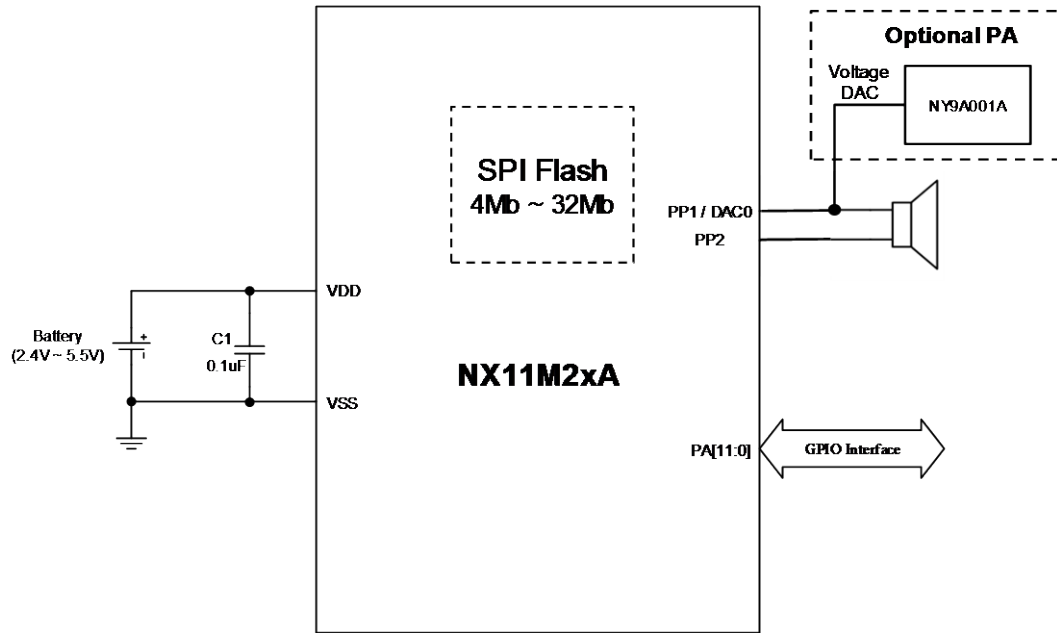
**18.5.4 I\_HRC @ 12 MHz**



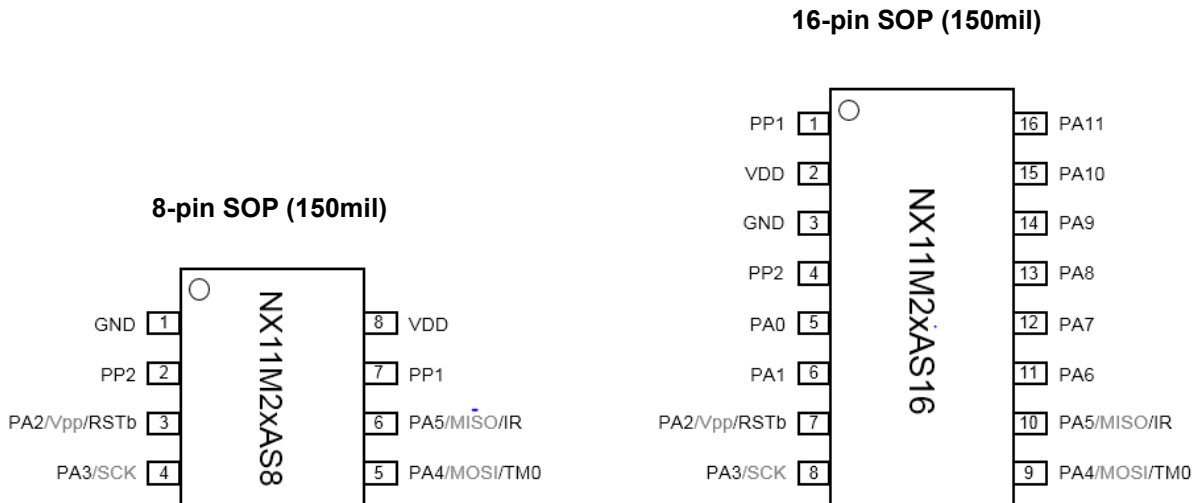
**18.5.5 I\_LRC @ 32 KHz**



## 19. APPLICATION

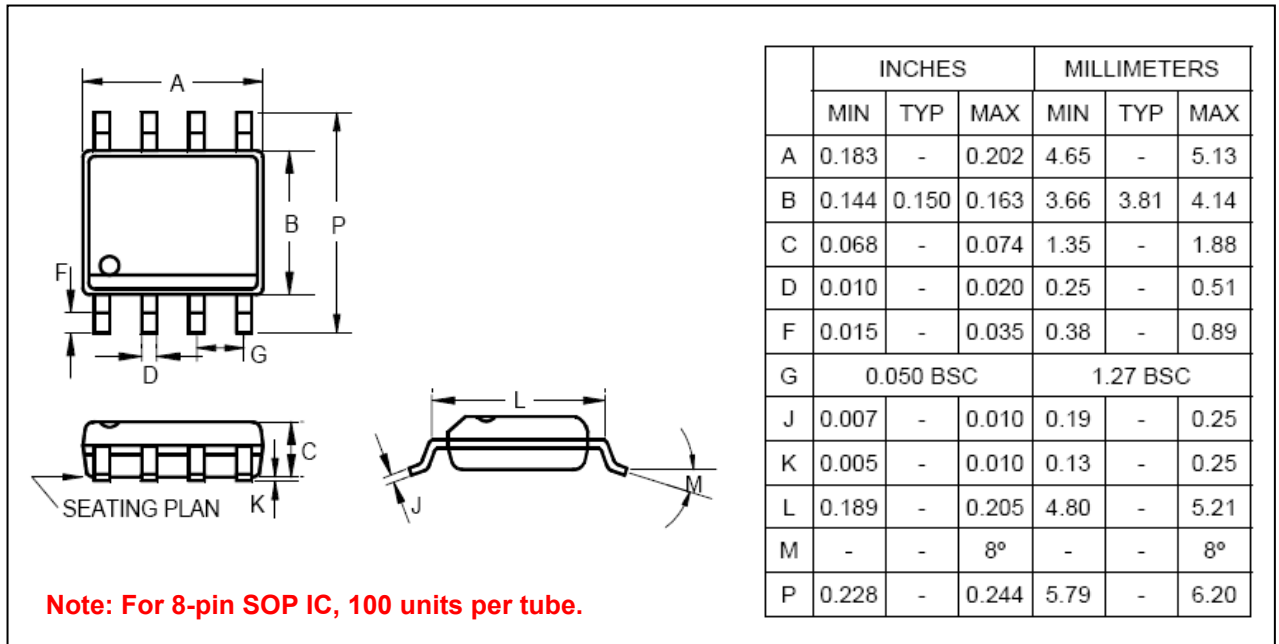


## 20. PACKAGE PIN ASSIGNMENT

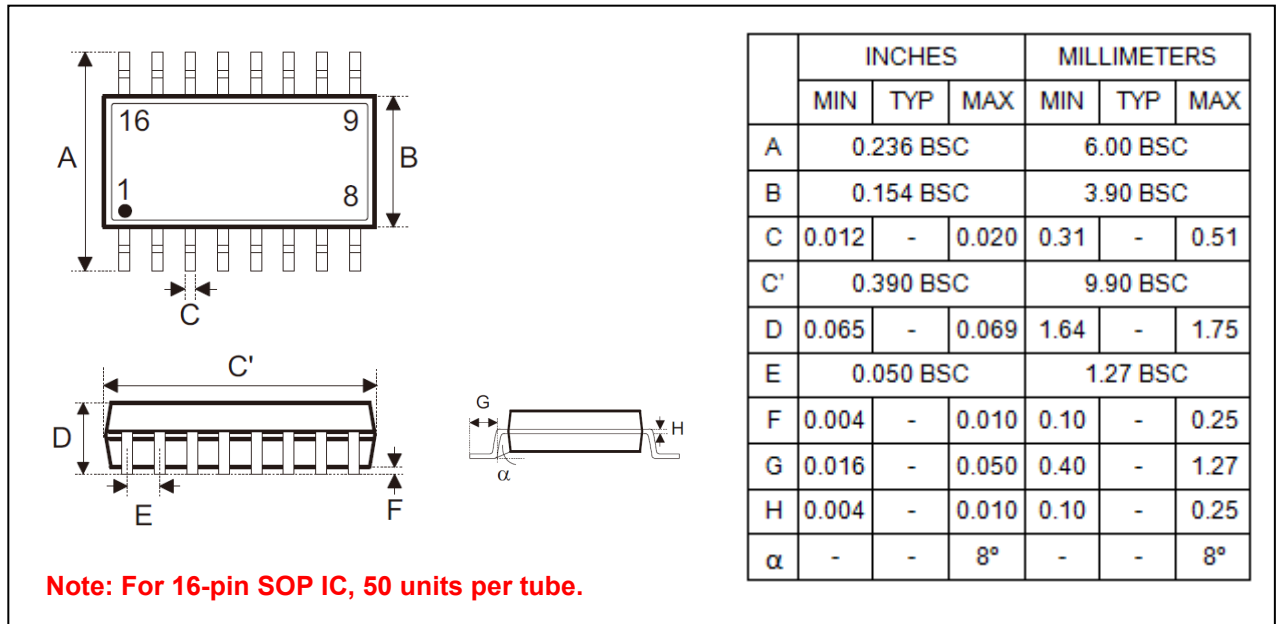


## 21. PACKAGE DIMENSION

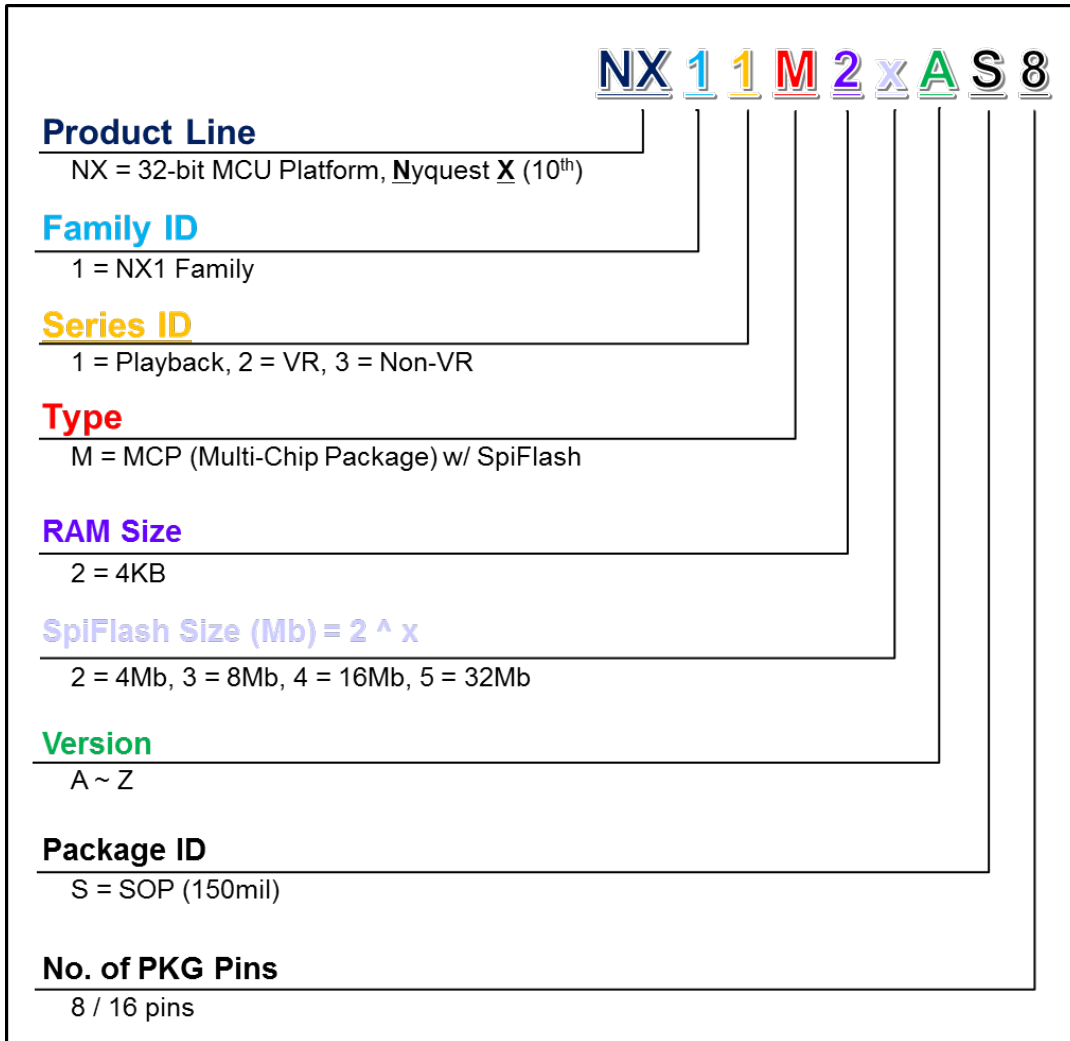
### 21.1 8-Pin Plastic SOP (150 mil)



### 21.2 SOP-16 (150mil, 1.27mm pin pitch)



## 22. ORDERING INFORMATION



P/N	Shipping Type	Remark
NX11M22AS8	SOP-8 (MCP)	Width 150 mil, pitch 1.27mm
NX11M22AS16	SOP-16 (MCP)	Width 150 mil, pitch 1.27mm
NX11M23AS8	SOP-8 (MCP)	Width 150 mil, pitch 1.27mm
NX11M23AS16	SOP-16 (MCP)	Width 150 mil, pitch 1.27mm
NX11M24AS8	SOP-8 (MCP)	Width 150 mil, pitch 1.27mm
NX11M24AS16	SOP-16 (MCP)	Width 150 mil, pitch 1.27mm
NX11M25AS8	SOP-8 (MCP)	Width 150 mil, pitch 1.27mm
NX11M25AS16	SOP-16 (MCP)	Width 150 mil, pitch 1.27mm