



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

# DATA SHEET

## **NX1 OTP Series**

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**Single-Chip 32-bit MCU with CELP, SBC,  
ADPCM Coding & 16-ch MIDI**

**Version 2.8**

**Aug. 16, 2022**

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## Revision History

| <b>Version</b> | <b>Date</b> | <b>Description</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                             | <b>Modified Page</b>                                                                   |
|----------------|-------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------|
| 1.0            | 2016/11/30  | Formal release.                                                                                                                                                                                                                                                                                                                                                                                                                                                                | -                                                                                      |
| 1.1            | 2017/02/24  | 1. NX1 line-up.<br>2. NX11P22A: NX11P22AB, LQFP-48 / SSOP-24.<br>3. Block diagram.<br>4. Pin names & description.<br>5. Application.<br>6. Die pad diagram.<br>7. Ordering information.                                                                                                                                                                                                                                                                                        | 4, 7<br>5, 8, 25, 27<br>9<br>10<br>21<br>23<br>29                                      |
| 1.2            | 2017/05/31  | 1. Add LVR values per I <sub>HRC</sub> conditions.<br>2. Rename VDD_SPI0 to SPI0_VDD.<br>3. DC Characteristics.<br>4. Voltage vs. Frequency.<br>5. Application circuit.<br>6. Modify NX11P22AB COB.<br>7. Add NX12P44AB COB.<br>8. Change pin assignment for NX12P44AU24 and NX12P44AQ64.<br>9. NX11P22AB & NX12P44AB COB size.                                                                                                                                                | 4, 7<br>10, 19, 24~27<br>20, 21<br>22<br>24, 25<br>28<br>28<br>28, 29<br>31            |
| 1.3            | 2017/08/30  | 1. Modify LVR values.<br>2. Modify PWM-IO from 4 pins to 8 pins for NX12P54A / NX12P64A.<br>3. Change NX12P44AU24 SSOP24 to NX12P44AQ32 LQFP-32.<br>4. Rename pin names from ADC# to AIN#.<br>5. Change Core LDO voltage.<br>6. Update "Voltage vs. Frequency" for I <sub>HRC</sub> / I <sub>LRC</sub> .<br>7. Add NX12P34A, NX12P54A, NX12P64A die pad diagram.<br>8. Add LQFP-32 (7mm x 7mm) package dimension.<br>9. Add NX12P34A, NX12P54A, NX12P64A ordering information. | 4, 7<br>4, 7<br>3, 5, 6, 8, 32<br>10, 27, 29<br>19<br>22, 23<br>27, 29, 30<br>34<br>36 |
| 1.4            | 2017/11/30  | 1. Update Push-Pull output power from 1.3-watt to 1.5-watt.<br>2. Update product line-up for NX11P21A.<br>3. Update SBC bandwidth from 12KHz to 16KHz.<br>4. Add pad description for PA2/AIN2/RSTb/Vpp.<br>5. Add function description for SPI0_VDD, LDO, AGC and PGA.<br>6. Update Core LDO voltage.<br>7. Update DC/AC characteristics.                                                                                                                                      | 4, 6, 7, 9<br>5, 8<br>6, 9<br>11<br>15, 18<br>20<br>21, 22                             |

| <b>Version</b> | <b>Date</b> | <b>Description</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | <b>Modified Page</b>                                                                         |
|----------------|-------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------|
|                |             | 8. Add DAC Characteristics.<br>9. Modify NX11PxxA / NX12PxxA application circuit.<br>10. Add NX11P21A pad diagram and modify for others.<br>11. Remove pad diagrams of NX12P34A, NX12P54A, NX12P64A.<br>12. Add NX11P21AB COB pin assignment.<br>13. Add SOP-16 / SSOP-24 packages pin assignment for NX11P21A.<br>14. Add SOP-16 package dimension.<br>15. Add ordering information for NX11P21A series.                                                                                                  | 23<br>25, 26<br>27 ~ 29<br>-<br>30<br>31<br>34<br>36                                         |
| 1.5            | 2018/02/24  | 1. Modify Trim accuracy for LO_CLK.<br>2. Add user-configurable LVR options.<br>3. Update Product Line-Up of NX1 Series.<br>4. Add MCP feature.<br>5. Modify RTC interrupt options.<br>6. Revise Block Diagram.<br>7. Add PA2 / RSTb / Vpp for NX11M2xA.<br>8. Separate Application to PGA/AGC modes for NX12PxxA.<br>9. Update Die Pad Diagrams for NX11P22A, NX12P44A.<br>10. Add SOP-8 / SOP-16 Packages for NX11M2xA.<br>11. Add SOP-8 Package Dimension.<br>12. Add NX11M2xA in Ordering Information. | 5, 9<br>5, 9<br>5, 9<br>6, 10<br>6, 10, 18<br>11<br>12<br>28, 29<br>30, 31<br>34<br>37<br>40 |
| 1.6            | 2018/05/31  | 1. Improve Trim accuracy for LO_CLK.<br>2. 1.8V Option of SPI0_VDD not supported for NX11M.<br>3. PWMA / CSC not supported for NX11P21A / NX11M.<br>4. S/W-based algorithm appended with VR, Voice Changer, Ultrasound communication, etc.<br>5. OTP / SPI Flash programming interface pins MUX with PA2 for NX11P21A / NX11M.<br>6. Push-Pull PA output power added for NX11P21A / NX11M.<br>7. Application Circuit modified for PGA mode of NX12PxxA.                                                    | 6, 10<br>6, 10<br>7, 11, 13, 14<br>7, 8, 12<br>13, 14<br>25<br>29                            |

| <b>Version</b> | <b>Date</b> | <b>Description</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | <b>Modified Page</b>                                                                             |
|----------------|-------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------|
| 1.7            | 2018/08/31  | 1. Remove NX12P24A body.<br>2. Adjust LVR settings.<br>3. Modify Pad Description for NX12P44A / NX12P64A.<br>4. Add power-on stabilization time for accessing SPI Flash.<br>5. Add description for PGA gain setting.<br>6. Add NX12P64A body.<br>7. Add Application Circuit for NX11M2xA / NX12P64A.<br>8. Add Die Pad Diagram for NX12P64A.<br>9. Add COB Pin Assignment for NX12P64AB.<br>10. Correct PP1 / DAC0 & PP2 pin-outs for packages of NX11P21A.<br>11. Add SSOP-24 / LQFP-48 Package Pin Assignment for NX12P64A. | 6, 10<br>6, 10, 22<br>13, 14<br>16<br>20<br>25, 44<br>29, 30, 31<br>35<br>36<br>37<br>38, 39, 40 |
| 1.8            | 2018/12/04  | 1. Correct pin 12 to PA4/AIN4/TM0/SDO for NX12P64AU24.<br>2. Update pin assignments for NX12P64AU24 and NX12P64AQ48.<br>3. Add pin-out alternative for NX12P64AU24.<br>4. Correct NX12P64AU24 shipping type to SSOP-24.<br>5. Update LVR Voltage option for HI_CLK @ 32MHz.                                                                                                                                                                                                                                                   | 39<br>39, 40<br>40, 45<br>45<br>6, 10, 22                                                        |
| 1.9            | 2019/01/11  | 1. Add NX13P44A, NX13P64A.<br>2. Add VR column at Line-Up table.<br>3. Rename NX12P34A to NX13P34A for non-VR application.<br>4. Correct NX12P44AQ64 pin names.                                                                                                                                                                                                                                                                                                                                                               | 6, 10<br>6, 10<br>6, 10<br>40                                                                    |
| 2.0            | 2019/01/29  | 1. Rearrange pin name.<br>2. Correct name of pin 12 @ NX12P64AQ48 / NX13P64AQ48                                                                                                                                                                                                                                                                                                                                                                                                                                               | 32, 33, 34, 35, 37,<br>38, 40, 41<br>41                                                          |
| 2.1            | 2019/05/30  | 1. Add NX12M5xA / NX13M5xA<br>2. Add MOSI / MISO pin names for SPI0 / SPI1 to avoid confusion.<br>3. PP output current specified.<br>4. Add one 0.1uF capacitor at RSTb for NX11P22A & NX12P44A / NX13P44A.<br>5. Typo corrections.                                                                                                                                                                                                                                                                                           | 6, 10, 14, 50<br>14<br>27<br>31, 33<br>-                                                         |
| 2.2            | 2019/11/21  | 1. Line-up and Ordering Information updated.<br>2. Add NX11S2xA series.<br>3. Add 4.5Kbps for SBC.                                                                                                                                                                                                                                                                                                                                                                                                                            | 7, 11, 50, 51<br>12, 13, 15, 16, 20<br>9, 13                                                     |

| <b>Version</b> | <b>Date</b> | <b>Description</b>                                                                                                                                                                                    | <b>Modified Page</b>                           |
|----------------|-------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------|
| 2.3            | 2020/03/20  | 1. Modify application circuit for using crystal.<br>2. Add description for Test pad.<br>3. ALT 1 and ALT 2 swapped for PA14 pin of NX12P64A / NX12M / NX13M.                                          | 30, 32 ~ 34<br>16<br>15, 41, 45                |
| 2.4            | 2020/06/05  | 1. Rename programming pin names to avoid confusion.<br>2. Add ADC_VDD pin for NX12M / NX13M.<br>3. Update Product Line-Up.                                                                            | 14, 35 ~ 38<br>40 ~ 45<br>14, 34<br>7, 11      |
| 2.5            | 2021/11/26  | 1. Modify RTC clock & period.<br>2. Modify the thickness spec. of SOP-16 package.                                                                                                                     | 12<br>46                                       |
| 2.6            | 2021/12/24  | Revise I <sub>HALT</sub> with typical values.                                                                                                                                                         | 7, 11, 25                                      |
| 2.7            | 2022/5/30   | 1. Remove NX12P44A / NX13P44A.<br>2. Add back NX11M23A / NX12M53A / NX13M53A.<br>3. Modify application circuit to connect VDD to VDD_SPI1.                                                            | -<br>7, 11, 44<br>32                           |
| 2.8            | 2022/8/16   | 1. Rename to NX1 OTP Series.<br>2. Add notes for using multi-function Vpp/RSTb pin when selected as RSTb & GPIO.<br>3. Add Core / SPI0_VDD Voltage option.<br>4. Remove SDHC 2.0 & stereo DAC output. | 1<br>31, 32, 33, 34<br>24, 25<br>8, 12, 20, 22 |

## 1. 概述

NX1 系列是基於 32位元CPU 的高品質 Speech/MIDI 處理器，特別設計用來發揮數位處理的能力。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、抑或搭配 32.768KHz石英震盪器在低耗能情況下，作為精準計時用途。

NX1 系列包含數個產品，由OTP/RAM記憶體大小、I/O數目、以及功能多寡來區分。NX1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，NX1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。

NX1 涵蓋了大量實用的功能：3組16位元的計時器(Timer)；8通道硬體 PWM-IO 輸出，提供互補式輸出兼 Dead Zone 產生器，並具備外部訊號捕捉(Capture)功能；8通道、12位元的SAR類比數位轉換器(ADC)，具備MIC前置放大器、AGC/PGA，支援差動式MIC輸入，以及各式類比感測元件輸入；14位元的數位類比轉換器(DAC)加上1.5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用來控制外部的SPI flash，可選擇內建的 3.3V 或 1.8V 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；SPI1 則可外接2.4GHz RF或其他SPI 零件；符合SDHC 2.0 的記憶卡介面；I<sup>2</sup>C硬體介面和UART TX/RX 可作為串列通訊介面。

NX1 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；以及用OTP (One Time PROM) 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。

NX1 系列提供多種封裝型式來滿足各式多樣化的應用：Dice、SOP-16、SSOP-24、LQFP-32、LQFP-48、LQFP-64 以及堆疊 SPI flash 的小型 SOP-8 / SOP-16 / SSOP-24 多晶片封裝 (MCP, Multi-Chip Package)。

## 2. 功能

- 寬廣的工作電壓：2.4V ~ 5.5V
  - SPI0 上的 SPI flash 由內建 LDO 供電，可選 3.3V (預設值) 或 1.8V (NX11P21A / NX11M / NX12M / NX13M 不支援)。
  - 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 18 個量產母體，RAM 最大 12KB, OTP 最大 96KB，合封 SPI Flash 涵括 2Mb 至 32Mb。

| P/N      | RAM  | OTP  | Flash | I/O | SPI 0/I | I <sup>2</sup> C | UART | 16-bit Timer | PWM-IO | 12-bit ADC | MIC | X'tal | DAC | Push-Pull PA | VR | MCP | Package                |
|----------|------|------|-------|-----|---------|------------------|------|--------------|--------|------------|-----|-------|-----|--------------|----|-----|------------------------|
| NX11P21A | 4KB  | 32KB | -     | 18  | v / -   | -                | -    | 2            | -      | -          | -   | -     | v   | v            |    | -   | Dice, SOP-16, SSOP-24  |
| NX11P22A | 4KB  | 32KB | -     | 24  | v / -   | -                | -    | 2            | 4      | -          | -   | v     | v   | v            |    | -   | Dice, SSOP-24, LQFP-48 |
| NX12P64A | 12KB | 64KB | -     | 32  | v / v   | v                | v    | 3            | 8      | 8-ch       | v   | v     | v   | v            | v  | -   | Dice, SSOP-24, LQFP-48 |
| NX13P64A | 12KB | 64KB | -     | 32  | v / v   | v                | v    | 3            | 8      | 8-ch       | v   | v     | v   | v            |    | -   | Dice, SSOP-24, LQFP-48 |
| NX11S21A | 4KB  | 32KB | 2Mb   | 12  | v / -   | -                | -    | 2            | -      | -          | -   | -     | v   | v            |    | v   | SOP-8, SOP-16          |
| NX11S22A | 4KB  | 32KB | 4Mb   | 12  | v / -   | -                | -    | 2            | -      | -          | -   | -     | v   | v            |    | v   | SOP-8, SOP-16          |
| NX11M22A | 4KB  | 32KB | 4Mb   | 12  | v / -   | -                | -    | 2            | -      | -          | -   | -     | v   | v            |    | v   | SOP-8, SOP-16          |
| NX11M23A | 4KB  | 32KB | 8Mb   | 12  | v / -   | -                | -    | 2            | -      | -          | -   | -     | v   | v            |    | v   | SOP-8, SOP-16          |
| NX11M24A | 4KB  | 32KB | 16Mb  | 12  | v / -   | -                | -    | 2            | -      | -          | -   | -     | v   | v            |    | v   | SOP-8, SOP-16          |
| NX11M25A | 4KB  | 32KB | 32Mb  | 12  | v / -   | -                | -    | 2            | -      | -          | -   | -     | v   | v            |    | v   | SOP-8, SOP-16          |
| NX12M52A | 10KB | 96KB | 4Mb   | 16  | v / -   | v                | v    | 3            | 4      | 4-ch       | v   | v     | v   | v            | v  | v   | SOP-16, SSOP-24        |
| NX12M53A | 10KB | 96KB | 8Mb   | 16  | v / -   | v                | v    | 3            | 4      | 4-ch       | v   | v     | v   | v            | v  | v   | SOP-16, SSOP-24        |
| NX12M54A | 10KB | 96KB | 16Mb  | 16  | v / -   | v                | v    | 3            | 4      | 4-ch       | v   | v     | v   | v            | v  | v   | SOP-16, SSOP-24        |
| NX12M55A | 10KB | 96KB | 32Mb  | 16  | v / -   | v                | v    | 3            | 4      | 4-ch       | v   | v     | v   | v            | v  | v   | SOP-16, SSOP-24        |
| NX13M52A | 10KB | 96KB | 4Mb   | 16  | v / -   | v                | v    | 3            | 4      | 4-ch       | v   | v     | v   | v            |    | v   | SOP-16, SSOP-24        |
| NX13M53A | 10KB | 96KB | 8Mb   | 16  | v / -   | v                | v    | 3            | 4      | 4-ch       | v   | v     | v   | v            |    | v   | SOP-16, SSOP-24        |
| NX13M54A | 10KB | 96KB | 16Mb  | 16  | v / -   | v                | v    | 3            | 4      | 4-ch       | v   | v     | v   | v            |    | v   | SOP-16, SSOP-24        |
| NX13M55A | 10KB | 96KB | 32Mb  | 16  | v / -   | v                | v    | 3            | 4      | 4-ch       | v   | v     | v   | v            |    | v   | SOP-16, SSOP-24        |

Table 1 Product Line-Up of NX1 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 2.8V @ 32MHz for NX12, 2.7V @ 32MHz for NX11, 2.4V @ 24MHz, 2.0V @ 16MHz, 1.8V @ 12MHz。
- 三組 16 位下數計時器 (Timer0 / Timer1 / Timer2)。
- 兩組 PWM 產生器 (PWMA / PWMB)
  - 每組 PWM 產生器具有除頻器、16 位元計時器 (可獨立當作一般計時器使用)、4 個 16 位元脈寬暫存器。

- 每組最多 4 個獨立的 PWM 通道 (PWMA0 ~ PWMA3 / PWMB0 ~ PWMB3)。
- 提供具有 Dead-Zone 產生器的互補式輸出 (PWMA0 / PWMA1 & PWMB0 / PWMB1)。
- 支援外部信號捕捉功能 (僅 PWMA)。
- ADC (類比數位轉換器)
  - 八通道 (具自動切換通道功能)，12 位元 SAR ADC。
  - 可由計時器下溢(Timer0 / 1 / 2) 或軟件觸發。
- 內建 MIC 偏壓，2 級前置放大器，以及自動/程式增益控制(AGC / PGA)。
- 內建 14 位元 DAC(數位類比轉換器) 以及 1.3 瓦/1.5 瓦推挽式功放 (僅 NX11P22A)
  - 外部 ACIN 類比信號可與內部信號混音輸出至功放以推動喇叭。
- 最多 40 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。其中有 8 根 I/O 管腳 (PA8 ~ PA15) 可提供定電流(CSC) 輸出功能 (NX11P21A / NX11M / NX12M / NX13M 不支援)。
- 支援兩組主模式 SPI (Master)
  - 高達 32MHz 時脈。
  - 支援 32 位元模式，可定址超過 128Mb SPI flash。
  - 支援數據模式以及 XIP 模式 (在地執行程式，僅限 SPI0)。
  - 支援 x1 / x2 / x4 I/O 數據模式 (Single / Dual / Quad，僅限 SPI0，NX11P21A / NX11S 不支持 Quad)。
- 內建各式介面：IR 傳輸，UART，I<sup>2</sup>C。
- 支援實時時鐘(RTC)：16.384KHz (或 4.096KHz) / 1.024KHz / 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, 僅限 NX11M2xA / NX12M5xA / NX13M5xA 系列)
  - SPI Flash 堆疊在 SOP-8 / SOP-16 / SSOP-24 封裝內部
  - 支持 4Mb / 8Mb / 16Mb / 32Mb SPI Flash
  - SPI0 界面在封裝內部邦定，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-8，8 ~ 12 @ SOP-16，16 @ SSOP-24
  - 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 FDB，OTP 以及 ICE。
  - Q-FDB\_Writer 以及 OTP\_Writer 都可以支援 NX1 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)。
- 語音識別、變聲、超聲波傳輸等等。
- 支援 4 倍頻超採樣濾波器。
- 出貨形態
  - 裸片(Dice)。
  - 封裝片：SOP-16 / SSOP-24 / LQFP-48, SOP-8 / SOP-16 / SSOP-24 MCP (僅限 NX11S2xA / NX11Mx2A / NX12M5xA / NX13M5xA 系列)。

## 1. GENERAL DESCRIPTION

The NX1 series is a 32-bit MCU based high-quality speech/MIDI processor, which is specially designed for customers to innovate with advanced DSP power. 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 NX1 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, or may employ 32.768KHz X'tal oscillator for time-keeping applications.

The NX1 series consists of several derivatives with respect to ROM (OTP), RAM, I/O and functions. With memory-mapped architecture, the NX1 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 external SPI flash.

There are various useful features inside the NX1 series: Three sets of 16-bit Timers; 8-ch H/W PWM-I/O pins, which provide complimentary outputs (with dead zone generator) and capture feature; 8-channel, 12-bit SAR ADC with MIC pre-amplifier & AGC / PGA that supports differential MIC input; 14-bit DAC + 1.5-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 SPI flash control, powered by embedded optional 3.3V / 1.8V LDO, which supports single/dual/quad I/O mode with XIP (**eX**ecute **I**n **P**lace) capability; SPI1 for 2.4GHz RF module or other SPI devices; SDHC 2.0-compliant memory card; I<sup>2</sup>C H/W interface and UART TX / RX for serial communication.

Except developing by C language at *NYIDE* environment, which provides customers with more controllability over complicated projects. Moreover, The NX1 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 @ FDB (Flash Demo Board) and mass production @ OTP. Besides, NX\_Programmer can also provide ICP (In-Circuit Programming) function to program SPI flash for customers to fabricate PCBA in advance.

Various package forms are available for the NX1 series: Dice, SOP-16, SSOP-24, LQFP-32, LQFP-48, LQFP-64 and the innovative SOP-8 / SOP-16 / SSOP-24 MCP (Multi-Chip Package), where SPI flash is stacked inside for applications that require small footprints.

## 2. FEATURES

- Wide Operating Voltage: 2.4V ~ 5.5V
  - SPI flash @ SPI0 powered by embedded LDO, 3.3V (default) / 1.8V optional (not for NX11P21A / NX11M / NX12M / NX13M).
  - 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 18 IC bodies. The maximum RAM size is 12KB, maximum OTP size is 96KB, and SPI Flash for MCP ranges from 2Mb to 32Mb.

| P/N      | RAM  | OTP  | Flash | I/O | SPI 0/1 | I <sup>2</sup> C | UART | 16-bit Timer | PWM-IO | 12-bit ADC | MIC | X'tal | DAC | Push-Pull PA | VR | MCP | Package                |
|----------|------|------|-------|-----|---------|------------------|------|--------------|--------|------------|-----|-------|-----|--------------|----|-----|------------------------|
| NX11P21A | 4KB  | 32KB | -     | 18  | v / -   | -                | -    | 2            | -      | -          | -   | -     | v   | v            |    | -   | Dice, SOP-16, SSOP-24  |
| NX11P22A | 4KB  | 32KB | -     | 24  | v / -   | -                | -    | 2            | 4      | -          | -   | v     | v   | v            |    | -   | Dice, SSOP-24, LQFP-48 |
| NX12P64A | 12KB | 64KB | -     | 32  | v / v   | v                | v    | 3            | 8      | 8-ch       | v   | v     | v   | v            | v  | -   | Dice, SSOP-24, LQFP-48 |
| NX13P64A | 12KB | 64KB | -     | 32  | v / v   | v                | v    | 3            | 8      | 8-ch       | v   | v     | v   | v            |    | -   | Dice, SSOP-24, LQFP-48 |
| NX11S21A | 4KB  | 32KB | 2Mb   | 12  | v / -   | -                | -    | 2            | -      | -          | -   | -     | v   | v            |    | v   | SOP-8, SOP-16          |
| NX11S22A | 4KB  | 32KB | 4Mb   | 12  | v / -   | -                | -    | 2            | -      | -          | -   | -     | v   | v            |    | v   | SOP-8, SOP-16          |
| NX11M22A | 4KB  | 32KB | 4Mb   | 12  | v / -   | -                | -    | 2            | -      | -          | -   | -     | v   | v            |    | v   | SOP-8, SOP-16          |
| NX11M23A | 4KB  | 32KB | 8Mb   | 12  | v / -   | -                | -    | 2            | -      | -          | -   | -     | v   | v            |    | v   | SOP-8, SOP-16          |
| NX11M24A | 4KB  | 32KB | 16Mb  | 12  | v / -   | -                | -    | 2            | -      | -          | -   | -     | v   | v            |    | v   | SOP-8, SOP-16          |
| NX11M25A | 4KB  | 32KB | 32Mb  | 12  | v / -   | -                | -    | 2            | -      | -          | -   | -     | v   | v            |    | v   | SOP-8, SOP-16          |
| NX12M52A | 10KB | 96KB | 4Mb   | 16  | v / -   | v                | v    | 3            | 4      | 4-ch       | v   | v     | v   | v            | v  | v   | SOP-16, SSOP-24        |
| NX12M53A | 10KB | 96KB | 8Mb   | 16  | v / -   | v                | v    | 3            | 4      | 4-ch       | v   | v     | v   | v            | v  | v   | SOP-16, SSOP-24        |
| NX12M54A | 10KB | 96KB | 16Mb  | 16  | v / -   | v                | v    | 3            | 4      | 4-ch       | v   | v     | v   | v            | v  | v   | SOP-16, SSOP-24        |
| NX12M55A | 10KB | 96KB | 32Mb  | 16  | v / -   | v                | v    | 3            | 4      | 4-ch       | v   | v     | v   | v            | v  | v   | SOP-16, SSOP-24        |
| NX13M52A | 10KB | 96KB | 4Mb   | 16  | v / -   | v                | v    | 3            | 4      | 4-ch       | v   | v     | v   | v            |    | v   | SOP-16, SSOP-24        |
| NX13M53A | 10KB | 96KB | 8Mb   | 16  | v / -   | v                | v    | 3            | 4      | 4-ch       | v   | v     | v   | v            |    | v   | SOP-16, SSOP-24        |
| NX13M54A | 10KB | 96KB | 16Mb  | 16  | v / -   | v                | v    | 3            | 4      | 4-ch       | v   | v     | v   | v            |    | v   | SOP-16, SSOP-24        |
| NX13M55A | 10KB | 96KB | 32Mb  | 16  | v / -   | v                | v    | 3            | 4      | 4-ch       | v   | v     | v   | v            |    | v   | SOP-16, SSOP-24        |

Table 1 Product Line-Up of NX1 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 2.8V @ 32MHz for NX12, 2.7V @ 32MHz for NX11, 2.4V @ 24MHz, 2.0V @ 16MHz, 1.8V @ 12MHz.
- Timers (Timer0 / Timer1 / Timer2): Each Timer consists of divider and 16-bit down-counter with various clock sources.

- Two PWM Generators (PWMA / PWMB)
  - Each generator consists of a clock divider, a 16-bit timer (that can be used as a general timer) and four 16-bit duty cycle registers.
  - Up to 4 independent PWM channels per generator (PWMA0 ~ PWMA3 / PWMB0 ~ PWMB3).
  - Provide complementary outputs @ PWMA0 / PWMA1 & PWMB0 / PWMB1, with dead-zone generator.
  - Capture supported @ PWMA.
- ADC (Analog Digital Conversion)
  - 8-ch (with auto scan mode), 12-bit resolution SAR (Successive Approximate Register) ADC.
  - Trigger by underflow of Timer0 /1 /2, or software manually.
- Built-in MIC bias, 2-stage of pre-amplifiers and AGC/PGA for gain control.
- Built-in 14-bit DAC + 1.3-Watt / 1.5-Watt Push-Pull power amplifier (for NX11P22A only)
  - Line-In to mix with internal analog output @ power amplifier to drive speaker.
- Up to 40 pins GPIO. Bit configurability for every I/O pin by register control, except pull-up value by byte. There are 8 pins (PA8 ~ PA15) supported with CSC (Constant Sink Current) capability (not for NX11P21A / NX11M / NX12M / NX13M).
- Two SPI masters supported
  - Up to 32MHz clock speed.
  - 32-bit mode supported to address more than 128Mb SPI flash.
  - Support Data mode and XIP mode (eXecute In Place, for SPI0 only).
  - Support Single / Dual / Quad I/O mode of SPI flash (for SPI0 only. Quad I/O not supported for NX11P21A / NX11S).
- IR TX, UART, I<sup>2</sup>C supported.
- RTC with 16.384KHz (or 4.096KHz) / 1.024KHz / 64Hz / 2Hz interrupts.
- WDT (Watch-Dog Timer) supported with optional 188ms / 750ms Reset.
- MCP (Multi-Chip Package) for NX11S2xA / NX11M2xA / NX12M5xA / NX13M5xA series
  - SPI Flash stacked inside low-cost SOP-8 / SOP-16 / SSOP-24 packages
  - Support 2Mb / 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, 8 ~ 12 @ SOP-16, 16 @ SSOP-24
  - 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™ with FDB, OTP & ICE.
- Q-FDB\_Writer & OTP\_Writer also support NX1 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.
  - Voice Recognition, Voice Changer, Ultrasound communication, etc.
- Noise filter @ 4x Up-Sampling.
- Shipping Form
  - Dice.
  - Package: SOP-16 / SSOP-24 / LQFP-48, SOP-8 / SOP-16 / SSOP-24 MCP (only for NX11S2xA / NX11M2xA / NX12M5xA / NX13M5xA series).

### 3. BLOCK DIAGRAM

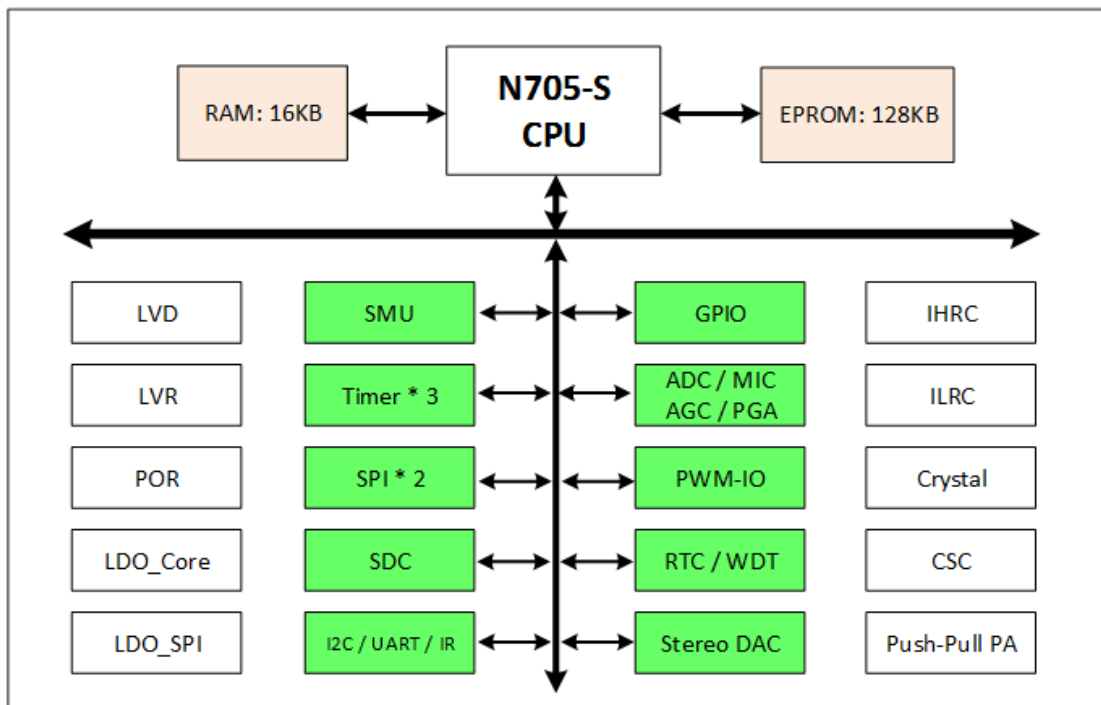


Figure 1 Block Diagram of NX1 Series

#### 4. PAD DESCRIPTION

| Name                      | ALT 1 | ALT 2 | Type           | Description                                                                                                                                                                                         |
|---------------------------|-------|-------|----------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Power &amp; Ground</b> |       |       |                |                                                                                                                                                                                                     |
| VDD#                      | -     | -     | P, I           | Power input                                                                                                                                                                                         |
| VDD_ADC                   | -     | -     | AP, I          | Power input for MIC / ADC / AGC                                                                                                                                                                     |
| VREF_ADC                  | -     | -     | AP, I          | ADC's Reference Power input                                                                                                                                                                         |
| ADC_VDD                   | -     | -     | P, O           | Power output for analog circuitry at NX12M/NX13M only. This pin must be connected with 0.1uF cap to ground and is bonded to VDD_ADC & VREF_ADC internally.                                          |
| SPI0_VDD                  | -     | -     | P, O           | Power output for SPI0 flash via internal LDO                                                                                                                                                        |
| VDD_SPI1                  | -     | -     | P, I           | Power input for IO pins PB8 ~ PB11                                                                                                                                                                  |
| VDD_SDC                   | -     | -     | P, I           | Power input for IO port C, SDC interface                                                                                                                                                            |
| VSS#                      | -     | -     | P, I           | Ground                                                                                                                                                                                              |
| <b>AGC</b>                |       |       |                |                                                                                                                                                                                                     |
| VMIC                      | -     | -     | AO             | MIC bias                                                                                                                                                                                            |
| MICP                      | -     | -     | AI             | MIC+                                                                                                                                                                                                |
| MICN                      | -     | -     | AI             | MIC-                                                                                                                                                                                                |
| <b>PP / DAC</b>           |       |       |                |                                                                                                                                                                                                     |
| ACIN                      | -     | -     | AI             | Line in                                                                                                                                                                                             |
| PP1                       | DAC0  | -     | AO             | Push-Pull PA output 1 or DAC0                                                                                                                                                                       |
| PP2                       | DAC1  | -     | AO             | Push-Pull PA output 2 or DAC1                                                                                                                                                                       |
| <b>Port A</b>             |       |       |                |                                                                                                                                                                                                     |
| PA0                       | AIN0  | -     | I/O, AI        | PA0 or Analog input 0                                                                                                                                                                               |
| PA1                       | AIN1  | -     | I/O, AI        | PA1 or Analog input 1                                                                                                                                                                               |
| PA2/Vpp                   | AIN2  | RSTb  | I/O, AI<br>I/P | PA2/Vpp (only for OTP / SPI Flash programming @ NX11P21A / NX11M2xA / NX11S2xA), Analog input 2. PA2 as RSTb pin if IC without ADC function, otherwise PA15 will be the RSTb pin. (Except NX11P22A) |
| PA3/SCK                   | AIN3  | -     | I/O, AI        | PA3/Programming Clock, or Analog input 3                                                                                                                                                            |
| PA4/MOSI                  | TM0   | AIN4  | I/O, AI, I     | PA4/Programming Input, Analog input 4 or Timer input 0                                                                                                                                              |
| PA5/MISO                  | IR    | AIN5  | I/O, AI, O     | PA5/Programming Output, Analog input 5 or IR output                                                                                                                                                 |
| PA6                       | TXD   | AIN6  | I/O, AI, O     | PA6, Analog input 6 or TX output of UART                                                                                                                                                            |
| PA7                       | RXD   | AIN7  | I/O, AI, I     | PA7, Analog input 7 or RX input of UART                                                                                                                                                             |
| PA8                       | PWMA0 | -     | I/O, O         | PA8 or PWMA0 output.<br><u>Constant Sink Optional (not for NX11P21A / NX11S / NX11M / NX12M / NX13M)</u>                                                                                            |
| PA9                       | PWMA1 | -     | I/O, O         | PA9 or PWMA1 output.<br><u>Constant Sink Optional (not for NX11P21A / NX11S / NX11M / NX12M / NX13M)</u>                                                                                            |
| PA10                      | PWMA2 | -     | I/O, O         | PA10 or PWMA2 output.<br><u>Constant Sink Optional (not for NX11P21A / NX11S / NX11M / NX12M / NX13M)</u>                                                                                           |
| PA11                      | PWMA3 | -     | I/O, O         | PA11 or PWMA3 output.<br><u>Constant Sink Optional (not for NX11P21A / NX11S / NX11M / NX12M / NX13M)</u>                                                                                           |

| Name          | ALT 1    | ALT 2 | Type      | Description                                                                                                                                                                                                                                                                     |
|---------------|----------|-------|-----------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| PA12          | SDA      | -     | I/O, I/O  | PA12 or I <sup>2</sup> C's SDA.<br><u>Constant Sink Optional (not for NX11P21A / NX11S / NX11M / NX12M / NX13M)</u>                                                                                                                                                             |
| PA13          | SCL      | -     | I/O, O    | PA13 or I <sup>2</sup> C's SCL.<br><u>Constant Sink Optional (not for NX11P21A / NX11S / NX11M / NX12M / NX13M)</u>                                                                                                                                                             |
| PA14          | TM1      | INT1  | I/O, I, I | PA14, Timer input 1, or ext. Interrupt 1 (For NX12P64A / NX12M / NX13M only).<br><u>Constant Sink Optional (not for NX11P21A / NX11S / NX11M / NX12M / NX13M)</u>                                                                                                               |
| PA15/Vpp      | INT0     | RSTb  | I/O, I, I | PA15/Vpp (only for OTP / SPI Flash programming @ NX12P64A / NX13P64A), ext. Interrupt 0.<br>PA15 as RSTb pin if IC with ADC function, otherwise PA2 will be the RSTb pin. (Except NX11P22A)<br><u>Constant Sink Optional (not for NX11P21A / NX11S / NX11M / NX12M / NX13M)</u> |
| <b>Port B</b> |          |       |           |                                                                                                                                                                                                                                                                                 |
| PB0           | SPI0_CSb | -     | I/O, O    | PB0 or SPI0's CSb                                                                                                                                                                                                                                                               |
| PB1           | SPI0_SCK | -     | I/O, O    | PB1 or SPI0's SCK                                                                                                                                                                                                                                                               |
| PB2           | SPI0_IO0 | -     | I/O, I/O  | PB2 or SPI0's IO0 (MOSI)                                                                                                                                                                                                                                                        |
| PB3           | SPI0_IO1 | -     | I/O, I/O  | PB3 or SPI0's IO1 (MISO)                                                                                                                                                                                                                                                        |
| PB4           | SPI0_IO2 | -     | I/O, I/O  | PB4 or SPI0's IO2                                                                                                                                                                                                                                                               |
| PB5           | SPI0_IO3 | -     | I/O, I/O  | PB5 or SPI0's IO3                                                                                                                                                                                                                                                               |
| PB6           | Xin      | -     | I/O, I    | PB6 or Xin of X'tal                                                                                                                                                                                                                                                             |
| PB7           | Xout     | -     | I/O, O    | PB7 or Xout of X'tal                                                                                                                                                                                                                                                            |
| PB8           | SPI1_CSb | -     | I/O, O    | PB8 or SPI1's CSb                                                                                                                                                                                                                                                               |
| PB9           | SPI1_SCK | -     | I/O, O    | PB9 or SPI1's SCK                                                                                                                                                                                                                                                               |
| PB10          | SPI1_SDO | -     | I/O, O    | PB10 or SPI1's SDO (MOSI)                                                                                                                                                                                                                                                       |
| PB11          | SPI1_SDI | -     | I/O, I    | PB11 or SPI1's SDI (MISO)                                                                                                                                                                                                                                                       |
| PB12          | PWMB0    | -     | I/O, O    | PB12 or PWMB0 output                                                                                                                                                                                                                                                            |
| PB13          | PWMB1    | -     | I/O, O    | PB13 or PWMB1 output                                                                                                                                                                                                                                                            |
| PB14          | PWMB2    | -     | I/O, O    | PB14 or PWMB2 output                                                                                                                                                                                                                                                            |
| PB15          | PWMB3    | -     | I/O, O    | PB15 or PWMB3 output                                                                                                                                                                                                                                                            |
| <b>Port C</b> |          |       |           |                                                                                                                                                                                                                                                                                 |
| PC0           | SDC_CLK  | -     | I/O, O    | PC0 or CLK for SDC                                                                                                                                                                                                                                                              |
| PC1           | SDC_CMD  | -     | I/O, I/O  | PC1 or CMD for SDC                                                                                                                                                                                                                                                              |
| PC2           | SDC_IO0  | -     | I/O, I/O  | PC2 or IO0 for SDC                                                                                                                                                                                                                                                              |
| PC3           | SDC_IO1  | -     | I/O, I/O  | PC3 or IO1 for SDC                                                                                                                                                                                                                                                              |
| PC4           | SDC_IO2  | -     | I/O, I/O  | PC4 or IO2 for SDC                                                                                                                                                                                                                                                              |
| PC5           | SDC_IO3  | -     | I/O, I/O  | PC5 or IO3 for SDC                                                                                                                                                                                                                                                              |
| PC6           | SDC_CD   | -     | I/O, I    | PC6 or CD for SDC                                                                                                                                                                                                                                                               |
| PC7           | SDC_WP   | -     | I/O, I    | PC7 or WP for SDC                                                                                                                                                                                                                                                               |
| <b>Other</b>  |          |       |           |                                                                                                                                                                                                                                                                                 |

| Name     | ALT 1 | ALT 2 | Type | Description                                                       |
|----------|-------|-------|------|-------------------------------------------------------------------|
| Test     | -     | -     | I    | Test pin, which should be left open for normal operation.         |
| RSTb/Vpp | -     | -     | I/P  | Reset pin / Vpp (for OTP / SPI Flash programming @ NX11P22A only) |

*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 NX1 series is depicted in Figure 2 Memory Map of the NX1 Series. The OTP ROM, RAM, function registers, and interrupt vectors, are all memory mapped. The maximum OTP size is up to 128KB, while the maximum RAM size is up to 16KB. Total addressing space is 16MB, while SPI flash is mapped within 0x80\_0000 ~ 0x9F\_FFFF (2MB space) for XIP and data storage purposes.

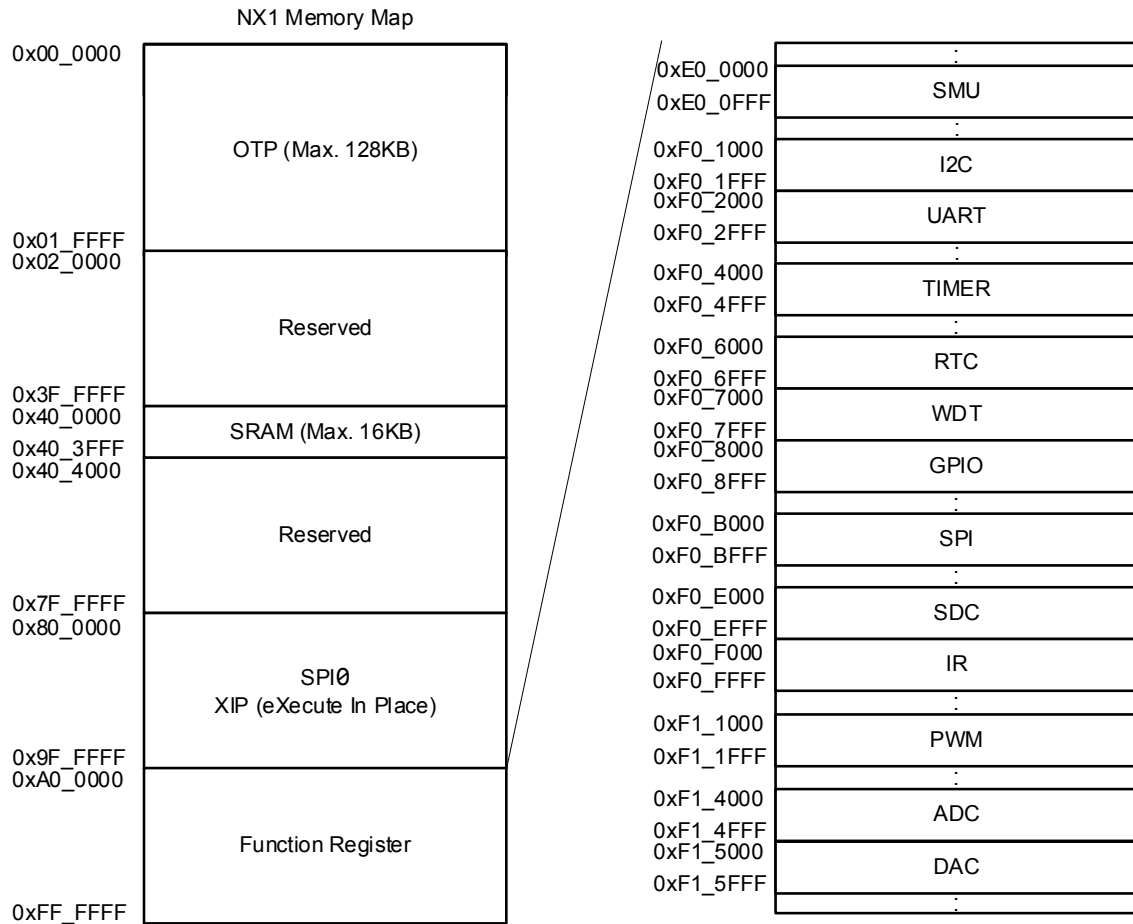


Figure 2 Memory Map of the NX1 Series

## 6. CLOCK GENERATOR

The clock generator consists of 3 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.

- External crystal oscillators: 12MHz / 16MHz X'tal for HI\_CLK, or 32,768Hz X'tal for LO\_CLK source. Beside 12MHz / 16MHz clocks, there is a frequency doubler inside the clock generator to output 24MHz / 32MHz as well, depending on the choice of the HI\_CLK.

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

## 7. OPERATING MODE

The NX1 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 to save power consumption. At standby mode, the NX1 series will stop almost all operations, except peripheral blocks with clock source from LO\_CLK, to wake-up periodically. At halt mode, the NX1 series will stop all operations, waiting for external events to wake it up.

When the NX1 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.

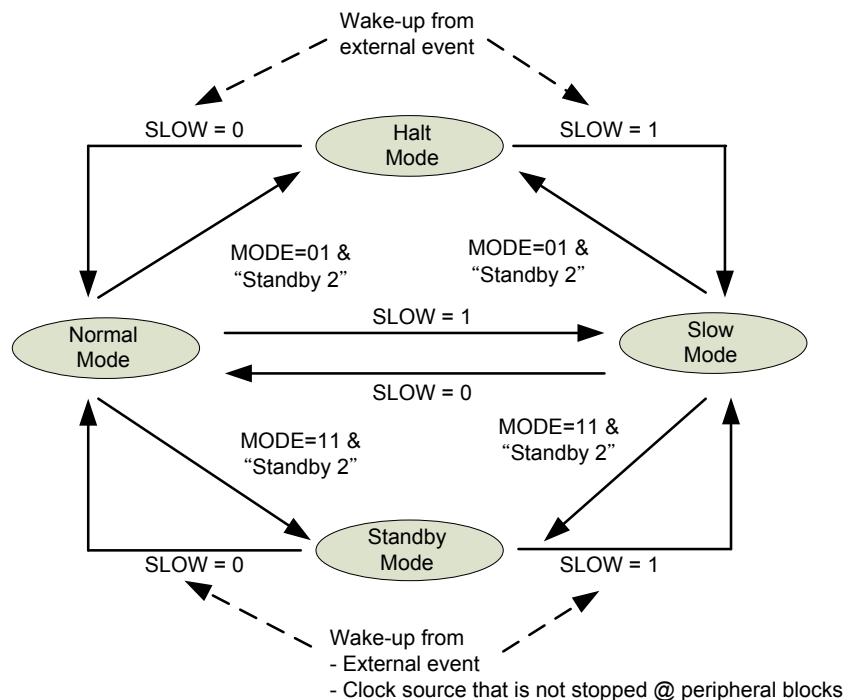


Figure 3 Four Operating Modes

## 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 40 pins are available. These are shared multiple function pins under control of the alternate multiple function registers. A total of 40 pins are arranged in 3 ports named with Port A (PA), Port B (PB) and Port C (PC). The PA port has 16 pins, the PB port has 16 pins and the PC port has 8 pins.

Each pin can be configured as input or output, weak / strong pull-high resistor and can generate interrupt signal to CPU. Among them, 8 pins (PA8 ~ PA15) are supported with CSC (Constant Sink Current) capability, which help keep the current thru LED constant without the current-limiting resistor.

### 9.2 SPI

There are two SPI masters supported. One is the SPI0 that is dedicated for connecting with an external SPI flash device 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<sup>1</sup> 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. The other is the SPI1 master with single I/O mode, which can be used to interface with popular devices like 2.4GHz RF for a wireless connectivity.

The SPI0 is generally powered by the SPI0\_VDD, which is designed with two kinds of LDO (Low Drop-Out) regulators: one is the Heavy-Load LDO, and the other one is the Light-Load LDO. Heavy-Load LDO, rated at 40mA sourcing capability & 200uA power consumption, is used under normal mode for read / erase / write operations to the external SPI Flash. For power-saving purpose, the Light-Load LDO provides merely 5mA sourcing capability, consumes only 2uA power consumption, and is used to prevent from floating @ VDD\_ADC for microphone input applications, or to lower the power consumption @ slow mode. Due to limited sourcing capability @ Light-Load LDO, it can only be used for reading SPI Flash. Users may determine by S/W programming if the Light-Load LDO is required under slow / standby / halt modes.

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<sup>1</sup> Quad I/O mode not supported for NX11S2xA series.

### 9.3 I<sup>2</sup>C

The I<sup>2</sup>C (Inter-Integrated Circuit) master/slave controller support the following features.

- Standard-mode (100 Kb/s), Fast-mode (400 Kb/s) and Fast-mode Plus (1 Mb/s) protocols
- Programmable Master/Slave mode
- Support 7-bit and 10-bit addressing mode
- Support general call address
- Auto clock stretching

### 9.4 UART

The NX1 provides two UART (Universal Asynchronous Receiver Transmitter) modules, UART is a full-duplex, asynchronous communication channel that communicates with peripheral devices and personal computers through protocols such as RS-232.

- Supports 5 to 8 bits per character
- Supports 1, 1.5 and 2 STOP bits
- Supports even, odd and stick parity bits
- Supports programmable baud rate
- Supports parity errors, framing errors and data overrun detection

### 9.5 PWM-IO

The NX1 has 2 sets of PWM-IO generators (PWMA / PWMB), each with four PWM outputs (PWMA0 ~ PWMA3, PWMB0 ~ PWMB3). Each four PWM outputs share a PWM-Timer, every output has its own duty and output port. Besides, there are two complementary PWM pairs (PWMA0 / PWMA1, PWMB0 / PWMB1) with dead zone implemented.

The NX1 also supports capture function by using the 16-bit Timer/Counter at PWMA, where PWMA0 ~ PWMA3 is disabled when capture function enabled.

- Four PWM outputs share a 16-bit timer
- Programmable divider as the clock source of timer
- 16 bits for PWM's duty
- 8 bits for determining the length of dead zone
- Capture source is one of PA0 ~ PA15

### 9.6 IR TX

The NX1 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 NX1 has three 16-bit timers: TIMER0 / TIMER1 / TIMER2, which can be used as a trigger source for DAC / PWM-IO or as a function of time delay, clock generation, etc.

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

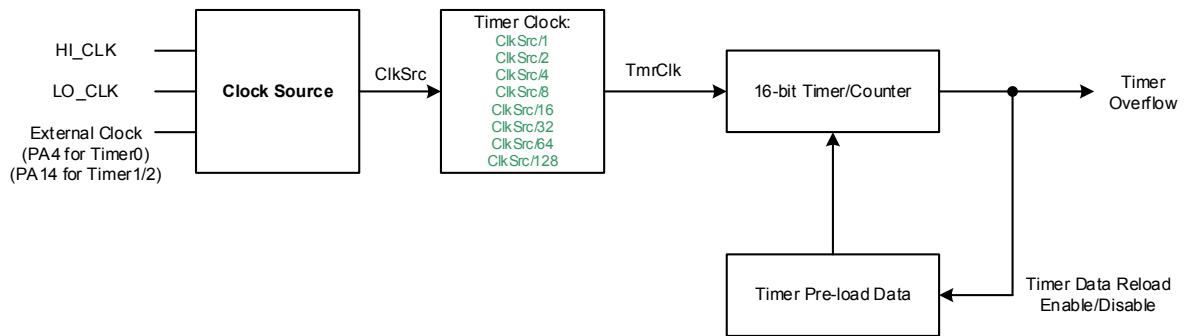


Figure 4 Timer Block Diagram

## 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: 16.384KHz (or 4.096KHz), 1.024KHz, 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.

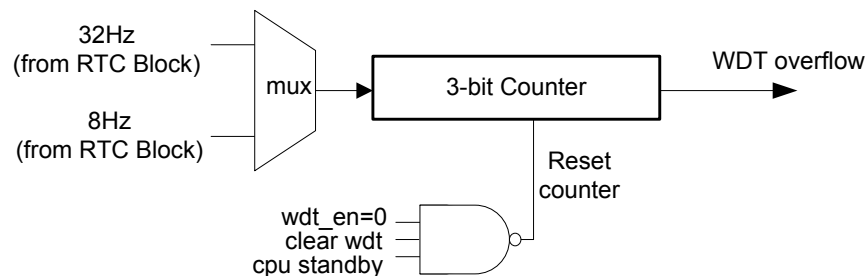


Figure 5 WDT Block Diagram

### 13. ADC

The NX1 provide one 12-bit Analog-to-Digital converter with eight input channels. The A/D converter supports single and continuous scan mode. It can be started by software or TIMER trigger.

- Provide 8-level FIFO or data registers for each channel.
- Auto scan mode, which can auto get 4/3/2 channel's data by just one trigger.

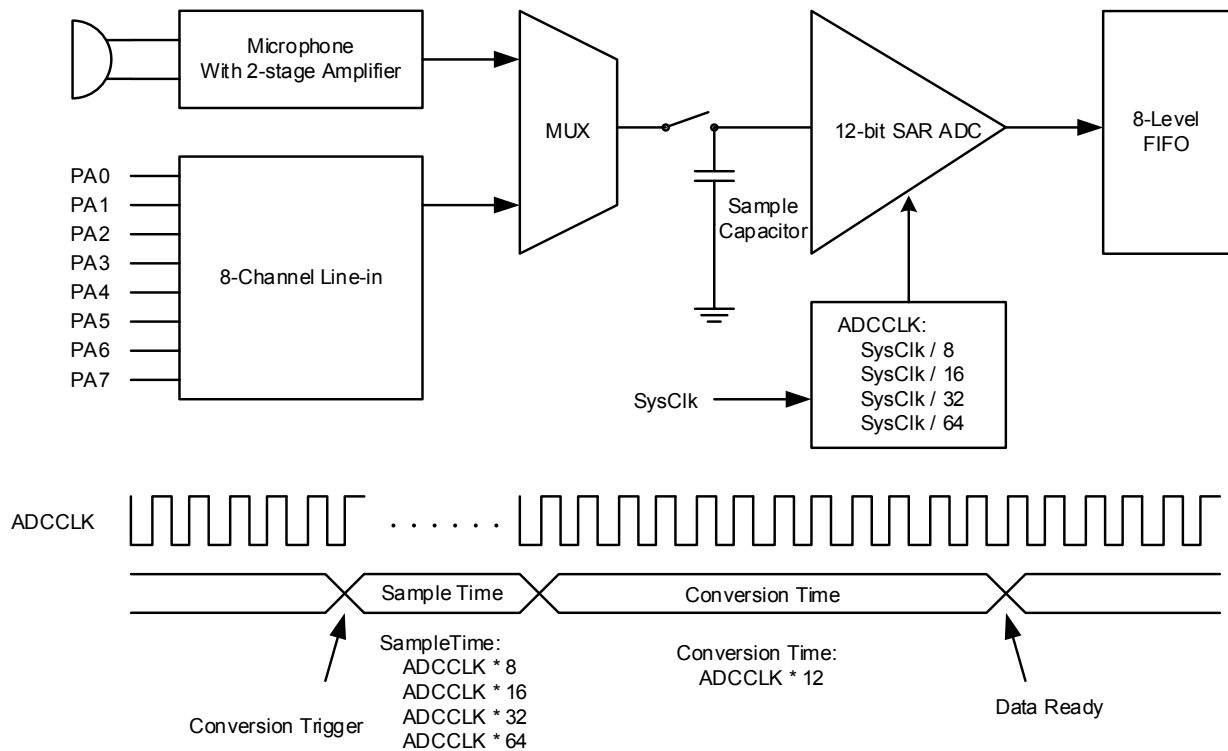


Figure 6 ADC Block Diagram

### 14. AGC & PGA

For applications with microphone input, there are two kinds of gain control: one is the AGC (Auto Gain Control), the other is the PGA (Programmable Gain Adjustment). For AGC, the 1<sup>st</sup> stage gain of pre-amplifier is controlled by the AGC along with external R/C setting, while the 2<sup>nd</sup> stage gain of pre-amplifier is fixed. For PGA, the 1<sup>st</sup> stage pre-amplifier gain is fixed at 15x, while the gain of 2<sup>nd</sup> stage of pre-amplifier is controlled by S/W program. For more details, please refer to the 19. Application and User's Manual for NX1 series.

Depending on the MIC sensitivity, distance between user and MIC, and component value of application circuit, overall PGA gain of the 2-stage pre-amplifiers might vary accordingly. Please refer to NX1 User's Manual for more details.

### 15. DAC & PP

The NX1 provides two data buffers with 8-level FIFO each and one 14-bit Digital-to-Analog converter 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

External ACIN can be mixed with internal analog output at the Push-Pull Power Amplifier stage, such that the combined analog signal could be used to drive the speaker directly.

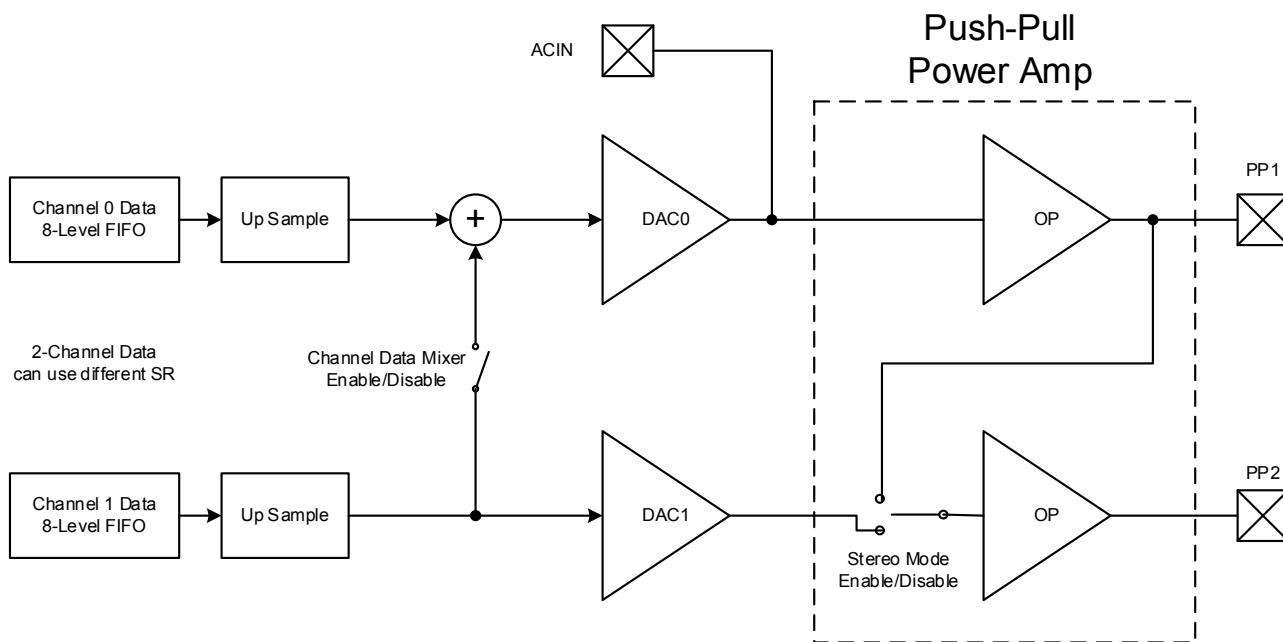


Figure 7 Block Diagram of DAC and PP PA

## 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 NX1 series, as shown in Table 3 User Options.

| Item | Name                                                                    | Options                                                                                                                                                                                                                                                                                                                                                           |
|------|-------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1    | High Oscillation Source                                                 | 1. I_HRC<br>2. E_HXT                                                                                                                                                                                                                                                                                                                                              |
| 2    | Low Oscillation Source                                                  | 1. I_LRC<br>2. E_LXT                                                                                                                                                                                                                                                                                                                                              |
| 3    | HI_CLK Frequency                                                        | 1. 32MHz<br>2. 24MHz<br>3. 16MHz<br>4. 12MHz                                                                                                                                                                                                                                                                                                                      |
| 4    | VDD Voltage                                                             | 1. 4.5V<br>2. 3.0V                                                                                                                                                                                                                                                                                                                                                |
| 5    | SPI0_VDD Voltage<br>(for NX11P22 / NX12P64 / NX13P64)                   | 1. 3.3V<br>2. 2.5V (for NX12P64 / NX13P64 only)<br>3. 1.8V                                                                                                                                                                                                                                                                                                        |
| 6    | LVR Voltage <sup>*1</sup>                                               | 1. 3.0V / 2.9V / <u>2.8V</u> / 2.7V / 2.6V (HI_CLK @ 32MHz, <b>NX12</b> )<br>2. <b>2.9V</b> / <b>2.8V</b> / <u>2.7V</u> / 2.6V / 2.5V (HI_CLK @ 32MHz, <b>NX11</b> )<br>3. 2.6V / 2.5V / <u>2.4V</u> / 2.3V / 2.2V (HI_CLK @ 24MHz)<br>4. 2.2V / 2.1V / <u>2.0V</u> / 1.9V / 1.8V (HI_CLK @ 16MHz)<br>5. 2.0V / 1.9V / <u>1.8V</u> / 1.7V / 1.6V (HI_CLK @ 12MHz) |
| 7    | Core / SPI0_VDD Voltage <sup>*2</sup><br>(for NX12M, NX11M and NX11P21) | 1. 3.3V (HI_CLK @ 32MHz)<br>2. 2.8V (HI_CLK @ 24MHz / 16MHz / 12MHz, NX12M / NX11P21)<br>3. 2.7V (HI_CLK @ 24MHz / 16MHz / 12MHz, NX11M)<br>4. 2.5V (HI_CLK @ 16MHz / 12MHz)                                                                                                                                                                                      |

Table 3 User Options

<sup>\*1</sup> Default LVR setting is marked as Underlined in the option.

<sup>\*2</sup> The option of Core / SPI0\_VDD Voltage is a minimum value trimmed to guarantee proper operation. For example, 2.8V option means the output voltage is 2.8V (minimum) & above.

## 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 | 0 ~ +70                          | °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,<br>Disable SPI0_VDD*1           |
|            |                   |             | 4.5      |      | 1    |      |      |                                                              |
|            |                   |             | 3        |      | 2    |      | uA   | CPU stop, all functions off,<br>Enable SPI0_VDD*1            |
|            |                   |             | 4.5      |      | 2    |      |      |                                                              |
| $I_{SB}$   | Standby Current   |             | 3        |      | 3    |      | uA   | CPU stop, all functions off,<br>RTC on,<br>Enable SPI0_VDD*1 |
|            |                   |             | 4.5      |      | 3    |      |      |                                                              |
| $I_{OP}$   | Operating Current | Slow Mode   | 3        |      | 58.3 |      | uA   | CPU_CLK=32.768KHz,<br>Enable SPI0_VDD*1                      |
|            |                   |             | 4.5      |      | 75   |      |      |                                                              |
|            |                   | Normal Mode | 3        |      | 6.1  |      | mA   | CPU_CLK = 12MHz,<br>Core_LDO = 2.3V,<br>Enable SPI0_VDD*2    |
|            |                   |             | 3        |      | 7.5  |      |      | CPU_CLK = 16MHz,<br>Core_LDO = 2.3V,<br>Enable SPI0_VDD*2    |
|            |                   |             | 4.5      |      | 12.0 |      |      | CPU_CLK = 24MHz,<br>Core_LDO = 2.7V,<br>Enable SPI0_VDD*2    |
|            |                   |             | 4.5      |      | 19.1 |      |      | CPU_CLK = 32MHz,<br>Core_LDO = 3.3V,<br>Enable SPI0_VDD*2    |
|            |                   |             |          |      |      |      |      |                                                              |
|            |                   |             |          |      |      |      |      |                                                              |

| Symbol          | Parameter                                                     |                   | V <sub>DD</sub> | Min.                                   | Typ. | Max. | Unit | Condition                                                                                 |
|-----------------|---------------------------------------------------------------|-------------------|-----------------|----------------------------------------|------|------|------|-------------------------------------------------------------------------------------------|
| I <sub>IL</sub> | Input current<br>(Internal pull-high)                         | Weak<br>(1MΩ)     | 3               |                                        | -2.7 |      | uA   | V <sub>IL</sub> = 0V                                                                      |
|                 |                                                               |                   | 4.5             |                                        | -7.2 |      |      |                                                                                           |
|                 |                                                               | Strong<br>(100KΩ) | 3               |                                        | -30  |      |      |                                                                                           |
|                 |                                                               |                   | 4.5             |                                        | -78  |      |      |                                                                                           |
|                 |                                                               | SDC pad<br>(20KΩ) | 3               |                                        | -144 |      |      |                                                                                           |
|                 |                                                               |                   | 4.5             |                                        | -215 |      |      |                                                                                           |
| I <sub>OH</sub> | Normal drive current<br>(PA, PB[7:6], PB[15:12])              | 3                 |                 | -8.7                                   |      |      | mA   | V <sub>OH</sub> = 2.0V                                                                    |
|                 |                                                               | 4.5               |                 | -13.7                                  |      |      |      | V <sub>OH</sub> = 3.5V                                                                    |
|                 | Normal drive current<br>(SPI0, SPI1, SDC)                     | 3                 |                 | -12.9                                  |      |      |      | V <sub>OH</sub> = 2.0V                                                                    |
|                 |                                                               | 4.5               |                 | -20.2                                  |      |      |      | V <sub>OH</sub> = 3.5V                                                                    |
|                 | Large drive current<br>(SPI0, SPI1, SDC)                      | 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<br><br>(CSC, constant sink current,<br>not for NX11P21A and NX11M) |
|                 |                                                               | 4.5               |                 | 19.2                                   |      |      |      |                                                                                           |
|                 | Large sink current                                            | 3                 |                 | 24.3                                   |      |      |      |                                                                                           |
|                 |                                                               | 4.5               |                 | 37.1                                   |      |      |      |                                                                                           |
|                 | Normal constant sink current<br>(PA[15:8])                    | 3                 |                 | 13                                     |      |      |      |                                                                                           |
|                 |                                                               | 4.5               |                 | 13                                     |      |      |      |                                                                                           |
|                 | Large constant sink current<br>(PA[15:8])                     | 3                 |                 | 20                                     |      |      |      |                                                                                           |
|                 |                                                               | 4.5               |                 | 20                                     |      |      |      |                                                                                           |
| I <sub>PP</sub> | Push-Pull Output Current                                      | 3                 |                 | 180 <sup>*3</sup><br>200 <sup>*4</sup> |      |      | mA   | Load = 8_Ω                                                                                |
|                 |                                                               | 4.5               |                 | 280 <sup>*3</sup><br>300 <sup>*4</sup> |      |      |      |                                                                                           |
| ΔF/F            | Frequency deviation<br>by voltage drop<br>(I_HRC=32MHz/24MHz) | 4.5               |                 | -0.5                                   |      |      | %    | $\frac{F_{osc}(4.5v) - F_{osc}(3.3v)}{F_{osc}(4.5v)}$                                     |
|                 | Frequency deviation<br>by voltage drop<br>(I_HRC=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<br>by lot                                 | 3                 | -0.5            |                                        |      | 0.5  | %    | $\frac{F_{osc}(3.0v) - F_{typ}(3.0v)}{F_{typ}(3.0v)}$                                     |

<sup>\*1</sup> Light-Load LDO @ SPI0\_VDD is rated at 5mA for lowering power consumption @ Halt, Standby, and Slow modes.

<sup>\*2</sup> Heavy-Load LDO @ SPI0\_VDD is rated at 40mA for read / erase / write operation to the SPI Flash @ Normal mode.

<sup>\*3</sup> PP current for NX11P21A / NX11M2xA / NX12P64A / NX13P64A / NX12M5xA / NX13M5xA.

<sup>\*4</sup> PP current for NX11P22A.

### 18.3 ADC Characteristics *(V<sub>DD</sub>=3.3V, T<sub>A</sub>=25°C, unless otherwise specified)*

| Symbol            | Characteristics                              | Min.                  | Typ.        | Max.                  | Unit |
|-------------------|----------------------------------------------|-----------------------|-------------|-----------------------|------|
| V <sub>INL</sub>  | ADC LINE_IN Input Voltage Range from PA[7:0] | V <sub>SS</sub> - 0.3 |             | V <sub>DD</sub> + 0.3 | V    |
| V <sub>INM</sub>  | ADC Microphone Input Voltage Range           | V <sub>SS</sub> - 0.3 |             | V <sub>DD</sub> + 0.3 | V    |
| B <sub>RES</sub>  | Resolution of ADC                            |                       |             | 12                    | Bit  |
| ENOB              | Effective Number of Bits                     |                       | 10          |                       | Bit  |
| INL               | Integral Non-Linearity of ADC                |                       | +/-4        |                       | LSB  |
| DNL               | Differential Non-Linearity of ADC            |                       | +1.5 / -0.9 |                       | LSB  |
| F <sub>CONV</sub> | AD Conversion Rate                           |                       |             | SYS_CLK/184           | Hz   |

### 18.4 DAC Characteristics *(V<sub>DD</sub>=5V, T<sub>A</sub>=25°C, unless otherwise specified)*

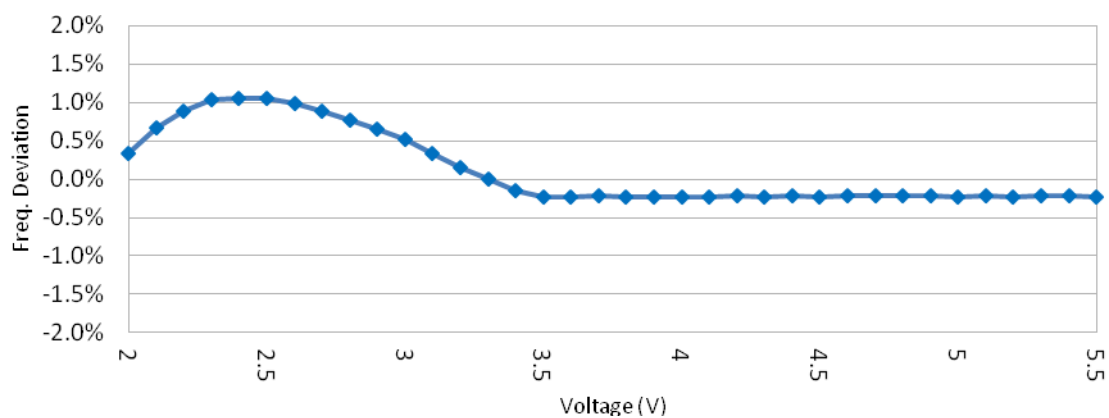
| Symbol           | Characteristics                                      | Min. | Typ.                                   | Max. | Unit  | Condition |
|------------------|------------------------------------------------------|------|----------------------------------------|------|-------|-----------|
| B <sub>RES</sub> | Resolution of DAC                                    |      |                                        | 14   | Bit   | -         |
| DR               | Dynamic Range<br>( V <sub>in</sub> = -60 dBFS )      |      | -73                                    |      | dBr A | No Load   |
| SNR              | Noise at No Signal<br>( 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 <sup>*1</sup><br>1.5 <sup>*2</sup> |      | W     |           |

<sup>\*1</sup> 1.3-Watt for NX11M2xA / NX11P21A / NX12P64A / NX13P64A / NX12M5xA / NX13M5xA.

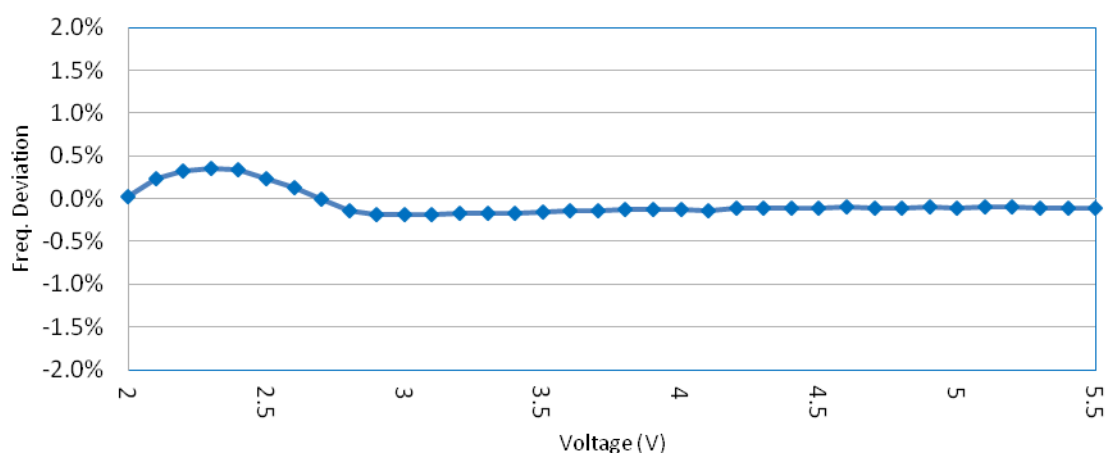
<sup>\*2</sup> 1.5-Watt for NX11P22A.

## 18.5 Voltage vs. Frequency

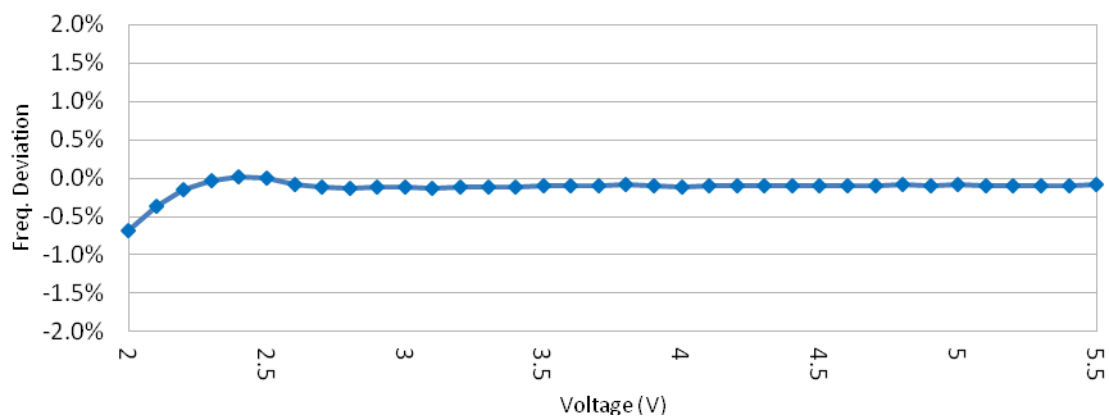
### 18.5.1 I<sub>HRC</sub> @ 32 MHz



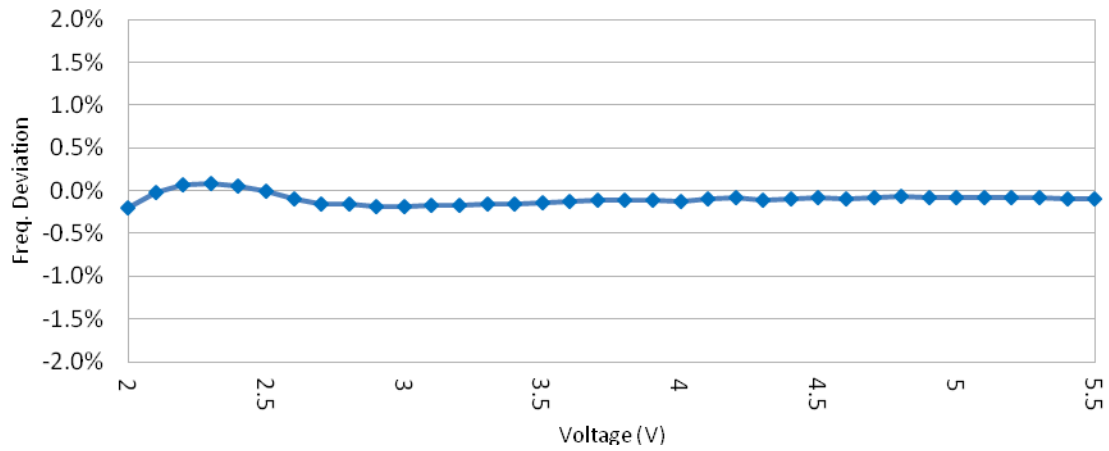
### 18.5.2 I<sub>HRC</sub> @ 24 MHz



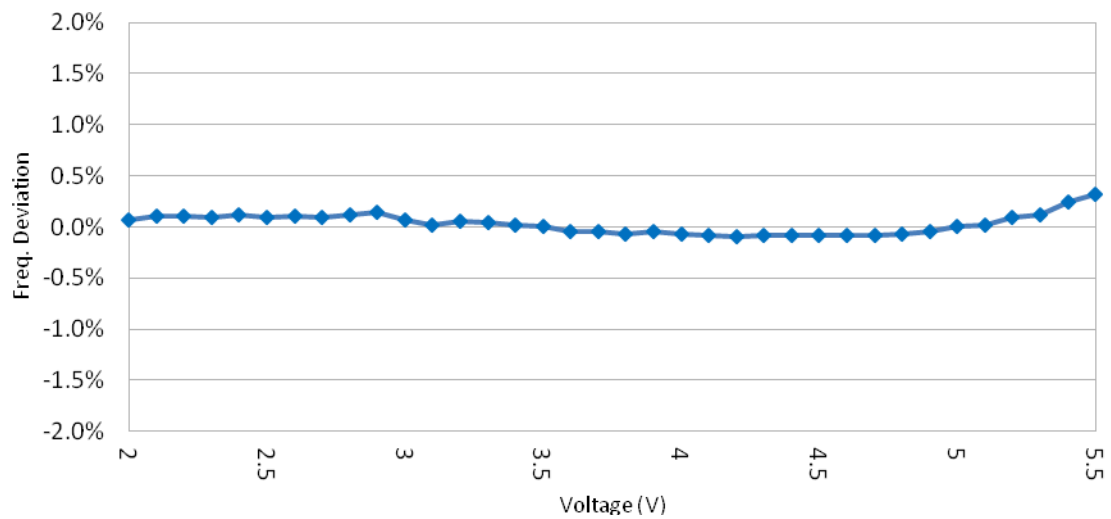
### 18.5.3 I<sub>HRC</sub> @ 16 MHz



**18.5.4 I\_HRC @ 12 MHz**

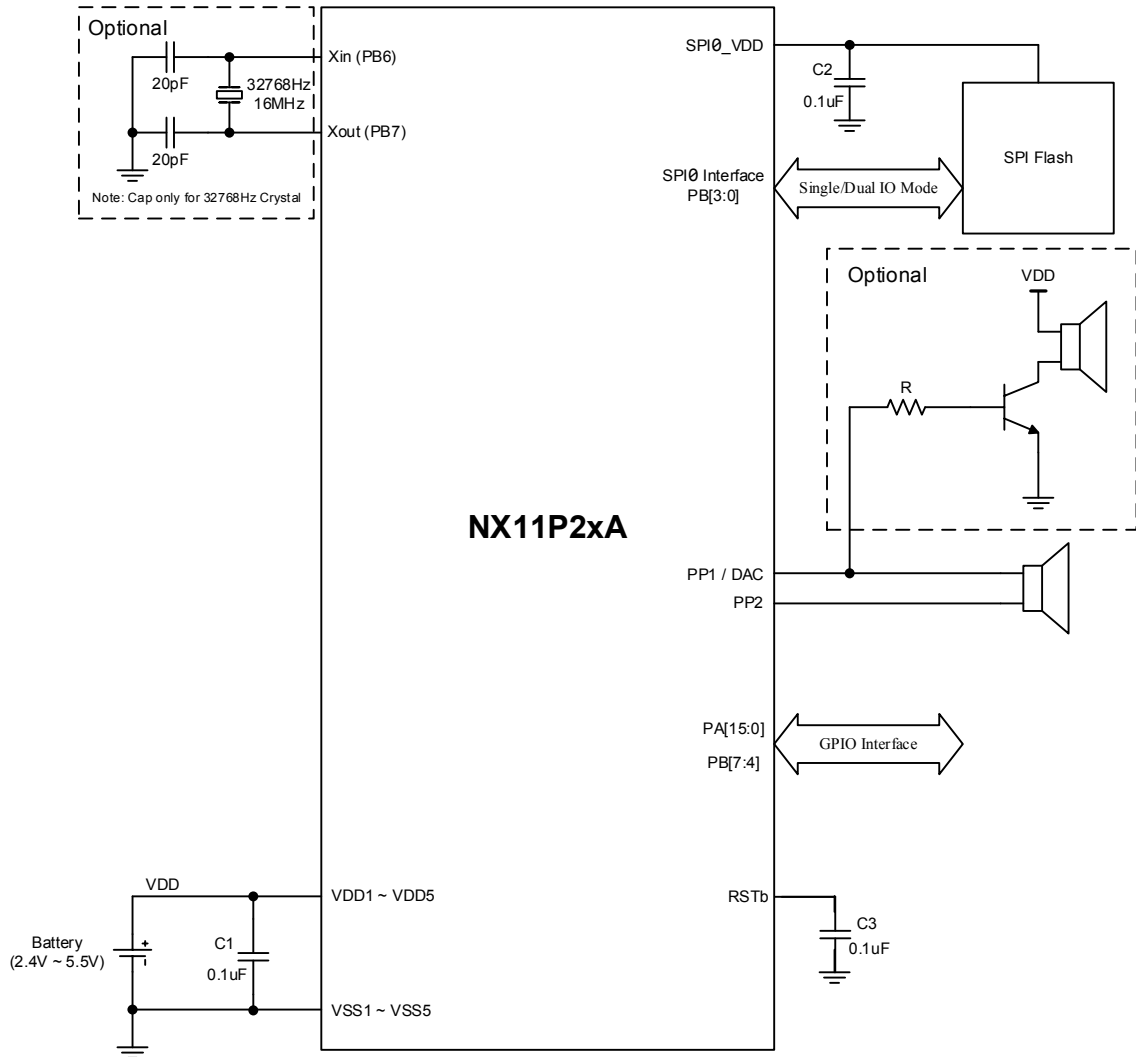


**18.5.5 I\_LRC @ 32 KHz**



## 19. APPLICATION

### 19.1 NX11P2xA

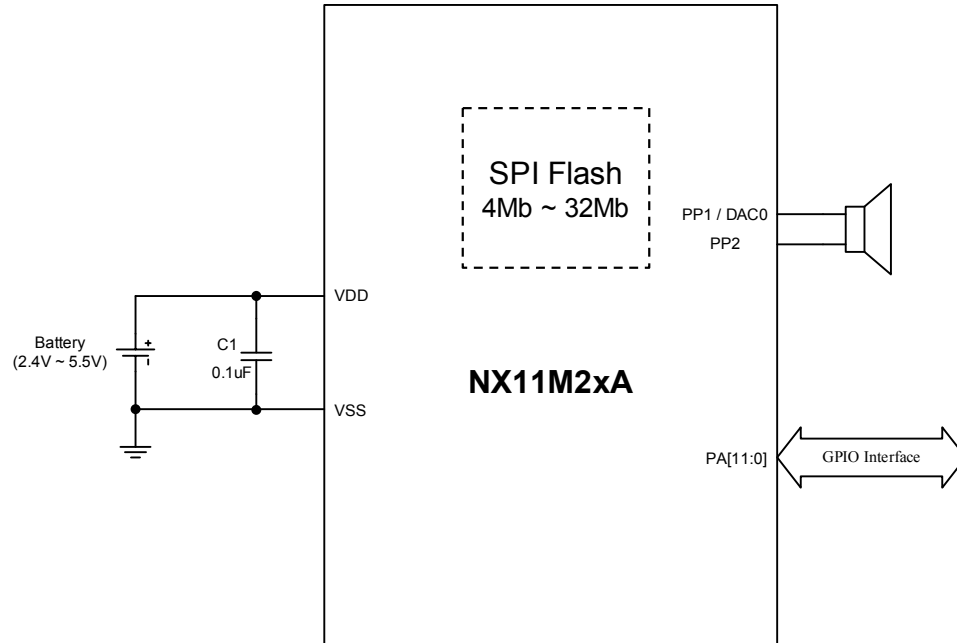


**Note 1:** C3 is recommended for RSTb of NX11P22A, where the RSTb pad is dedicated as a reset signal.

**Note 2:** C3 is NOT required at all for PA2/Vpp/RSTb of NX11P21A when selected as RSTb. Add a 30Kohm pull up additionally if C3 is used.

**Note 3:** Do not use PA2/Vpp/RSTb as GPIO pin as much as possible. If used as GPIO, please avoid highly inductive load, like motor or spring switch.

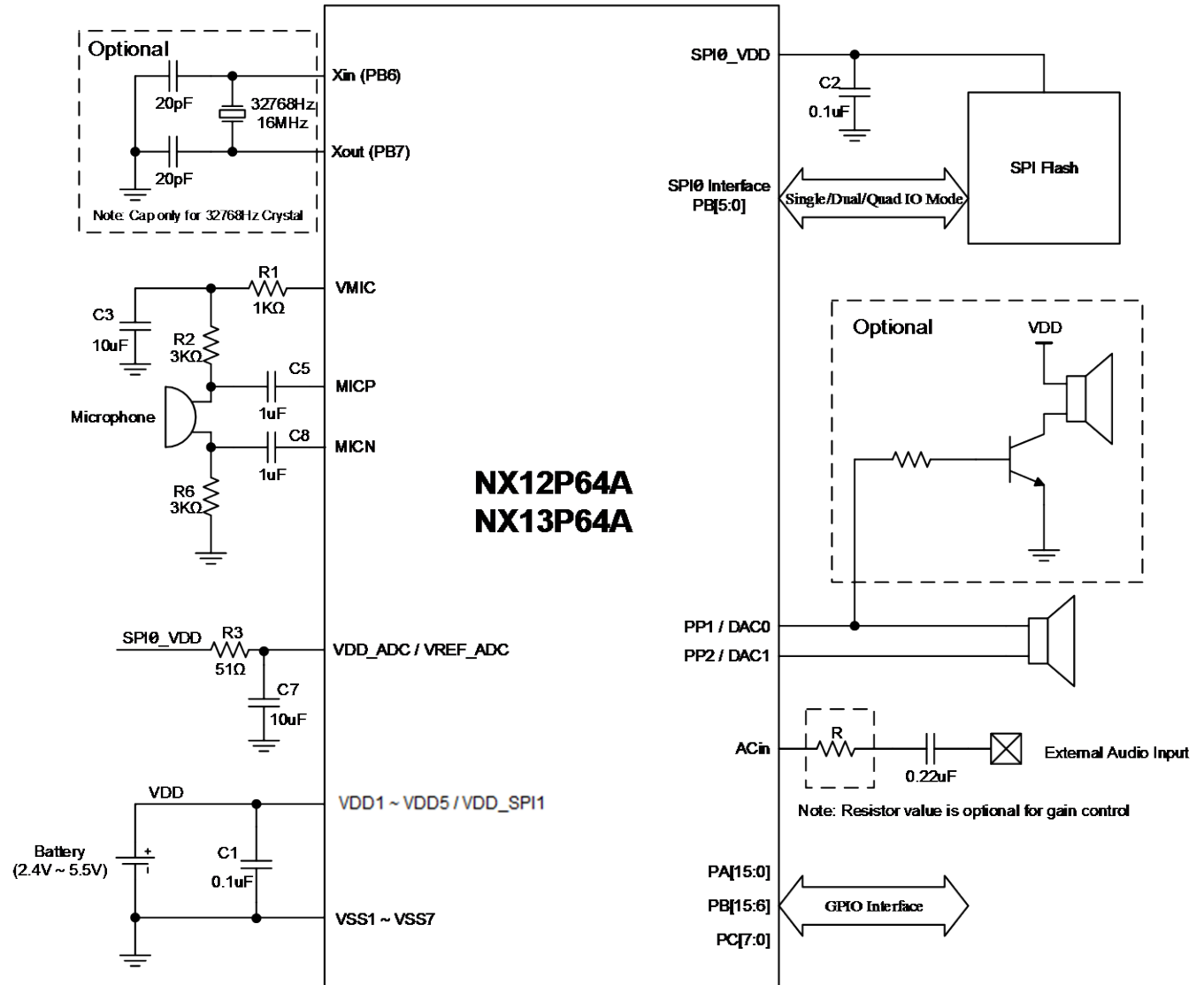
**Note 4:** For IHRC crystal @ 16MHz / 12MHz, do NOT add the compensation capacitors at X<sub>in</sub> / X<sub>out</sub> pins.

**19.2 NX11M2xA**


***Note 1:*** 0.1uF capacitor is NOT required at all for PA2/Vpp/RSTb when selected as RSTb. Add a 30Kohm pull up additionally if such capacitor is used.

***Note 2:*** Do not use PA2/Vpp/RSTb as GPIO pin as much as possible. If used as GPIO, please avoid highly inductive load, like motor or spring switch.

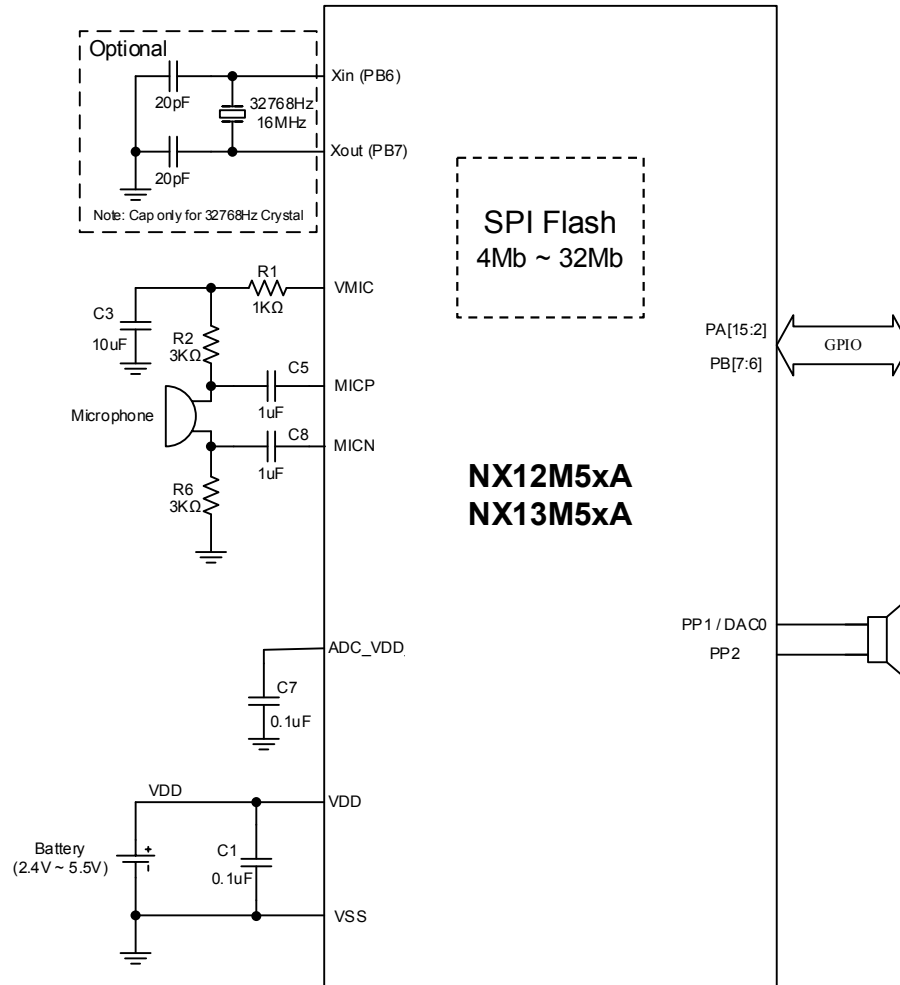
### 19.3 NX12P64A / NX13P64A



**Note 1:** No capacitor is required at all for PA15/Vpp/INT0/RSTb of NX1xP64A when selected as RSTb. Add a 30Kohm pull up additionally if 0.1uF capacitor is used.

**Note 2:** Do not use PA15/Vpp/INT0/RSTb as GPIO pin as much as possible. If used as GPIO, please avoid highly inductive load, like motor or spring switch.

**Note 3:** For IHRC crystal @ 16MHz / 12MHz, do NOT add the compensation capacitors at Xin / Xout pins.

**19.4 NX12M5xA / NX13M5xA**


**Note 1:** No capacitor is required at all for PA15/Vpp/INT0/RSTb of NX1xP64A when selected as RSTb. Add a 30Kohm pull up additionally if 0.1uF capacitor is used.

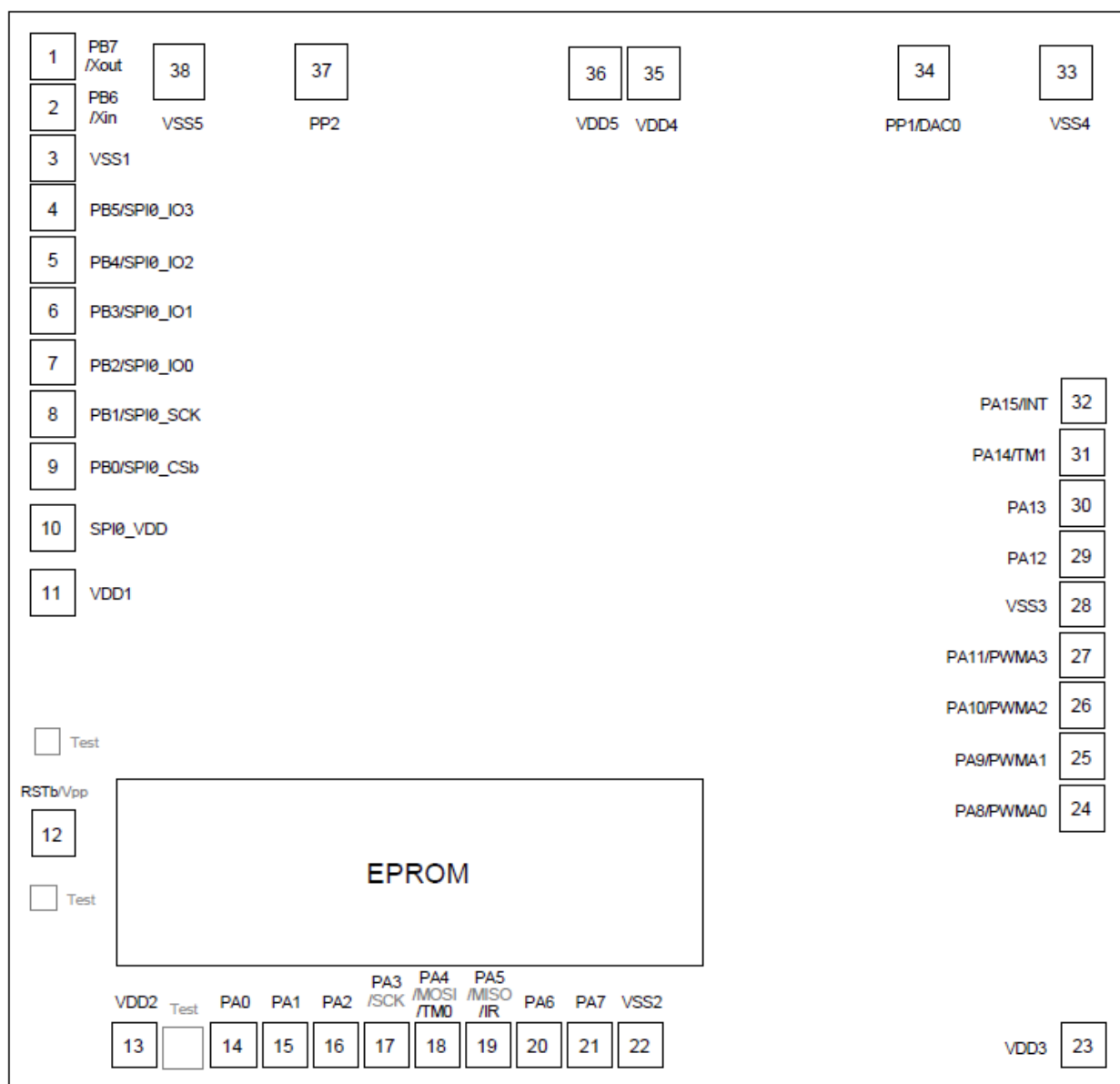
**Note 2:** Do not use PA15/Vpp/INT0/RSTb as GPIO pin as much as possible. If used as GPIO, please avoid highly inductive load, like motor or spring switch.

**Note 3:** For IHRC crystal @ 16MHz / 12MHz, do NOT add the compensation capacitors at X<sub>in</sub> / X<sub>out</sub> pins.

## 20. DIE PAD DIAGRAM

### 20.1 NX11P21A

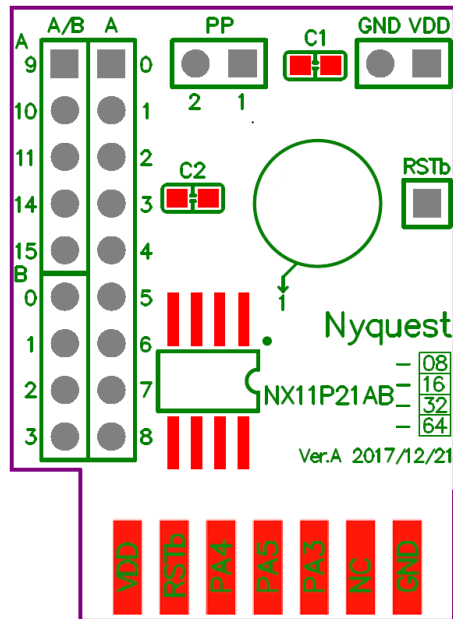
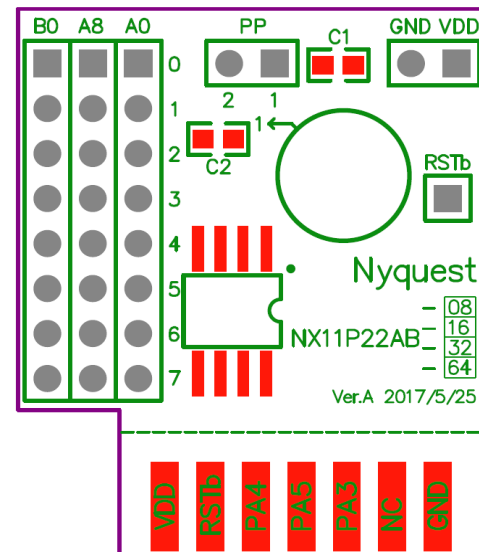
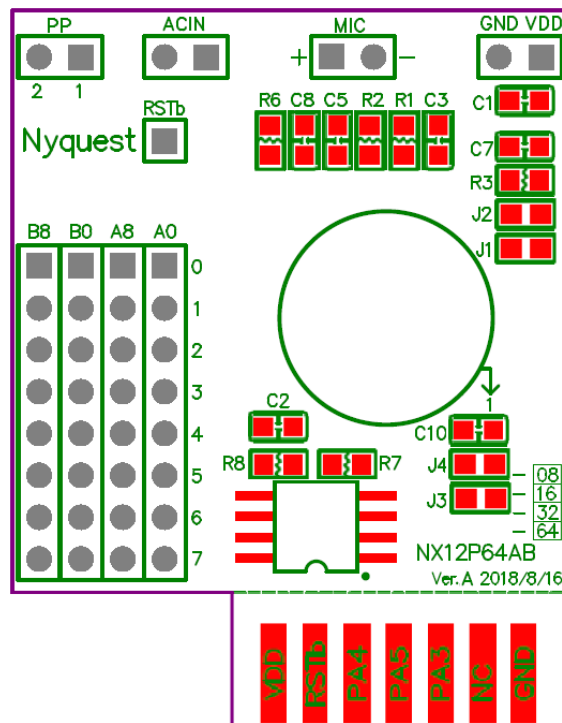


**20.2 NX11P22A**


The diagram shows the ATtiny10 microcontroller with 28 pins. The functions for each pin are as follows:

- Pin 1:** PB15 /PWMB3
- Pin 2:** PB14 /PWMB2
- Pin 3:** PB13/PWMB1
- Pin 4:** PB12/PWMB0
- Pin 5:** VSS1
- Pin 6:** PB11/SPI1\_SDI
- Pin 7:** PB10/SPI1\_SDO
- Pin 8:** PB9/SPI1\_SCK
- Pin 9:** PB8/SPI1\_CSb
- Pin 10:** VDD\_SPI1
- Pin 11:** PB7/Xout
- Pin 12:** PB6/Xin
- Pin 13:** VSS2
- Pin 14:** PB5/SPI0\_IO3
- Pin 15:** PB4/SPI0\_IO2
- Pin 16:** PB3/SPI0\_IO1
- Pin 17:** PB2 /SPI0\_IO0
- Pin 18:** SPI0\_VDD
- Pin 19:** PB1 /SPI0\_SCK
- Pin 20:** PB0 /SPI0\_CSb
- Pin 21:** VDD1
- Pin 22:** VDD2
- Pin 23:** VDD\_ADC
- Pin 24:** VMIC
- Pin 25:** MICN
- Pin 26:** VREF\_ADC
- Pin 27:** MICP
- Pin 28:** VSS3
- Pin 29:** PA0/AIN0
- Pin 30:** PA1/AIN1
- Pin 31:** PA2/AIN2
- Pin 32:** PA3/SCK/AIN3
- Pin 33:** PA4/MOSI/TM0/AIN4
- Pin 34:** PA5/MISO/IR/AIN5
- Pin 35:** PA6/TXD/AIN6
- Pin 36:** PA7/RXD/AIN7
- Pin 37:** VSS4
- Pin 38:** VDD3
- Pin 39:** PA8/PWMA0
- Pin 40:** PA9/PWMA1
- Pin 41:** PA10/PWMA2
- Pin 42:** PA11 /PWMA3
- Pin 43:** VSS5
- Pin 44:** PA12 /SDA
- Pin 45:** PA13/SCL
- Pin 46:** PA15 /Npp
- Pin 47:** PA14 /INT1/TM1
- Pin 48:** ACIN

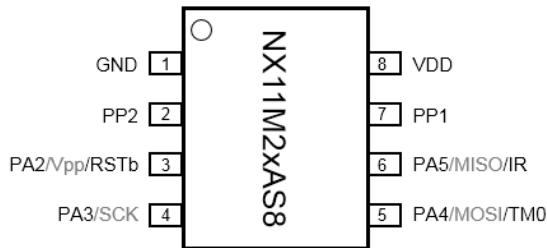
## 21. COB PIN ASSIGNMENT

**NX11P21AB (18 I/O w/o ADC)**

**NX11P22AB (24 I/O w/o ADC)**

**NX12P64AB / NX13P64AB (32 I/O with ADC)**


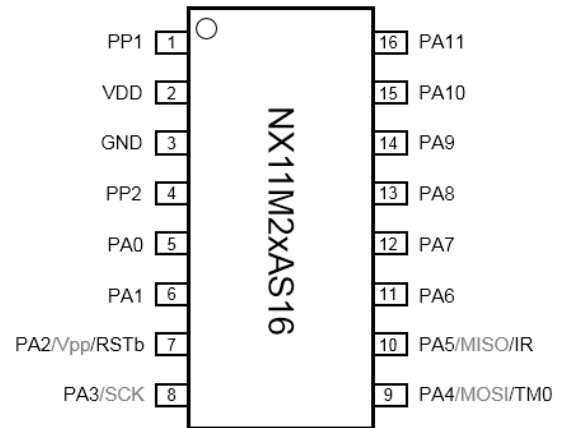
**Note:** C1 is VDD power cap, C2 is SPI0\_VDD cap. For the value of other components, please see [18. Application](#).

## 22. PACKAGE PIN ASSIGNMENT

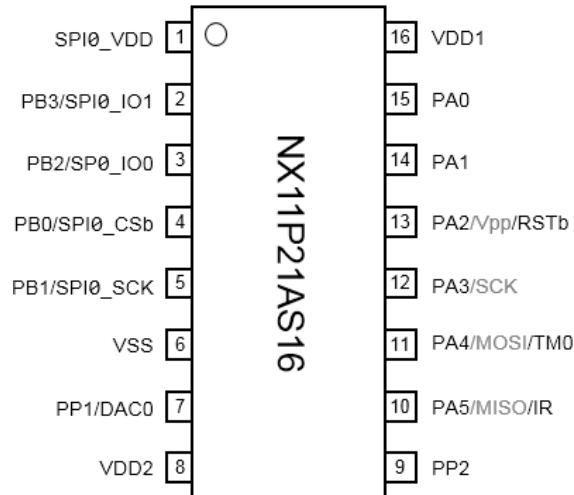
**8-pin SOP (150mil)**



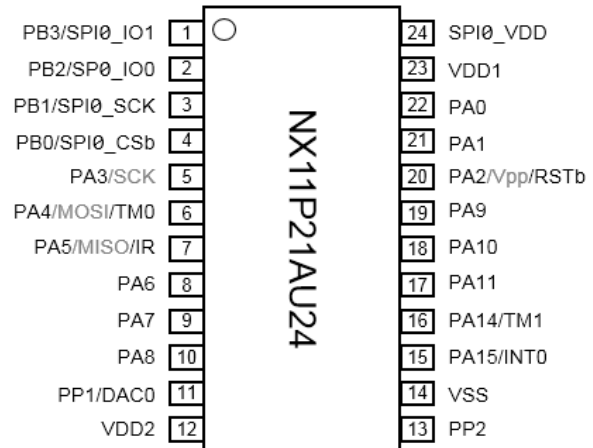
**16-pin SOP (150mil)**



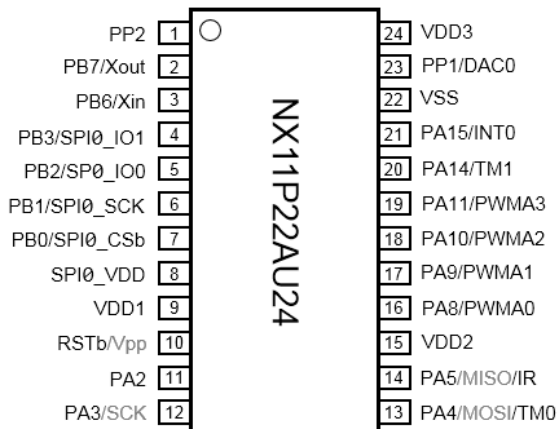
**16-pin SOP (150mil)**

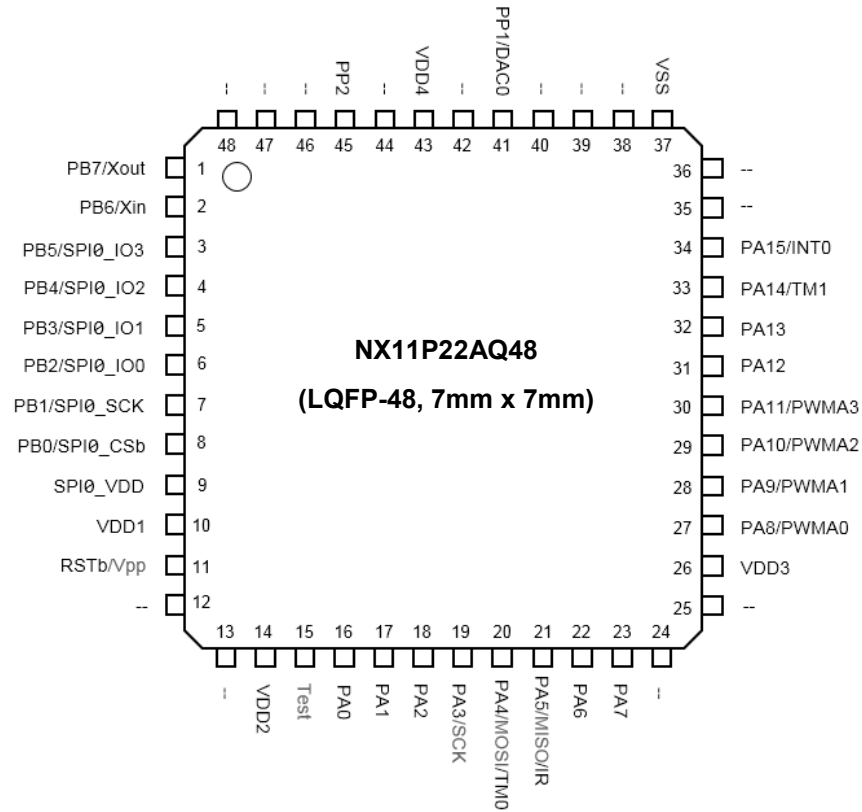


**24-pin SSOP (150mil)**

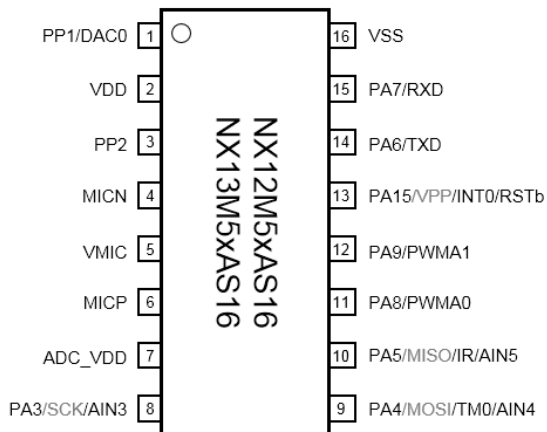


**24-pin SSOP (150mil)**

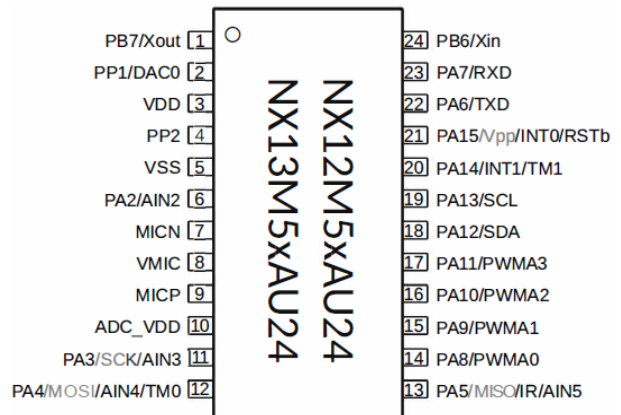


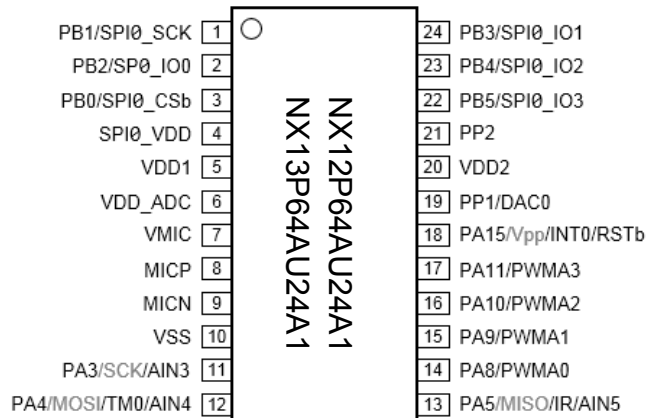
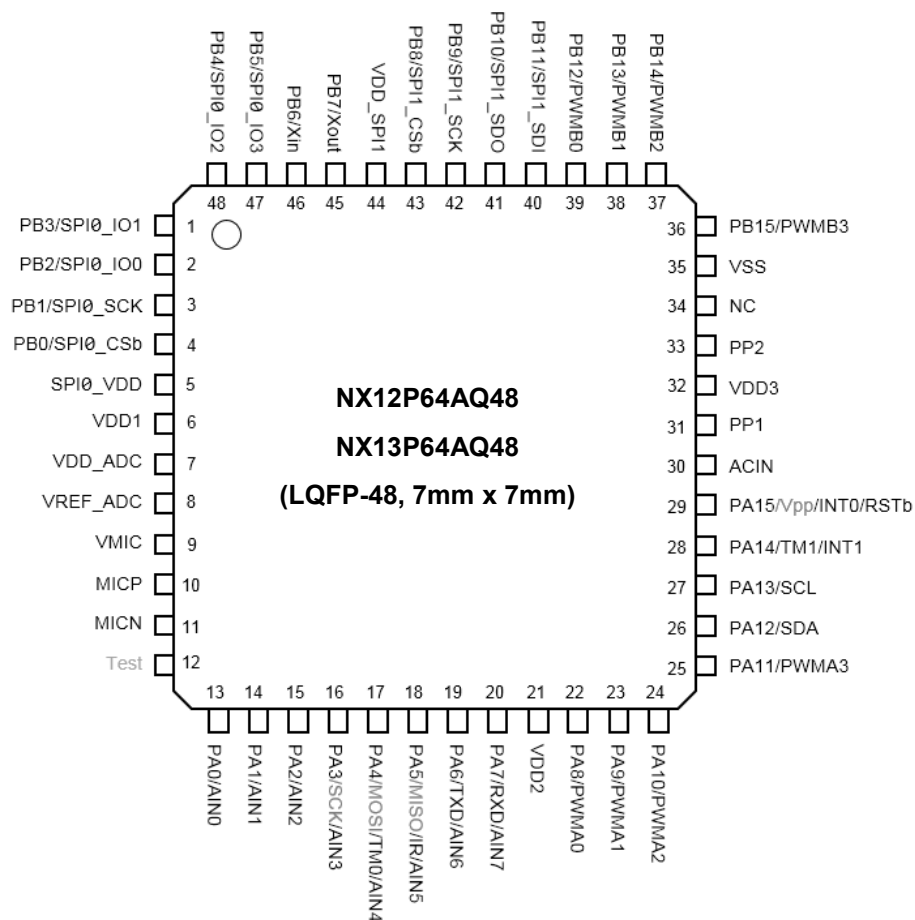
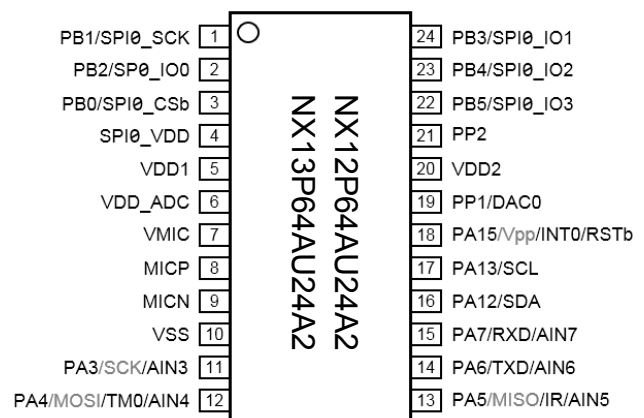


**16-pin SOP (150mil)**



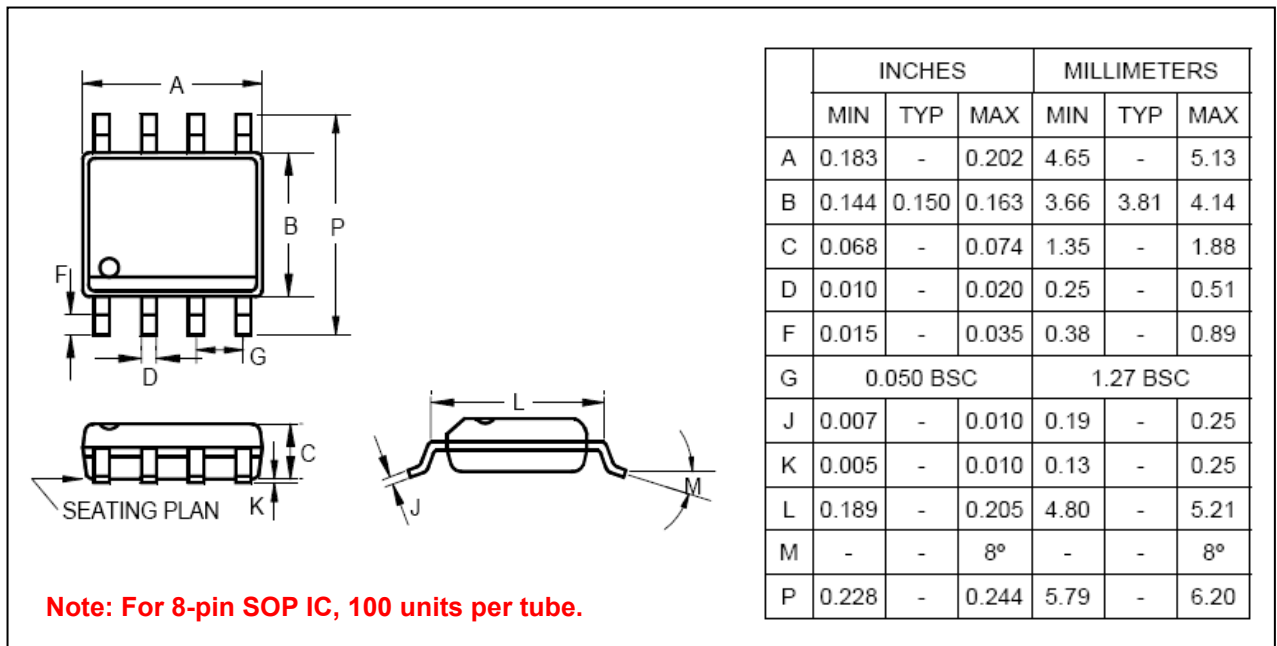
**24-pin SSOP (150mil)**



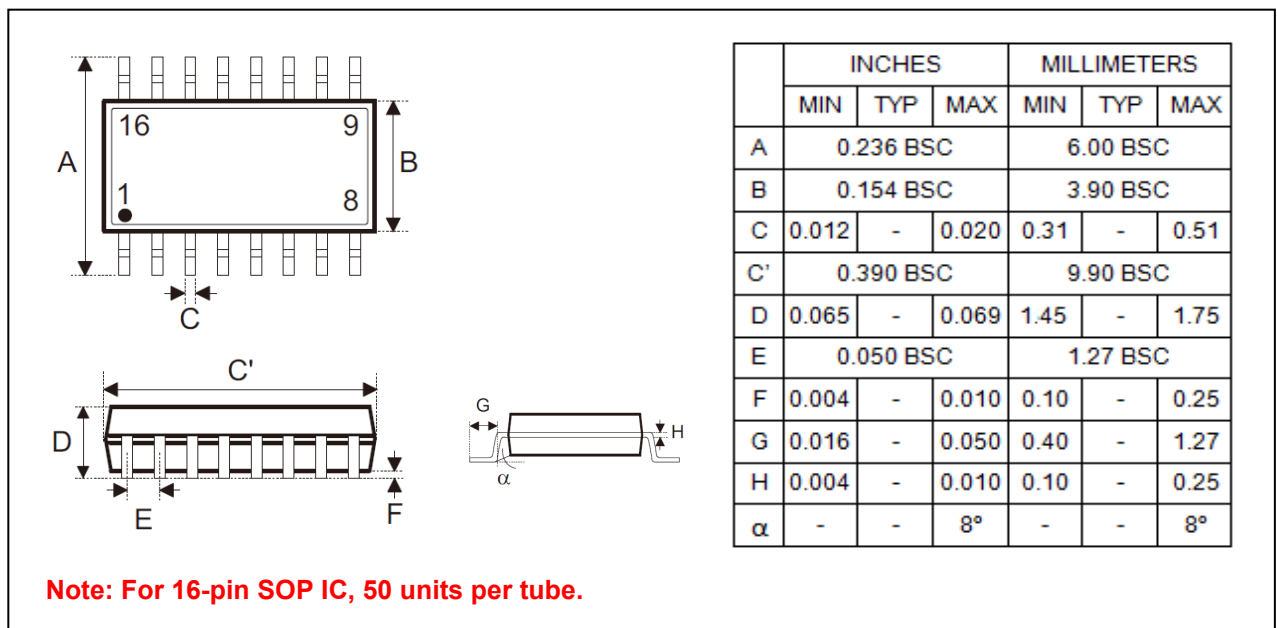
**24-pin SSOP (150mil)**

**24-pin SSOP (150mil)**


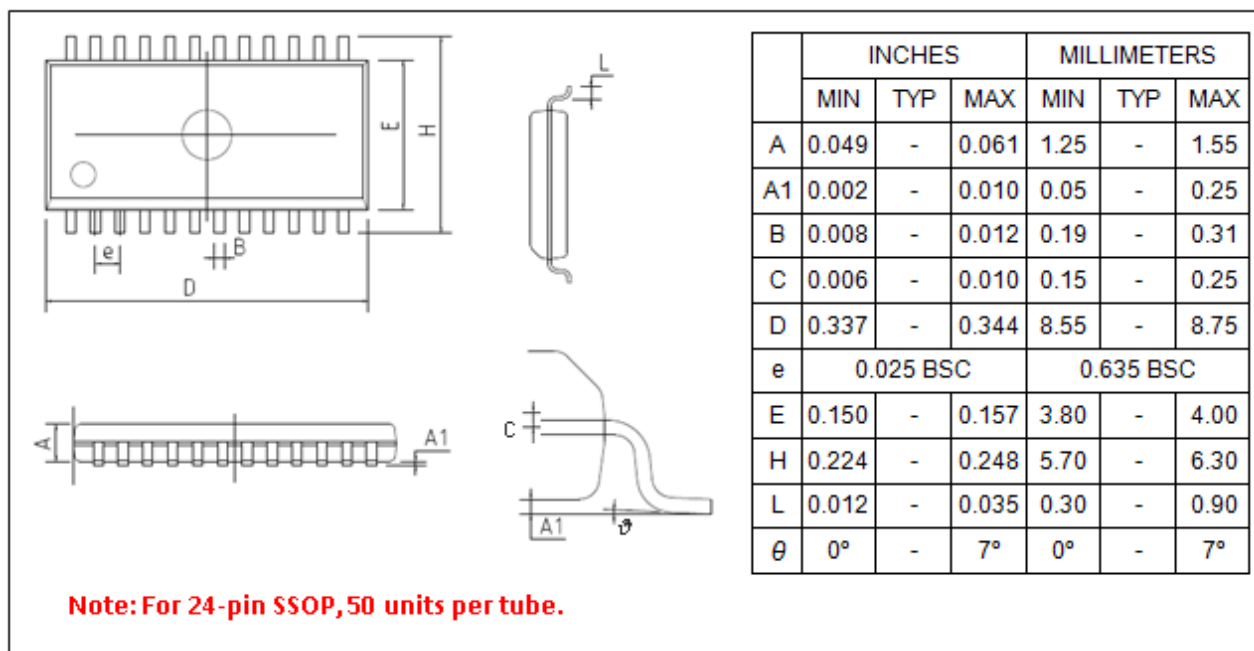
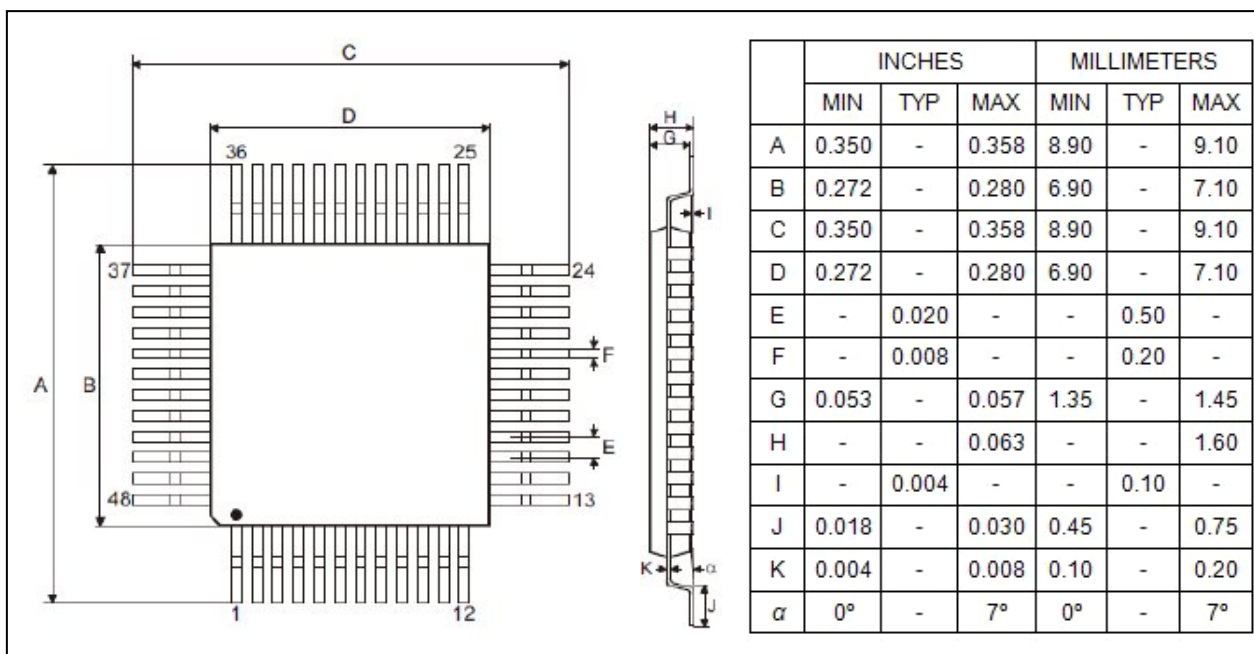
## 23. PACKAGE DIMENSION

### 23.1 8-Pin Plastic SOP (150 mil)



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



**23.3 SSOP-24 (150mil, 0.635mm pin pitch)**

**23.4 LQFP-48 (7mm x 7mm)**


**24. ORDERING INFORMATION**

| <i>P/N</i>     | <i>Shipping Type</i>  | <i>Remark</i>                              |
|----------------|-----------------------|--------------------------------------------|
| NX11P21A       | Dice                  | Empty ROM data                             |
| NX11P21A-xxxx  | Dice, pre-programmed  | Programmed ROM data                        |
| NX11P21AW-xxxx | Wafer, pre-programmed | Programmed ROM data                        |
| NX11P21AB      | COB                   | 24.1mm x 26.4mm (24.1mm x 33.4mm w/ V-Cut) |
| NX11P21AS16    | SOP-16                | Width 150 mil, pitch 1.27mm                |
| NX11P21AU24    | SSOP-24               | Width 150 mil, pitch 0.635mm               |
| NX11P22A       | Dice                  | Empty ROM data                             |
| NX11P22A-xxxx  | Dice, pre-programmed  | Programmed ROM data                        |
| NX11P22AW-xxxx | Wafer, pre-programmed | Programmed ROM data                        |
| NX11P22AB      | COB                   | 26mm x 23.9mm (26mm x 30.9mm w/ V-Cut)     |
| NX11P22AU24    | SSOP-24               | Width 150 mil, pitch 0.635mm               |
| NX11P22AQ48    | LQFP-48               | Quad, 7mm x 7mm, pitch 0.5mm               |
| NX12P64A       | Dice                  | Empty ROM data                             |
| NX12P64A-xxxx  | Dice, pre-programmed  | Programmed ROM data                        |
| NX12P64AW-xxxx | Wafer, pre-programmed | Programmed ROM data                        |
| NX12P64AB      | COB                   | 33.7mm x 35.3mm (33.7mm x 43.6mm w/ V-Cut) |
| NX12P64AU24A1  | SSOP-24               | Width 150 mil, pitch 0.635mm               |
| NX12P64AU24A2  | SSOP-24               | Width 150 mil, pitch 0.635mm               |
| NX12P64AQ48    | LQFP-48               | Quad, 7mm x 7mm, pitch 0.5mm               |
| NX13P64A       | Dice                  | Empty ROM data                             |
| NX13P64A-xxxx  | Dice, pre-programmed  | Programmed ROM data                        |
| NX13P64AW-xxxx | Wafer, pre-programmed | Programmed ROM data                        |
| NX13P64AB      | COB                   | 33.7mm x 35.3mm (33.7mm x 43.6mm w/ V-Cut) |
| NX13P64AU24A1  | SSOP-24               | Width 150 mil, pitch 0.635mm               |
| NX13P64AU24A2  | SSOP-24               | Width 150 mil, pitch 0.635mm               |
| NX13P64AQ48    | LQFP-48               | Quad, 7mm x 7mm, pitch 0.5mm               |
| NX11S21AS8     | SOP-8 (MCP)           | Width 150 mil, pitch 1.27mm                |
| NX11S21AS16    | SOP-16 (MCP)          | Width 150 mil, pitch 1.27mm                |
| NX11S22AS8     | SOP-8 (MCP)           | Width 150 mil, pitch 1.27mm                |
| NX11S22AS16    | SOP-16 (MCP)          | Width 150 mil, pitch 1.27mm                |
| 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                |

| <i>P/N</i>  | <i>Shipping Type</i> | <i>Remark</i>                |
|-------------|----------------------|------------------------------|
| 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  |
| NX12M52AS16 | SOP-16 (MCP)         | Width 150 mil, pitch 1.27mm  |
| NX12M52AU24 | SSOP-24 (MCP)        | Width 150 mil, pitch 0.635mm |
| NX12M53AS16 | SOP-16 (MCP)         | Width 150 mil, pitch 1.27mm  |
| NX12M53AU24 | SSOP-24 (MCP)        | Width 150 mil, pitch 0.635mm |
| NX12M54AS16 | SOP-16 (MCP)         | Width 150 mil, pitch 1.27mm  |
| NX12M54AU24 | SSOP-24 (MCP)        | Width 150 mil, pitch 0.635mm |
| NX12M55AS16 | SOP-16 (MCP)         | Width 150 mil, pitch 1.27mm  |
| NX12M55AU24 | SSOP-24 (MCP)        | Width 150 mil, pitch 0.635mm |
| NX13M52AS16 | SOP-16 (MCP)         | Width 150 mil, pitch 1.27mm  |
| NX13M52AU24 | SSOP-24 (MCP)        | Width 150 mil, pitch 0.635mm |
| NX13M53AS16 | SOP-16 (MCP)         | Width 150 mil, pitch 1.27mm  |
| NX13M53AU24 | SSOP-24 (MCP)        | Width 150 mil, pitch 0.635mm |
| NX13M54AS16 | SOP-16 (MCP)         | Width 150 mil, pitch 1.27mm  |
| NX13M54AU24 | SSOP-24 (MCP)        | Width 150 mil, pitch 0.635mm |
| NX13M55AS16 | SOP-16 (MCP)         | Width 150 mil, pitch 1.27mm  |
| NX13M55AU24 | SSOP-24 (MCP)        | Width 150 mil, pitch 0.635mm |