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

DATA SHEET

# NY9UP01A

## Single Remote Controller with13 I/O

**Version 1.5**

**Aug. 13, 2018**

# Revision History

| *Version* | *Date* | *Description* | *Modified Page* |
|---|---|---|---|
| 1.0 | 2016/11/22 | Formal release. | - |
| 1.1 | 2016/12/08 | Modify package pin assignment. | 11 |
| 1.2 | 2017/02/14 | Adjust LVR to 1.6V. | 3, 4, 7 |
| 1.3 | 2017/05/25 | 1. Modify the descriptions of LVD in Features and Application.<br>2. Remove Die package related descriptions. | 3, 4, 10<br>- |
| 1.4 | 2017/11/24 | 1. Adjust POR to 1.6V.<br>2. Adjust LVR to 1.4V. | 3, 4<br>3, 4, 7 |
| 1.5 | 2018/08/13 | 1. Adjust POR to 1.3V.<br>2. Adjust LVR to 1.3V. | 3, 4<br>3, 4, 7 |

## 1. 概述

NY9UP01A 產品爲單一遙控器的4位元微控制器，為嵌入式EPROM架構的OTP IC (One Time Programmable)。NY9UP01A有13根I/O並支援T-type按鍵矩陣。大灌電流的紅外線端口可以無需外加電晶體即能完成發射與接收功能。使用RISC精簡指令集架構，共有38條指令，可以很方便地以程式控制來完成不同的應用。提供待機模式(Halt mode)，可大幅度延長電池壽命。

## 2. 功能

- 工作電壓範圍： 2.0V ~ 3.6V。
- 4-bit RISC 精簡指令集架構的微控制器，共有38條指令。
- 768 x 10-bit ROM。
- 32 x 4-bit RAM，支援間接定址模式。
- 1MHz 指令頻率。
- 提供待機模式(Halt mode)，可節省功耗，靜態電流(Isb)小於1uA @3.0V。
- 在 2.0V ~ 3.6V 工作電壓與 -20°C ~ +70°C 的環境下，具有精準的 +/-1.0% 內阻震盪。
- 提供上電重置功能(POR=1.3V)。
- 提供低壓復位(LVR=1.3V)、看門狗計時(WDT)。
- 一個中斷輸入可連結到一組獨立的堆棧(Stack)，並有多種中斷來源可以使用。
- 13根彈性的I/O腳 (PAx, PBx, PCx, PD0)，可設定爲 initial output high, initial output low, bi-direction I/O with pull-high, bi-direction I/O without pull-high, initial pull-high input 或 initial floating input。
- 支援M-type、T-type或混合型態的按鍵喚醒。
- 紅外線端口提供 TX應用，TX可選配100%、50%大電流紅外線載波輸出或一般 Sink / Drive 輸出。
- 8位元的可讀計時器可以選擇時鐘源，提供給IR的TX載波頻率與RX學習型計數器使用。
- 提供可程式的Code資料保護模式。 *(當Security-Bit 被燒斷後，資料將無法讀取。)*

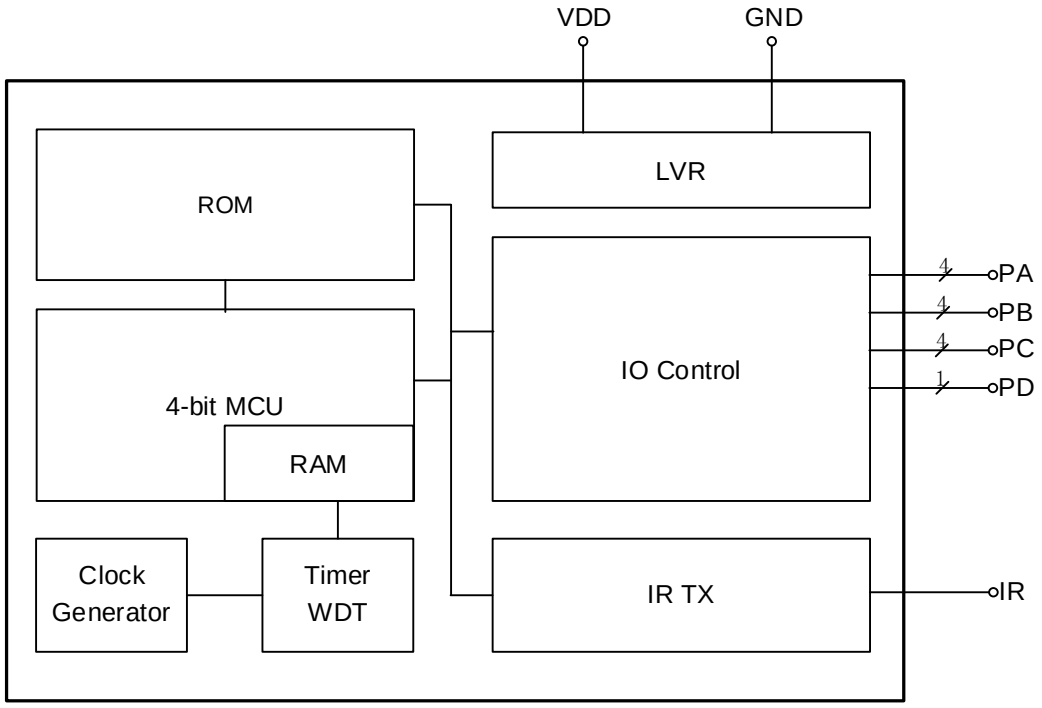
## 1. GENERAL DESCRIPTION

The NY9UP01A is a powerful 4-bit MCU with remote controller. It has 13 I/O ports and supports T-type key matrix. One large sink current IR port can transmit without any bipolar transistor. The RISC MCU architecture is very easy to use, and various applications can be easily implemented. There are 38 instructions, and most of them are executed in single cycle. Furthermore, it provides the HALT mode (sleep mode) to extend battery life.

## 2. FEATURES

- Operating voltage range: 2.0V to 3.6V.
- 4-bit RISC type micro-controller with 38 instructions.
- 768 x 10-bit program ROM.
- 32 x 4-bit RAM, indirect RAM addressing mode is supported.
- 1MHz instruction frequency.
- HALT mode to save power, standby current <1uA @3V.
- Precisely embedded oscillator with build-in resistor, +/- 1.0% deviation in 2.0V~3.6V and -20°C~+70°C.
- Power on reset (POR=1.3V).
- Low voltage reset (LVR=1.3V) and watch-dog reset both are supported to protect the system.
- One entrance for interrupt operation with an independent stack, multiple interrupt sources.
- 13 flexible I/Os of PAx, PBx, PCx and PD0 with optional function: initial output high, initial output low, bi-direction I/O with pull-high, bi-direction I/O without pull-high, initial pull-high input or initial floating input. *(Code option)*
- M-Type, T-type or mixed type key wakeup supported.
- IR provides TX application, optioned for 100%, 50% large current IR carrier output, or Normal (Sink/Drive) for TX.
- 8-bit readable timer with selectable timer clock source for IR TX carrier frequency.
- Programmable code protection is provided. *(When the Security-Bit is burnt down, data can't be read.)*

## 3. BLOCK DIAGRAM




## 4. PAD DESCRIPTION

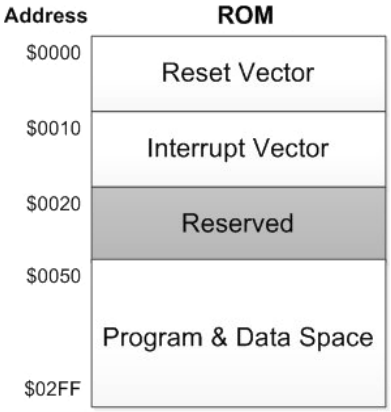
| Pad | ATT | Description |
|---|---|---|
| VDD | Power | Positive power. |
| GND | Power | Negative power. |
| IR | O | Infrared port (TX). |
| PA0/SDA | I/O | Bit 0 for Port A, or serial data input at programming mode. |
| PA1/SCL | I/O | Bit 1 for Port A, or serial clock input at programming mode. |
| PA2/Mode | I/O | Bit 2 for Port A, or select programming mode. |
| PA3/Vpp | I/O | Bit 3 for Port A, or positive high power for programming. |
| PB0~3 | I/O | PA0~3, PB0~3, PC0~3, PD0: 13 flexible I/Os with optional function.<br>Port can be set as normal I/O or key scan I/O, and key scan I/O can send key scan signal under halt mode. |
| PC0~3 | I/O | |
| PD0 | I/O | |

# 5. MEMORY ORGANIZATION

The NY9UP01A has 768 words ROM, 32 nibbles of RAM and 16 nibbles of dedicated system control register. The registers are divided into 10 nibbles of system registers and 6 nibbles of memory registers. Besides, there are several registers without address allocation, and they can only be accessed by the special instructions such as clock source register (TCS) and timer register (TM).

## 5.1 ROM

A program data single ROM is provided and its structure is shown below. The reserved region contains system information and can't be utilized by users.




## 5.2 RAM

NY9UP01A provide only 1 page, and the memory space is shared with the memory registers (address=0x00~0x07), the address for RAM is 0x20~0x3F.


In addition to the immediate addressing mode, the indexed addressing mode is also supported. The page and address of the indexed RAM should be stored into RPT1 and RPT0 first, and users can read from or write in the XMD memory register to realize the indexed RAM access.

# 6. INTERNAL OSCILLATOR

The system clock is 1MHz which is fast enough for most of applications. The clock generator is a Ring oscillator, and users can only select the internal resistor oscillation (INT-R). The INT-R oscillator accuracy is up to ± 0.5%, and the deviation is ± 1.0% in the full range of 2.0V~3.6V VDD and -20°C~+70°C temperature.

# 7. SYSTEM RESET

## 7.1 System Power-On & Power-Down

After Power-on, the power-on reset initialization will automatically be set out. The system takes about 16ms to leave from the reset initialization procedure, and enters the normal operation and the program counter (PC) will start at the reset vector to execute the desired program.

## 7.2 Low Voltage Reset & Detection (LVR)

When the system enters the normal operation, the power voltage must be kept in an effective working voltage range. If the power voltage is lower than the effective working voltage range, the system will work improperly.

To prevent the system crash, NY9UP01A series supplies Low Voltage Reset (LVR) detectors. Once the LVR detector detects a harmful low voltage supply, it will cause a low voltage reset. The so-called “low voltage reset” point of the NY9UP01A IC is about 1.3V.

## 7.3 Watch-Dog Timer (WDT)

To recover from program malfunction, the NY9UP01A IC supports an embedded watch-dog timer reset. The WDT function always works with the program executing. Users have to clear the WDT periodically to prevent from timing up with a reset generation. Typically, the minimum time-up period of the WDT is about 0.45s. Users can move a 0xE value to the INT system register to clear WDT.

# 8. I/O PORTS

There are 13 I/O ports, designated as PAx, PBx, PCx, PD0, and x=0~3. These ports can be configured by option code and I/O register, but the option code is fixed, and users can set I/O functions by I/O registers. The I/O ports can be configured as six statuses, initial output high, initial output low, I/O (bi-direction) with pull-high, I/O (bi-direction) without pull-high, initial pull-high input or initial floating input by option. And when the chip is running, the status can be changed by I/O register control.

The table below shows the relation between them. (PX means PA, PB, PC register)

| Category | Option | PX register write 1 | PX register write 0 |
|---|---|---|---|
| PXx (X=A~C, x=0~3) | initial output high | output high | output low |
| | initial output low | output high | output low |
| | I/O with pull-high | input with pull-high | output low |
| | I/O without pull-high (open drain) | Input floating | output low |
| | initial pull-high input | input with pull-high | input floating |
| | initial floating input | input with pull-high | input floating |

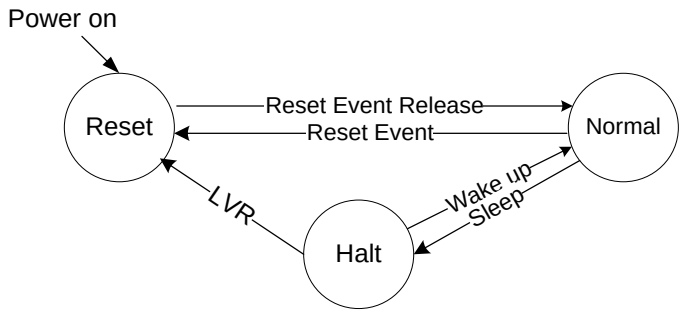
The pull-high resistor of all the I/O ports is about 125KΩ @3V for key matrix function usually.

## 9. IR TX

The NY9UP01A provides an independent pin (IR) for infrared transmit block, which is used to send infrared signal. For the function of transmitter, users can set a variety of IR carrier frequency by the given clock source (TCS), DTHN, DTLN and the given value of 8-bit IR timer register (TM).

## 10. POWER SAVING MODE

The relationship between power saving mode, reset & normal mode is shown below.




### 10.1 Halt Mode

The system enters the halt mode if the HALT command executed. The halt mode is also known as the sleep mode. As implied by the name, the IC falls asleep and the system clock is completely turned off, so all the IC functions are halted and it minimizes the power consumption.

The only way to wake-up the sleeping system is an input port wake-up. The IC keeps monitoring the input pads during the halt mode. If the input status of any input pad changes to low, the system will be woken-up. Then the succeeding instructions after the HALT instruction will be executed after the wake-up stable time (about 60us). So before executing the HALT instruction, users have to keep in mind that the input port status is high.

If the IC is waked-up from the halt mode by the occurrence of LVR, it goes into the reset procedure.

### 10.2 T-type Scan Mode

In T-type scanning application, each port (PA~PD) can be selected as scan key independently by option PXx (X=A~C, x=0~3) & PD0. And setting the port as bi-direction input ports is necessary under T-type scan mode. It works as input with pull-high resistor and output fixed frequency low pulse in halt mode. Any of the keys touch would cause system wake-up. Meanwhile, the frequency of key scan can be adjusted by option codes, such as about 15.625Hz, 31.25Hz, 62.5Hz and 125Hz.

# 11. ELECTRICAL CHARACTERISTICS

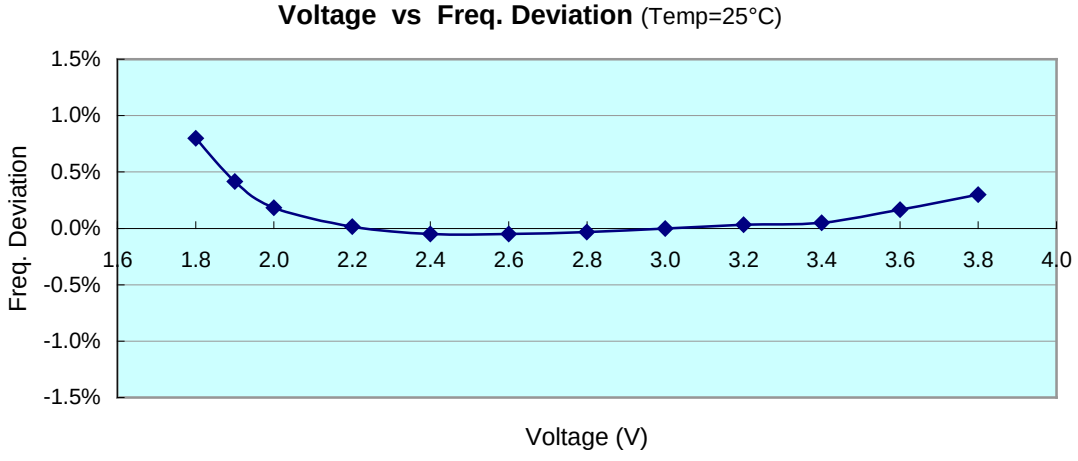
## 11.1 Absolute Maximum Rating

| Symbol | Parameter | Rated Value | Unit |
|---|---|---|---|
| $V_{DD}$ - $V_{SS}$ | Supply voltage | -0.3 ~ +4.0 | V |
| $V_{IN}$ | Input voltage | $V_{SS}$ -0.3V ~ $V_{DD}$+0.3 | V |
| $T_{OP}$ | Operating Temperature | -20 ~ +70 | °C |
| $T_{ST}$ | Storage Temperature | -40 ~ +85 | °C |

## 11.2 DC Characteristics *($V_{DD}$=3.0V, $T_A$=25ºC, unless otherwise specified)*

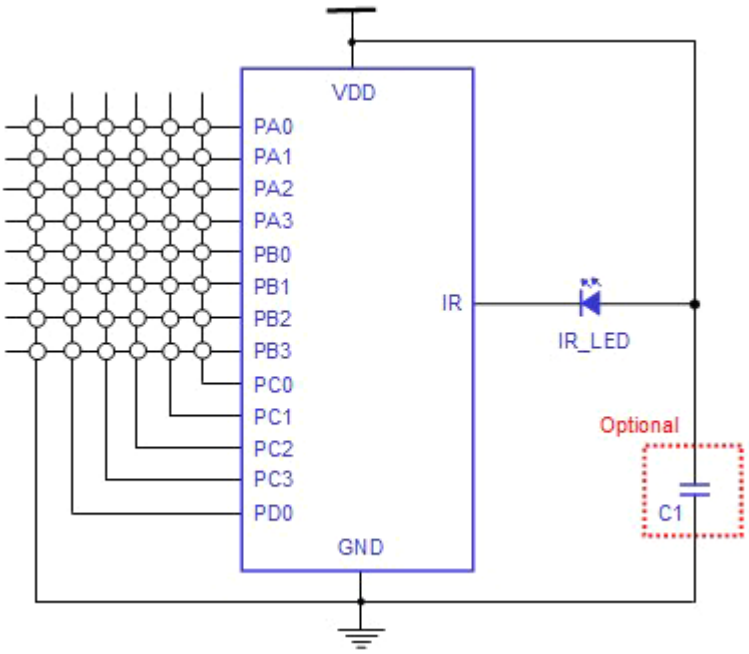
| Symbol | Parameter | | Min. | Typ. | Max. | Unit | Condition |
|---|---|---|---|---|---|---|---|
| $V_{DD}$ | Operating voltage | | 2.0 | 3 | 3.6 | V | 1 MHz |
| $I_{SB}$ | Supply current | Halt mode | | | 1 | uA | Sleep, no load |
| $I_{Scan}$ | | Scan mode | | | 2 | uA | T-type key scan |
| $I_{OP}$ | | Operating mode | | 1 | | mA | 1MHz, no load |
| $V_{IH}$ | Input high level | | | 0.7*$V_{DD}$ | | V | |
| $V_{IL}$ | Input low level | | | 0.5*$V_{DD}$ | | V | |
| $I_{IL}$ | Input current (Internal 125KΩ pull-high) | | | 24 | | uA | $V_{IL}$ = 0V |
| $I_{OH}$ | Output high current | | | -9 | | mA | $V_{OH}$ = 2.0V |
| $I_{OL}$ | Output low current | | | 18 | | mA | $V_{OL}$ = 1.0V |
| $I_{IR}$ | IR sink current | | | 450 | | mA | $V_{IR}$ = 1.5V |
| △F/F | Frequency lot deviation | | -1.0 | | 1.0 | % | $V_{DD}$: 2.0V ~ 3.6V, Temp: -20°C ~ +70°C |

## 11.3 Voltage vs. Frequency

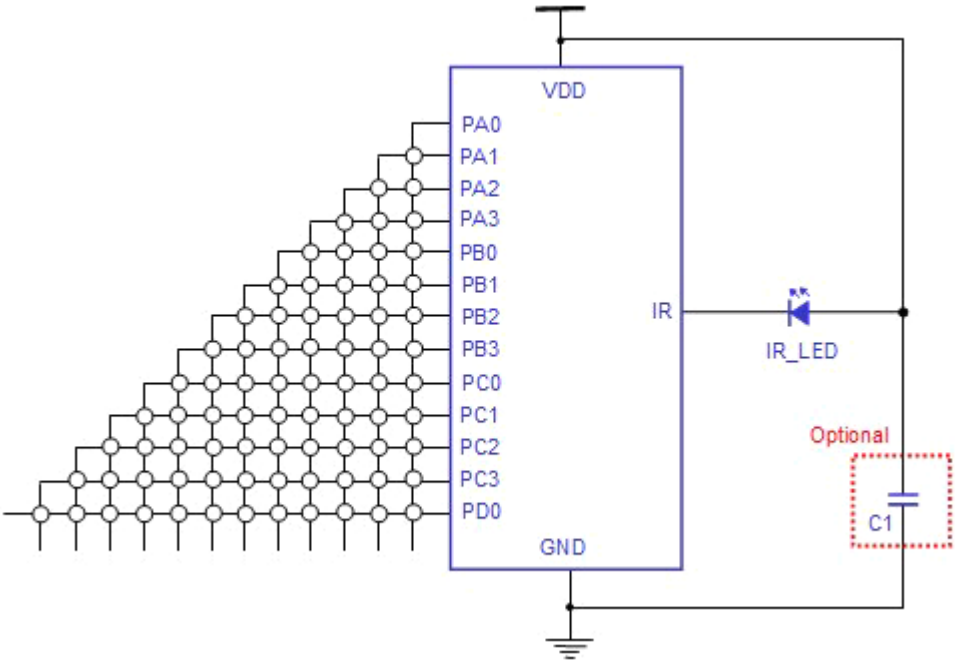


## 12. APPLICATION

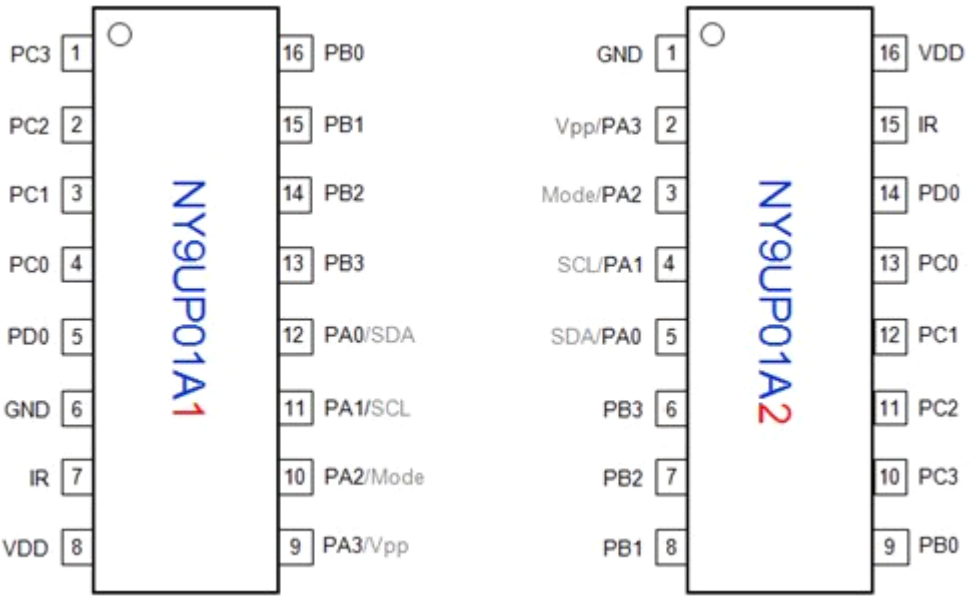
### (1) M-type Key Scan Keyboard (Matrix)



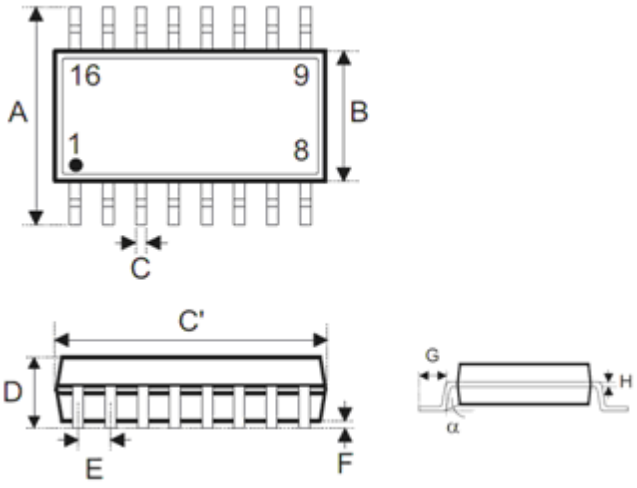

### (2) T-type Key Scan Keyboard (T-Scan)



## 13. PACKAGE PIN ASSIGNMENT




## 14. PACKAGE DIMENSION




| | INCHES | | | MILLIMETERS | | |
|---|---|---|---|---|---|---|
| | MIN | TYP | MAX | MIN | TYP | MAX |
| A | | 0.236 BSC | | | 6.00 BSC | |
| B | | 0.154 BSC | | | 3.90 BSC | |
| C | 0.012 | - | 0.020 | 0.31 | - | 0.51 |
| C' | | 0.390 BSC | | | 9.90 BSC | |
| D | 0.065 | - | 0.069 | 1.64 | - | 1.75 |
| E | | 0.050 BSC | | | 1.27 BSC | |
| F | 0.004 | - | 0.010 | 0.10 | - | 0.25 |
| G | 0.016 | - | 0.050 | 0.40 | - | 1.27 |
| H | 0.004 | - | 0.010 | 0.10 | - | 0.25 |
| α | - | - | 8° | - | - | 8° |

**Note: For 16-pin SOP, 50 units per tube.**

## 15. ORDERING INFORMATION

| *P/N* | *Shipping Type* | *Remarks* |
|---|---|---|
| NY9UP01AW-xxxx *1 | Wafer | Programmed ROM data |
| NY9UP01A1 | SOP-16, Width 150 mil | Tape & Reel: 2.5K pcs per Reel<br>Tube: 50 pcs per Tube |
| NY9UP01A2 | SOP-16, Width 150 mil | |

**1 "xxxx": Code number*