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

NY3AxxxD Series

1 I/O Single-Chip Speech Synthesizer

Version 1.0

Jun. 01, 2013

Revision History

Version	Date	Description	Modified Page
1.0	2013/06/01	Formal release.	-

1. 概述

NY3AxxxD系列產品為單晶片CMOS語音合成 IC，共有2個母體分別為NY3A003D 和NY3A006D。只有1個I/O腳，利用精準的內阻震盪故不需外加震盪電阻，只有一組PWM輸出，故無須再外加任何零件。語音合成方式為4-bit LOG-PCM，藉由製造過程中更換Code光罩，可將不同的語音資料寫入ROM中。用戶可使用簡便的 Q-Speech 工具軟體來快速地進行開發。

2. 功能

(1). 寬廣的工作電壓： 1.6V ~ 6.4V。

(2). 共有2個母體，ROM大小及秒數(@6kHz)如下：

	NY3A003D	NY3A006D
ROM Size	3D00H	7A00H
4-bit, 6kHz	2.6s	5.2s

(3). 語音最多可被分割成16個語音段(Voice Section)，每段長度可不同。 每一個語音段的長度(語音+ 靜音時間)最多可達 5.46 秒 (在6kHz取樣頻率下)。每一語音段中的語音+靜音長度必須為 80H (Hex) 的整數倍。

(4). 共有256個語音格(Voice Step)，可規劃成16個語音組(Voice Sentence)，每個語音組(Sentence)可放的語音格(Step)並沒有限制(但最多只有256個語音格)。每一語音格(Step)可指定一語音段(Section) 和 OKY 的輸出搭配 (當功能為POP且OKY設為輸出時)。

(5). 只有內建一組準確的頻率振盪器(+/- 3% 誤差)，*並無提供外部震盪電阻選項*。共有27種不同播放速度的選擇，但只可選擇其中一種播放速度。 **(新的播放速度必須搭配 *NY3(B)_FDB Ver.B*)**

1	2	3	4	5	6	7	8	9	10
20.0kHz	17.1kHz	15.0kHz	13.3kHz	12.0kHz	10.9kHz	10.0kHz	9.2kHz	8.6kHz	8.0kHz
11	12	13	14	15	16	17	18	19	20
7.5kHz	7.1kHz	6.7kHz	6.3kHz	6.0kHz	5.7kHz	5.5kHz	5.2kHz	5.0kHz	4.8kHz
21	22	23	24	25	26	27			
4.6kHz	4.4kHz	4.3kHz	4.1kHz	4.0kHz	3.9kHz	3.8kHz			

(6). 只有一個 OKY 的I/O腳。

(7). OKY當做輸入腳時的輸入選項：(光罩選擇)

    (a). 可選擇 Edge/Level, Hold/Unhold, Retrigger/Irretrigger 不同的觸發方式組合。

    (b). 可選擇 CDS+1.5M、CDS、1.5M 的下拉電阻 或 Floating。(CDS+1.5M選項: 當按鍵按下時，IC內部為1.5M 的下拉電阻；而當按鍵放開時，IC內部為 300K+1.5M 並聯 的下拉電阻 約250K。 CDS選項: 當按鍵按下時，IC內部為 Floating ；而當按鍵放開時，IC內部為 300K 的下拉電阻。)

    (c). 可選擇不同的防止誤動作(Debounce)時間：Long - 提供一般手動操作；Short - 提供彈跳開關使用。

    (d). 最多有16個 Sentence 的 One-Key sequential 或 random 的選擇。

(8). OKY當做輸出腳時可提供大電流來直推高亮度LED。(Iol=20mA @VDD=3V)

(9). OKY當做輸出腳有以下 4 種輸出選項：(光罩選擇)

    (a). Busy_High active：播放時送出高位準訊號。(Drive輸出)

(b). Busy_Low active：播放時送出低位準訊號。(Sink輸出)

(c). LED 3Hz flash：播放時 LED 3Hz Sink輸出閃爍。

(d). LED dynamic 1/2：播放時 LED根據1/2聲音位準做Sink輸出動態閃爍。

※ 注意: LED 3Hz flash 是指以 6kHz 的播放速度 時LED閃爍的頻率；不同的播放速度，LED閃爍的頻率也會不同。

(10). 特殊功能選項 ”上電播放” (Power-On-Play, POP)：電池一上電立即播放一次 ”上電播放語音組” (POP Sentence)，觸發模式固定為 Edge / Unhold / Irretrigger。如果結合 ”上電循環播放” (Power-On-Loop, POL) 功能，則該語音組會一直循環播放，觸發模式固定為 Level / Unhold / Irretrigger。

※ 注意：當選擇POP功能時，OKY只能設為輸出腳。

(11). 一組PWM輸出，可直接驅動喇叭或蜂鳴片。

1. GENERAL DESCRIPTION

The NY3AxxxD series are single-chip voice synthesizing CMOS IC. There are 2 bodies: NY3A003D and NY3A006D. There is only one I/O pin. Through accurate internal oscillation, external Rosc is unnecessary. There is only one PWM output for voice. Thus any external component is not required. Using 4-bit LOG-PCM algorithm, customer's speech data can be programmed into ROM by changing one code mask during fabrication. Besides, an interactive software developing tool "*Q-Speech*" is user-friendly and quick for programming.

2. FEATURES

(1). Wide operating voltage: 1.6V ~ 6.4V.

(2). There are 2 bodies. ROM size and speech duration @ 6kHz are as following.

	NY3A003D	NY3A006D
ROM Size	3D00H	7A00H
4-bit, 6kHz	2.6s	5.2s

(3). The total voice duration can be partitioned up to 16 *Voice Sections*. Each *Voice Section* length is flexible. Each voice length (voice+mute) can be individually up to 5.46 seconds at 6kHz S.R.. The *Voice Section* length of "voice length + mute length" must be the multiple of 80H (Hex).

(4). Total 256 *Voice Steps* are available for 16 *Voice Sentences*. Each *Sentence* can only use maximum 256 *Steps*. For each *Step*, it can specify one *Voice Section*.

(5). Only build in an accurate internal oscillator of +/- 3% tolerance, <u>no external R oscillator</u>. There are 27 kinds of options for play speed, but user can only select one of them to use. **(New play speed must be cooperated with *NY3(B)_FDB Ver.B* or later version.)**

1	2	3	4	5	6	7	8	9	10
20.0kHz	17.1kHz	15.0kHz	13.3kHz	12.0kHz	10.9kHz	10.0kHz	9.2kHz	8.6kHz	8.0kHz
11	12	13	14	15	16	17	18	19	20
7.5kHz	7.1kHz	6.7kHz	6.3kHz	6.0kHz	5.7kHz	5.5kHz	5.2kHz	5.0kHz	4.8kHz
21	22	23	24	25	26	27			
4.6kHz	4.4kHz	4.3kHz	4.1kHz	4.0kHz	3.9kHz	3.8kHz			

(6). There is only one OKY I/O pin.

(7). When OKY is set as input pin. Input option is shown below. (Mask option)

   (a). OKY input can select Edge/Level, Hold/Unhold and Retrigger/Irretrigger trigger modes.

   (b). OKY input can select CDS+1.5M, CDS, 1.5M pull-low resistor or Floating type.

     (CDS+1.5M option: Only 1.5M pull-low resistance at key-pressed, and 1.5M+300K in parallel pull-low resistance around 250K at key-released. CDS option: Floating at key-pressed, and 300K pull-low resistance at key-released.)

   (c). OKY input can select Debounce time: Long debounce for push-button. Short debounce for fast switch.

   (d). OKY input can select One-Key Sequential or Random for maximum 16 Sentences.

(8). When OKY is set as output pin, it supports large-current output and can directly drive high brightness LED. (I$_{ol}$=20mA @V$_{DD}$=3V)

(9). When OKY is set as output pin, there are 4 kinds of output options.

(a). Busy_High active: high active signal output during playing. (Drive output)

(b). Busy_Low active: low active signal output during playing. (Sink output)

(c). LED 3Hz flash: 3Hz sink signal output to drive LED during playing.

(d). LED dynamic 1/2: according to 1/2 sound level, dynamic sink signal output to drive LED during playing.

※ *Note: Where 3Hz flash is the LED flash rate at 6kHz sample rate. For different play speed, the LED flash rate is different from original 3Hz.*

(10). "*Power-On-Play*" special function (POP): When power is on, play the POP Sentence one time. The trigger mode is fixed as Edge / Unhold / Irretrigger. To cooperate with Power-On-Loop (POL) function, the POP Sentence will be played in loop. The trigger mode is fixed as Level / Unhold / Irretrigger.

※ *Note:* When POP function is selected, OKY must be set as output.

(11). One PWM output can directly drive speaker or buzzer.

3. BLOCK DIAGRAM
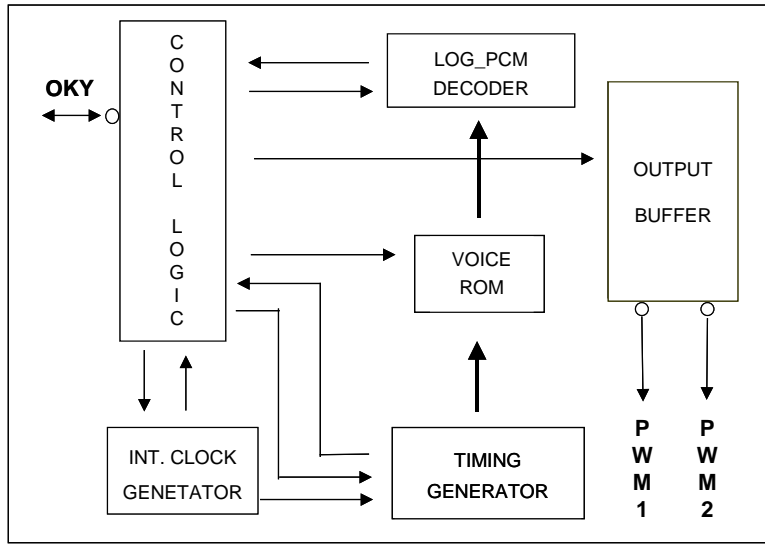
4. PAD DESCRIPTION

Pad Name	Pad No.	ATTR.	Description
OKY	1	I/O	Input or o output pin. To be input, active high.
GND	2	Power	Negative power.
VDD	3	Power	Positive power.
PWM1	4	O	PWM output 1.
PWM2	5	O	PWM output 2.

5. DEVELOPMENT & DEMONSTRATION

User can use "*Q-Speech*" software tool to develop the desired functions. After finishing the code programming, user will get 2 files of "**.bin**" and "**.htm**", the binary file and function check list. Through "FDB_Writer" operation, user can download the "**.bin**" file into NY3(B)_FDB-02 flash demo board to demonstrate the NY3AxxxD function. Once the function has been approved, user only need to send the "**.bin**" file to Nyquest for code release. For more details, please refer to "*Q-Speech*" user manual.

2Mb Flash Demo board	*NY3(B)_FDB-02 (Ver.B)*
Max. demo body	NY3A006D

6. ABSOLUTE MAXIMUM RATING

Symbol	Rating	Unit
VDD~GND	-0.5 ~ +7.5	V
Vin	GND-0.3 < Vin < VDD+0.3	V
Vout	GND < Vout < VDD	V
Top (operating)	-0 ~ +70	ºC
Tst (storage)	-55 ~ +150	ºC

7. DC CHARACTERISTICS

Symbol	Parameter		Min.	Typ.	Max.	Unit	Condition
V_{DD}	Operating voltage		1.6	3.0	6.4	V	
I_{sb}	Standby current, V_{DD}=3V/4.5V			0.2	0.5		No loading
I_{op}	Operating current	V_{DD}=3V		140		uA	
		V_{DD}=4.5V		380			
I_{ih}	Input current: OKY (1.5M pull-low)				2	uA	V_{DD}=3V
					5		V_{DD}=4.5V
I_{ih}	Input current: OKY (CDS: 300k pull-low)				10	uA	V_{DD}=3V
					25		V_{DD}=4.5V
I_{oh}	Output drive current			-10		mA	V_{DD}=3V, V_{oh}=1.0V
				-20			V_{DD}=4.5V, V_{oh}=2.2V
I_{ol}	Output sink current			20		mA	V_{DD}=3V, V_{ol}=1.0V
				34			V_{DD}=4.5V, V_{ol}=1.0V
I_{oh}	PWM1, PWM2 output current			-60		mA	V_{DD}=3V, V_{oh}=1.5V
I_{ol}				60			V_{DD}=3V, V_{ol}=1.5V
$\triangle$F/F	Frequency deviation by voltage drop	V_{DD}=3V		0.5		%	$\dfrac{Fosc(3.0v)-Fosc(2.4v)}{Fosc(3v)}$
		V_{DD}=4.5V		0.5			$\dfrac{Fosc(4.5v)-Fosc(3.0v)}{Fosc(4.5v)}$
$\triangle$F/F	Frequency lot deviation		-3		3	%	$\dfrac{Fmax(V_{DD})-Fmin(V_{DD})}{Fmax(V_{DD})}$
Fosc	Oscillation Frequency		653	768	800	kHz	V_{DD}=1.6~6.4V

Voltage vs Frequency (SR=6.0KHz@3V)
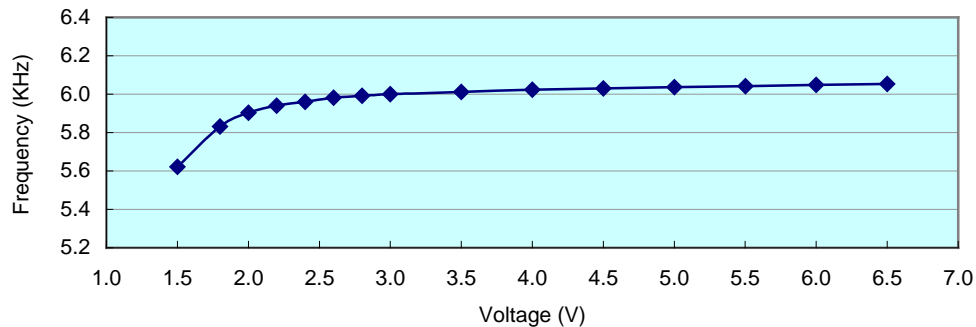
Voltage vs Freq. Deviation (SR=6.0KHz@3V)
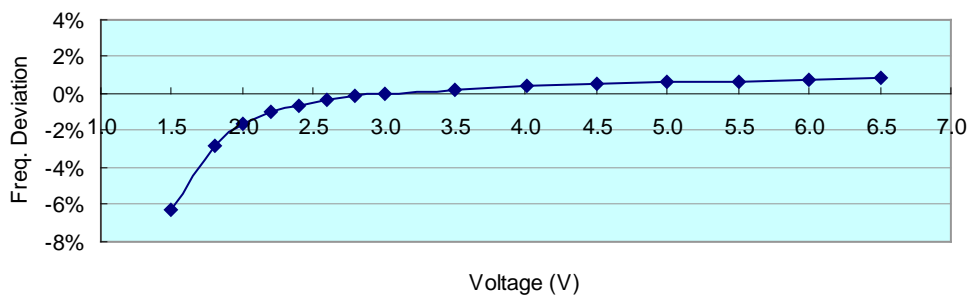
8. TIMING DIAGRAM

(1) Debounce Time

(a). Trigger while no playing voice
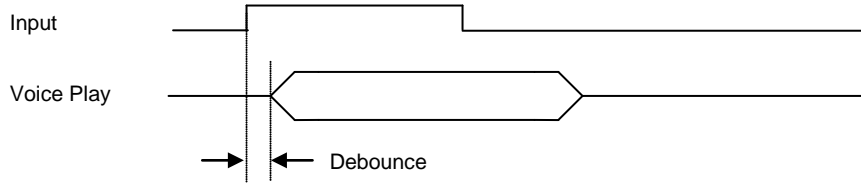
※ Debounce time is configured by 6 kHz S.R and the value is fixed. That is, Long debounce = 20ms, Short debounce = 50us
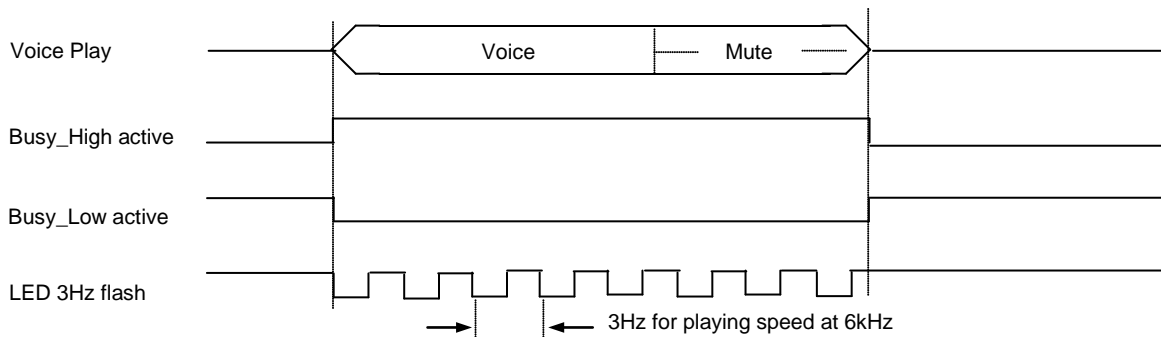
(b). Trigger While playing voice
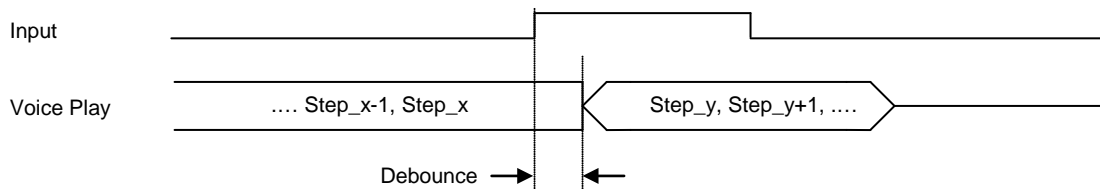
※ Debounce Time is configured by the S.R. of Step_x. At S.R. = 6kHz, Long debounce = 20ms, Short debounce = 50us

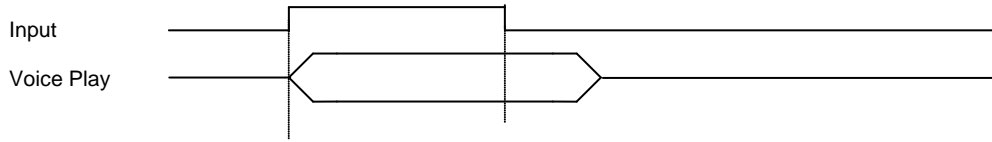For example, if Step_x S.R. = 8kHz, Long debounce = 20ms*(6k/8k) = 15ms, Short debounce = 50us*(6k/8k) = 37.5us

(2) Output Signal (OKY is set as output)

LED dynamic 1/2: When the voice amplitude is higher than 1/2 level, LED will be ON, i.e. output signal is low.

(1) Basic Operation

(a). Edge mode, Edge trigger

Input

Voice Play

(b). Edge mode, Level trigger

Input

Voice Play
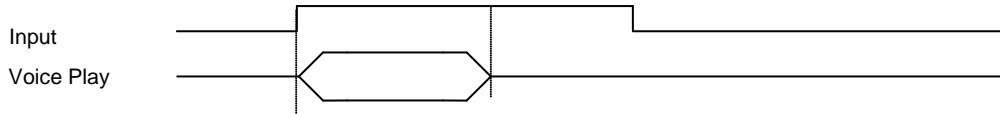
(c). Level mode, Edge trigger

Input

Voice Play
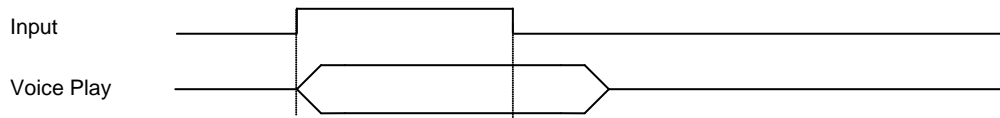
(d). Level mode, Level trigger

Input

Voice Play

(e). Retrigger mode
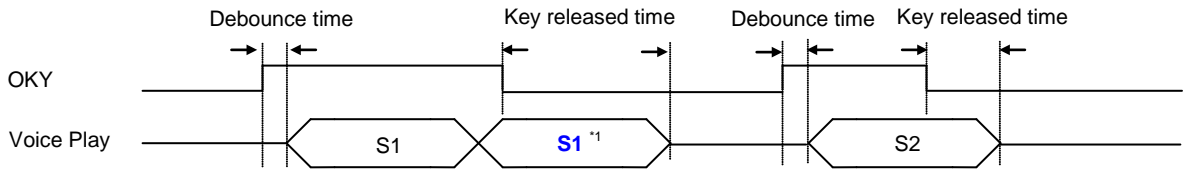
Input

Voice Play
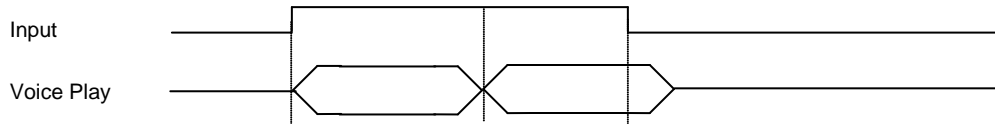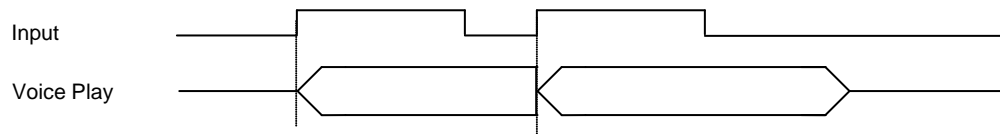
(f). Irretrigger mode

Input

Voice Play
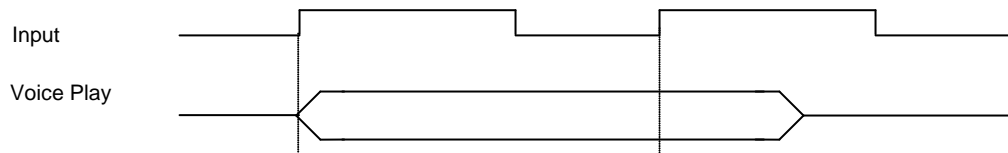
(3) Advanced Operation

(a). Sequential Function

OKY (L/U/I) =S1 S2 S3 S4

Sequential (or Random) number is counted during "debounce time" or "key released time". But the first-time trigger only relies on "debounce time" due to no "key release time".

*1: In OKY mode, Sequential number is counted only if there is debounce happened.

(b). Random Function

OKY (L/U/I) =S1 S2 S3 S4

x=1, 2, 3 or 4; y=1, 2, 3 or 4 (x and y are random number)
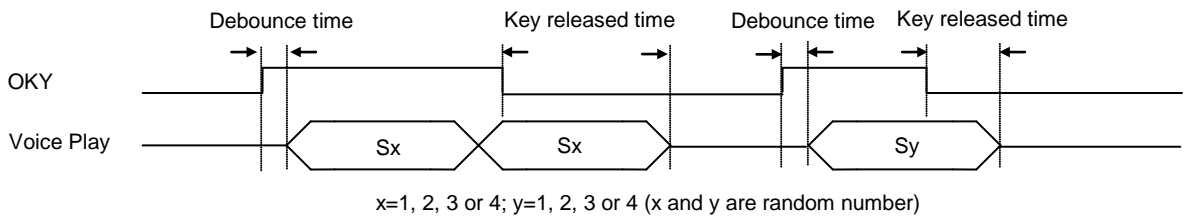
(c). Power-On-Play (POP) Function

(c-1) POP (E/U/I) = S1, OKY = 3Hz Sink

When OKY is set as output and the trigger mode of Power-On-Play is set as Edge mode, play voice one time.
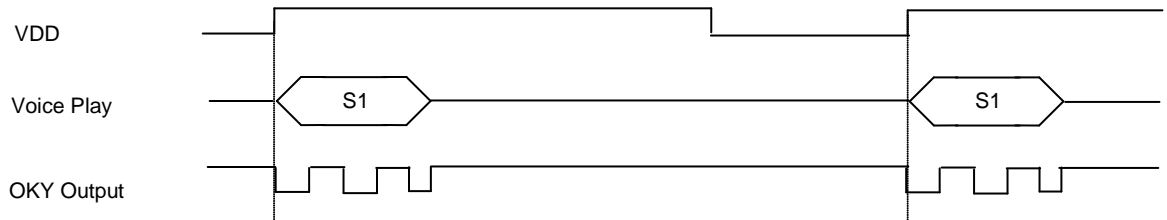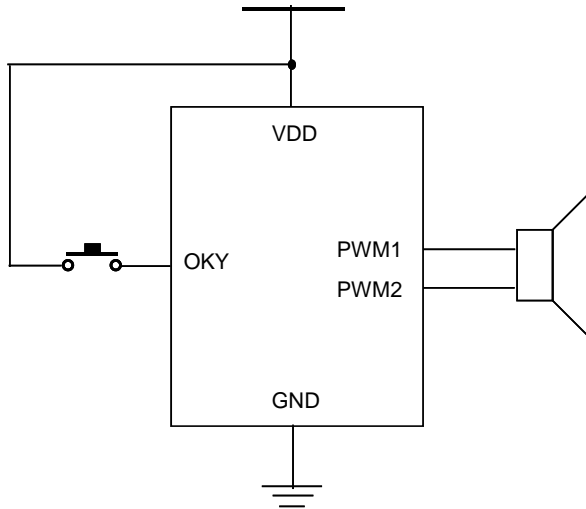

(c-2) POP (L/U/I) = S1, OKY = 3Hz Sink

When OKY is set as output and the trigger mode of Power-On-Play is set as Level mode, cooperating with Power-On-Loop (POL) function, play voice in loop.
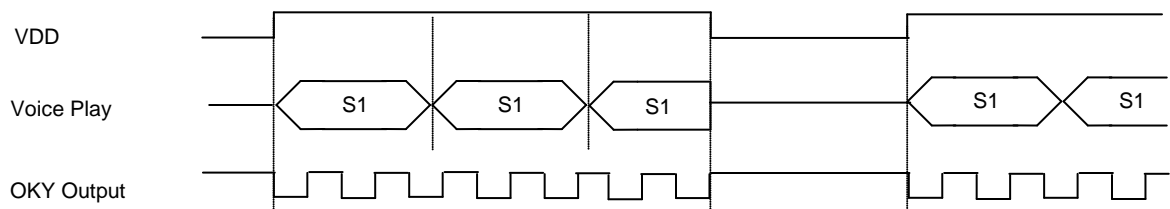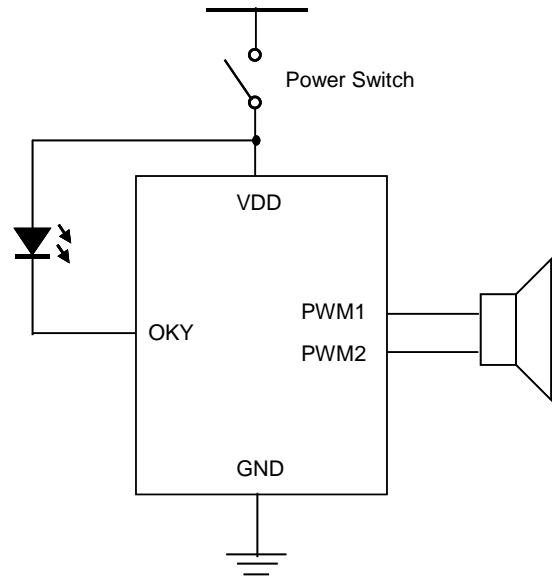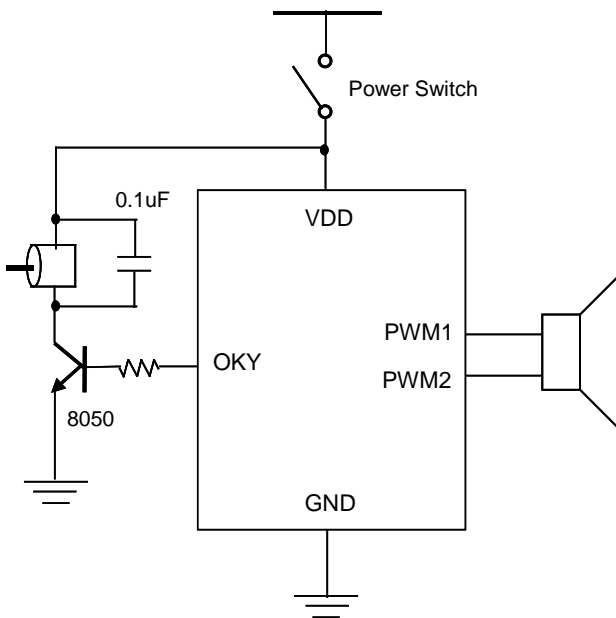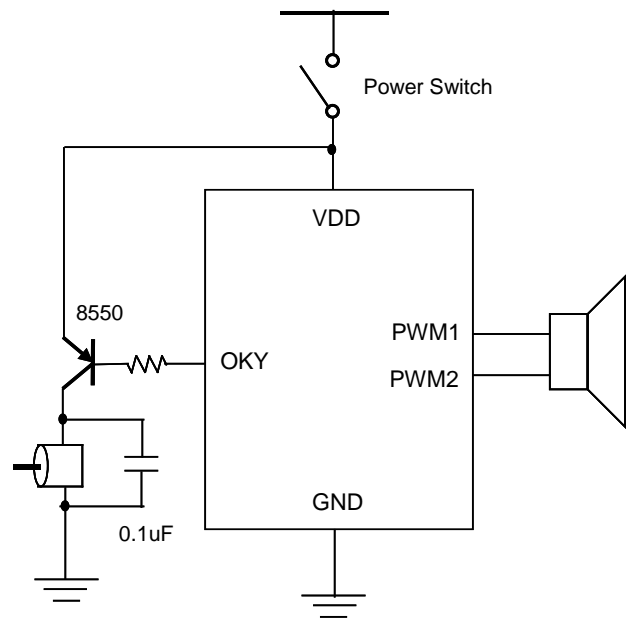
9. APPLICATION

(1) 1 trigger

(2) POP trigger with 1 LED (Sink)

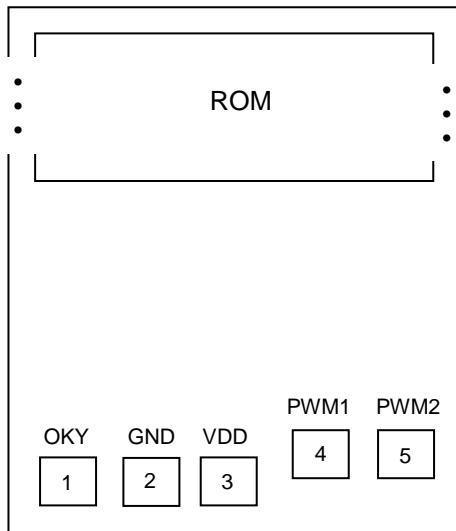**(3) POP trigger with 1 Motor (Drive)**

(4) POP trigger with 1 Motor (Sink)

* Please contact Nyquest or her agents if users want to add any power capacitor between VDD and GND.

10. DIE PAD DIAGRAM

* The IC substrate must be connected to GND or Floating.