



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

DATA SHEET

NY2D Series

1 I/O Single/Dual-Tone Synthesizer

Version 1.1

Jan. 4, 2017

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Revision History

<i>Version</i>	<i>Date</i>	<i>Description</i>	<i>Modified Page</i>
1.0	2016/11/18	Formally release.	-
1.1	2017/01/04	1. Modify voltage range to 1.3V~5.5V. 2. Modify LVR voltage to 1.2V. 3. Modify "Voltage vs Freq. Deviation" figure.	3, 5, 8 4, 6 8

1. 概述

NY2D系列產品為單晶片CMOS音樂合成 IC，只有1個母體 NY2D001A。具有1個I/O腳，利用精準的內阻震盪故不需外加震盪電阻，內建一組PWM輸出，故無須再外加任何零件。音樂合成方式為可程式的方波和包絡線，藉由製造過程中更換Code光罩，可將不同的音樂資料寫入ROM中。用戶可使用簡便的 *Q-Tone* 和 *Q-Melody* 工具軟體來快速地進行開發。

2. 功能

(1). 寬廣的工作電壓：1.3V ~ 5.5V。

(2). 只有1個母體，可支援的最大音樂音符如下：

P/N	NY2D001A
Note	Max. 256

(3). 只有1個I/O腳: IO1可選擇作輸入腳或是輸出腳。(光罩選擇)

(4). 音樂最多可被分割成最多8個音樂段(Melody Section)，每段長度可不同，每一音樂段中的音樂+靜音長度必須為 10H (Hex) 的整數倍。

(5). 最多有 16 個音樂格(Melody Step)，可規劃成 1 個音樂組(Melody Sentence)，IO1能指定 1 個音樂組(Sentence)。每一音樂格(Step)可指定任一個音樂段(Section)和 IO1 的輸出搭配(當IO1設為輸出時)。

(6). 音樂輸出通道能選擇固定為一通道(Tone-1) 或 兩通道(Tone-1 & Tone-2) 的音樂。(光罩選擇)

(7). 音樂最多為兩通道(Tone-1 & Tone-2)，每個通道可分別自訂一組包絡線(Envelope)。每個包絡線(Envelope)有128階變化，不同的包絡線畫法也會讓音色產生不同的變化。

(8). 音域範圍能選擇從第2個八度到第7個八度的音域(Octave 2~7)，或是從第3個八度到第8個八度的音域(Octave 3~8)。(光罩選擇)

(9). 可支援音樂的拍子(Tempo)為25種：234, 208, 188, 170, 156, 144, 134, 125, 117, 110, 104, 99, 94, 89, 85, 82, 78, 75, 72, 69, 67, 65, 63, 60, 59；可支援音樂的拍長(Beat)為7種: 4, 2, 1, 1/2, 1/4, 1/8, 1/16。另外提供拍長合成功能，可以用7種固定拍長來組合出任意長度的拍長，例如: $1 + 2 = 3$, $1/2 + 1/4 = 3/4$, $1/4 + 1/8 + 1/16 = 7/16$, ...。合成後的拍長套用一個包絡線，且合成內的拍長可以指定相同或不同的音高和輸出。

(10). 只有內建一組準確的頻率振盪器(+/- 1.5% 誤差)，並無提供外部震盪電阻選項。

(11). IO1當輸入腳的輸入選項：(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 1.5MΩ 的下拉電阻；而當按鍵放開時，IC內部為 300KΩ+1.5MΩ 並聯 的下拉電阻 約250KΩ。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 300KΩ 的下拉電阻。)

(c). 可選擇Debounce時間：Long - 提供一般按鍵使用；Short - 提供彈跳開關使用。

(12). IO1當輸出腳時可提供大電流來直推高亮度LED ($I_{ol}=20mA$ @VDD=3V)，或是設定為“定電流輸出”(Constant Sink Current, CSC)，以便在4.5V時限制電流輸出。

- (13). 所有的輸出腳都有以下 10 種輸出選項：(光罩選擇)
- (a). Stop_Low pulse：停止播放時送出低位準脈衝。
 - (b). Stop_High pulse：停止播放時送出高位準脈衝。
 - (c). Busy_High active：播放時送出高位準訊號。(Drive輸出)
 - (d). Busy_Low active：播放時送出低位準訊號。(Sink輸出)
 - (e). LED 2Hz flash：播放時 LED 2Hz Drive或Sink輸出閃爍。
 - (f). LED 4Hz flash：播放時 LED 4Hz Drive或Sink輸出閃爍。
 - (g). LED 8Hz flash：播放時 LED 8Hz Drive或Sink輸出閃爍。
 - (h). LED dynamic 1/2：播放時 LED根據1/2聲音位準做Drive或Sink輸出動態閃爍。
 - (i). LED dynamic 3/4：播放時 LED根據3/4聲音位準做Drive或Sink輸出動態閃爍。
 - (j). QLED訊號：可隨音樂作輸出的變化，每一個音符都可選擇一種QLED訊號，用戶使用此功能需先開啟 **Q-Melody** 來做QLED訊號編輯。QLED訊號有8種狀態可供選擇：根據包絡線時間長度來漸明、根據包絡線時間長度來漸暗、根據包絡線閃一下、根據音符閃一下、亮度為0%(全暗)、亮度為33%(1/3亮度)、亮度為66%(2/3亮度)、亮度為100%(全亮)。(IO1隨Tone-1音符音符做變化)
- ※ 注意: LED 2Hz / 4Hz / 8Hz / 16Hz flash 是指以 **TEMPO 117** 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。*
- (14). 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"上電播放音樂組"(POP Sentence)，觸發模式固定為 Edge / Unhold / Retrigger。如果結合Power-On-Loop功能，則該音樂組會一直循環播放，直到其他按鍵被觸發才會停止，並立即播放觸發按鍵所指定的音樂組。
- (15). 特殊功能選項 "內部觸發" (Internal-Feedback)：當IO1的聲音停止播放或播放結束時，利用內部的 Stop_High-Pulse信號來自動觸發IO1所指定的音樂組(Internal-Feedback Path)，循環播放該音樂組。
- ※ 注意: 當啟動此功能時，IO1只能當做輸入腳。*
- (16). 一組 8-bit PWM 輸出，可直接驅動8Ω、16Ω、32Ω、64Ω的喇叭或蜂鳴片。
- (17). 低壓復位(LVR)，當電壓瞬間低於 1.2V 時，IC 會自動復位。(光罩選擇)

(要進一步了解上述功能，請參考Q-Tone的使用手冊，或聯繫九齊科技或九齊代理商。)

1. GENERAL DESCRIPTION

The NY2D series are single-chip melody synthesizing CMOS IC. There only is one body: NY2D001A. It has one I/O pin. Through the accurate internal oscillation of built-in Rosc and one built-in PWM output, thus any external component is not required. Using programmable envelop of melody, customer's melody data can be programmed into ROM by changing one code mask during fabrication. Besides, the interactive software developing tools of "Q-Tone" and "Q-Melody" are user-friendly and quick for programming.

2. FEATURES

- (1). Wide operating voltage: 1.3V ~ 5.5V.
- (2). There is one body. The maximum number of notes is as following.

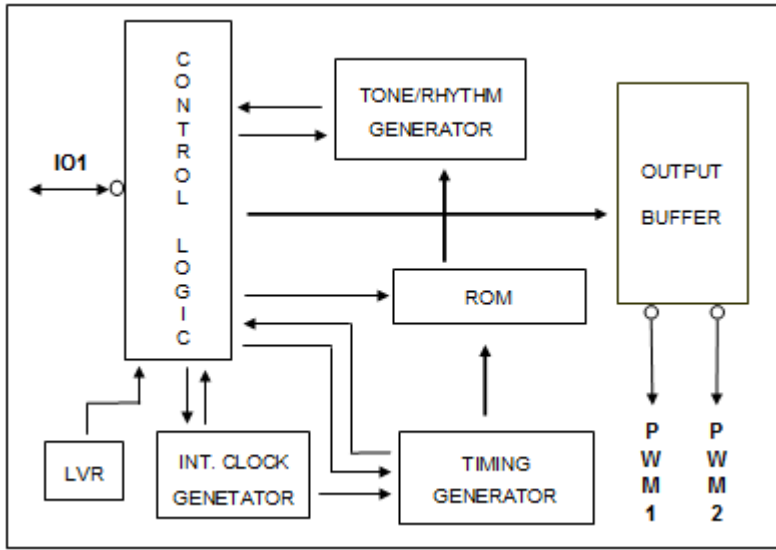
P/N	NY2D001A
Note	Max. 256

- (3). One I/O pin: IO1 can be either input or output pin (Mask option).
- (4). The total melody duration can be partitioned up to maximum 8 *Melody Sections*. Each *Melody Section* length is flexible. The *Melody Section* length of "Melody length + mute length" must be the multiple of 10H (Hex).
- (5). Total maximum 16 *Melody Steps* are available for one *Melody Sentence*. IO1 input can assign one *Sentences* only. Each *Step* can specify one *Melody Section* and enable/disable IO1 output option if IO1 is set as output.
- (6). Melody output channel can be either 1-ch (Tone-1) or 2-ch (Tone-1 & Tone-2) output. (Mask option)
- (7). The range of pitch can be either from the 2nd octave to the 7th octave (Octave 2~7) or from the 3rd octave to the 8th octave (Octave 3~8). (Mask option)
- (8). There are maximum two channels of Tone-1 and Tone-2 for melody. Each channel can assign one set of programmable envelope. There are 4-level altitudes of 0%, 25%, 50% and 100% for each square step. Through level change of different altitude, the timbre will be much of variety. In addition, there are 128-level altitudes for each envelope, and it can make timbre more various.
- (9). There are 25 kinds of tempo: 234, 208, 188, 170, 156, 144, 134, 125, 117, 110, 104, 99, 94, 89, 85, 82, 78, 75, 72, 69, 67, 65, 63, 60, 59. And there are 7 kinds of beat: 4, 2, 1, 1/2, 1/4, 1/8, 1/16. Besides, a beat synthesizing function is provided to synthesize arbitrary beat. For examples, 1 + 2 = 3, 1/2 + 1/4 = 3/4, 1/4 + 1/8 + 1/16 = 7/16, The synthesized beat imitates the original envelope, and the synthesizing beats can assign the same or different pitch and output option.
- (10). Only build in an accurate internal oscillator of +/- 1.5% tolerance, no external R oscillator.
- (11). Input option for input pin. (Mask option)
 - (a). Each input can select Edge/Level, Hold/Unhold and Retrigger/Irretrigger trigger modes.
 - (b). Each input can select CDS+1.5M, CDS, 1.5M pull-low resistor or Floating type.

- (CDS+1.5M option: Only 1.5M Ω pull-low resistance at key-pressed, and 300K Ω +1.5M Ω in parallel pull-low resistance around 250K Ω at key-released. CDS option: Floating at key-pressed, and 300K Ω pull-low resistance at key-released.)
- (c). Each input can select Debounce time: Long debounce for push-button. Short debounce for fast switch.
- (12). IO1 supports large-current output and can directly drive high brightness LED ($I_{ol}=20mA@V_{DD}=3V$). or it can be set as Constant Sink Current (CSC) output individually for current limit at 4.5V.
- (13). There are 10 kinds of output option for all output pins. (Mask option)
- (a). Stop_Low pulse: Low active stop-pulse output whenever device stop playing.
 - (b). Stop_High pulse: high active stop-pulse output whenever device stop playing.
 - (c). Busy_High active: high active signal output during playing. (Drive output)
 - (d). Busy_Low active: low active signal output during playing. (Sink output)
 - (e). LED 2Hz flash: 2Hz Sink or Drive signal output to drive LED during playing.
 - (f). LED 4Hz flash: 4Hz Sink or Drive signal output to drive LED during playing.
 - (g). LED 8Hz flash: 8Hz Sink or Drive signal output to drive LED during playing.
 - (h). LED dynamic 1/2: according to 1/2 sound level, dynamic Sink or Drive signal output to drive LED.
 - (i). LED dynamic 3/4: according to 3/4 sound level, dynamic Sink or Drive signal output to drive LED.
 - (j). QLED signal: output with melody. Each note can select one kind of QLED signal and user can edit the QLED signal by “Q-Melody”. There are 8 kinds of QLED signal: Ascend by envelope length, Descend by envelope length, Flash once by envelope, Flash once by note, 0% brightness (Off), 33% brightness (1/3), 66% brightness (2/3), 100% brightness (On). (*IO1 vary with Tone-1 note.*)
- ※ Note: While playing melody at TEMPO 117, the LED flash rate is fixed as 2Hz, 4Hz, 8Hz or 16Hz up to the output option. For different tempo, the LED flash rate is also different.*
- (14). “Power-On-Play” special function (POP): When power is on, play the POP Sentence one time. The trigger mode is fixed as Edge / Unhold / Retrigger. To cooperate with Power-On-Loop function, the POP Sentence will be played in loop until other key-trigger happened. When other key is triggered, it stops playing the POP Sentence and immediately plays the assigned sentence of triggered key.
- (15). “Internal-Feedback” special function: When the playing sentence of IO1 is stopped or over, continue to play the assigned sentence of IO1 in loop through internal Stop_High-Pulse signal (Internal-Feedback Path).
- ※ Note: When enable this function, IO1 is fixed as input pin.*
- (16). One 8-bit PWM output can directly drive 8, 16, 32, 64 Ω speaker or piezo-buzzer.
- (17). Low-Voltage-Reset (LVR). When voltage is lower than 1.2V, IC will reset by itself. (Mask Option)

(For details of the above functions, please refer to Q-Tone user manual, or contact Nyquest or her agents.)

3. BLOCK DIAGRAM



4. PAD DESCRIPTION

Pad Name	Pad No.	ATTR.	Description
IO1	1	I/O	Input or 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-Tone” & “Quick-IO” software tools 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 NY2_FDB flash demo board to demonstrate the NY2D function. Once the function has been approved, user only needs to send the “.bin” file to Nyquest for code release. For more details, please refer to “Q-Tone” & “Quick-IO” user manual.

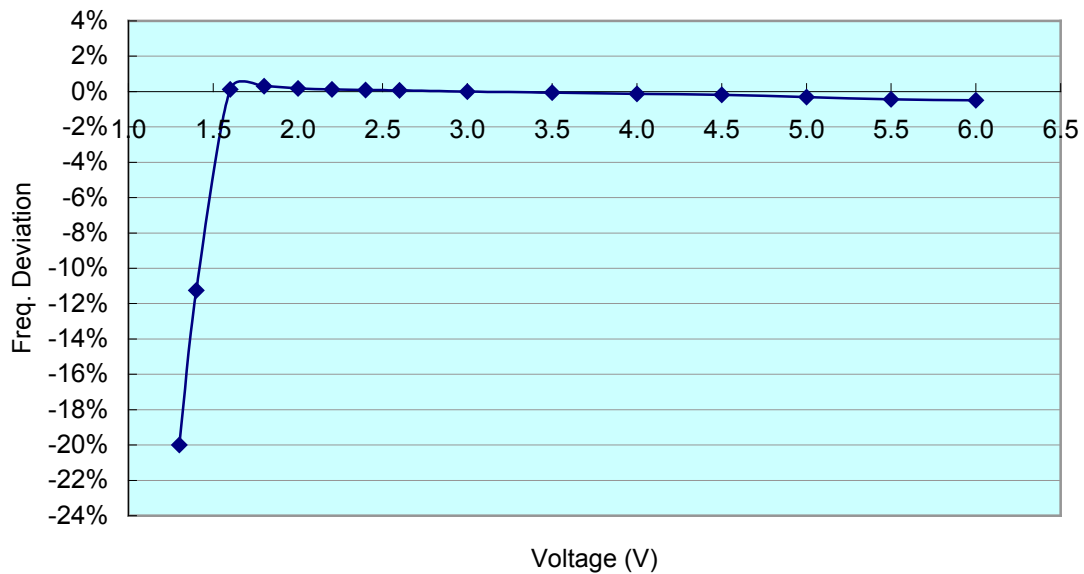
2Mb Flash Demo board	NY2_FDB-02
Max. demo body	NY2D001A

6. ABSOLUTE MAXIMUM RATING

Symbol	Rating	Unit
VDD~GND	-0.5 ~ +7.0	V
V _{in}	GND-0.3 < V _{in} < VDD+0.3	V
V _{out}	GND < V _{out} < VDD	V
T _{op} (operating)	-0 ~ +70	°C
T _{st} (storage)	-55 ~ +150	°C

7. DC CHARACTERISTICS

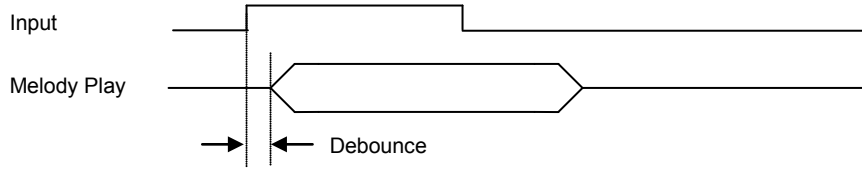
Symbol	Parameter	Min.	Typ.	Max.	Unit	Condition
VDD	Operating voltage	1.3	3.0	5.5	V	
I _{sb}	Standby current, VDD=3V/4.5V		0.05	0.1	uA	No loading
I _{op}	Operating current	VDD=3V	500			
		VDD=4.5V	1500			
I _{ih}	Input current (1.5M ohms pull-low)		2		uA	VDD=3V
			5			VDD=4.5V
I _{oh}	Output drive current		-7		mA	VDD=3V, V _{oh} =2.0V
			-11			VDD=4.5V, V _{oh} =3.5V
I _{ol}	Output sink current (LCO)		20		mA	VDD=3V, V _{ol} =1.0V
			30			VDD=4.5V, V _{ol} =1.0V
	Output constant sink current (CSC)		20		mA	VDD=3V, V _{ol} =1.0V
			21			VDD=4.5V, V _{ol} =1.0V
I _{oh}	PWM1, PWM2 output current (Normal)		-65		mA	VDD=3V, V _{oh} =1.5V
I _{ol}			65			VDD=3V, V _{ol} =1.5V
ΔF/F	Frequency deviation by voltage drop	VDD=3V	0.5		%	$\frac{F_{osc}(3.0v)-F_{osc}(2.4v)}{F_{osc}(3v)}$
		VDD=4.5V	-0.5			$\frac{F_{osc}(4.5v)-F_{osc}(3.0v)}{F_{osc}(4.5v)}$
ΔF/F	Frequency lot deviation, (VDD=3V)	-1.5		1.5	%	$\frac{F_{max}(3.0v)-F_{min}(3.0v)}{F_{max}(3.0v)}$
F _{osc}	Oscillation Frequency	1.20	1.54	1.60	MHz	VDD=1.3~5.5V

Voltage vs Freq. Deviation (Tempo=117 @3V)


8. TIMING DIAGRAM

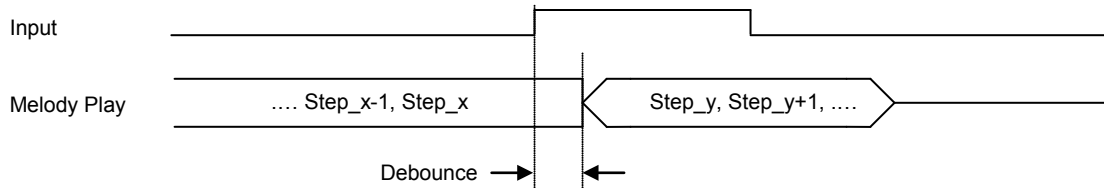
(1) Debounce Time

(a). Trigger while no playing melody



※ Debounce time is configured by tempo=117 and the value is fixed. That is, Long debounce = 24ms, Short debounce = 32us

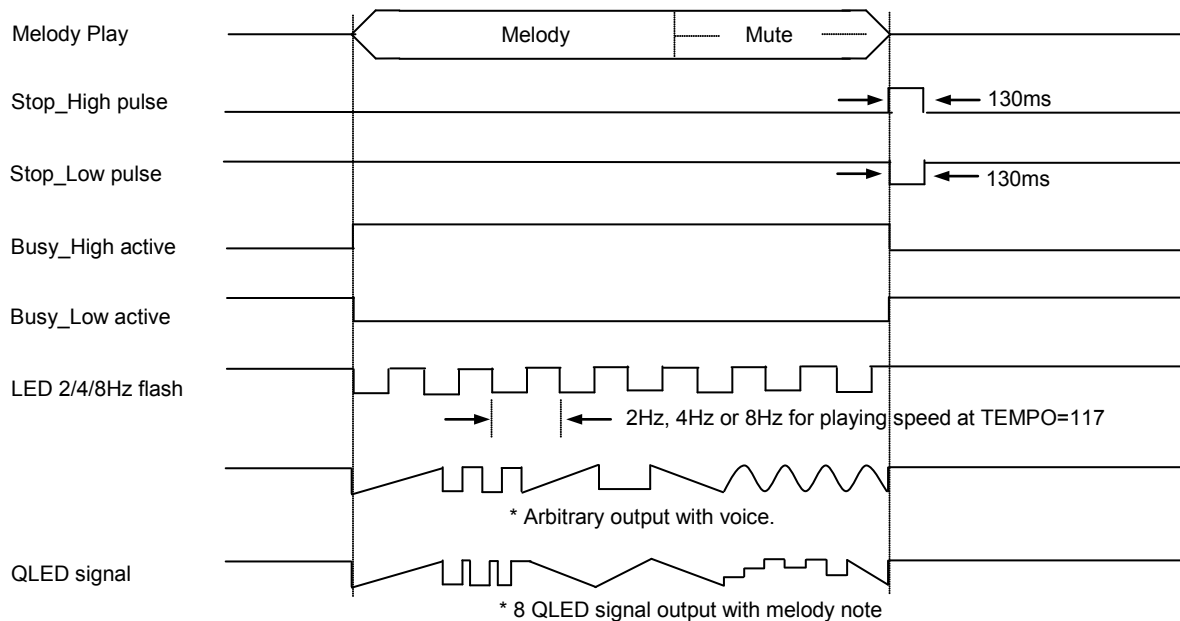
(b). Trigger While playing Melody



※ Debounce Time is configured by the tempo of Step_x. At tempo = 117, Long debounce = 24ms, Short debounce = 32us

For example, if Step_x tempo = 78, Long debounce = $24ms * (117/78) = 36ms$, Short debounce = $32us * (117/78) = 48us$

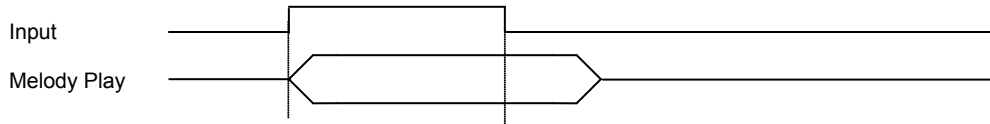
(2) Output Signal (IO1)



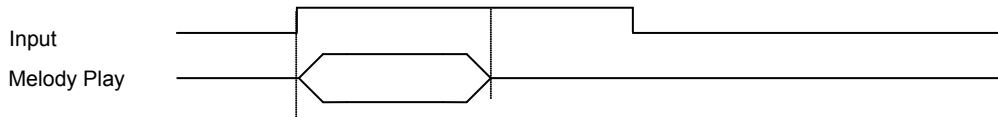
LED dynamic 1/2 or 3/4: When the voice amplitude is higher than 1/2 or 3/4 level, LED will be ON, e.g. output signal is low at sink mode.

(4) Basic Operation

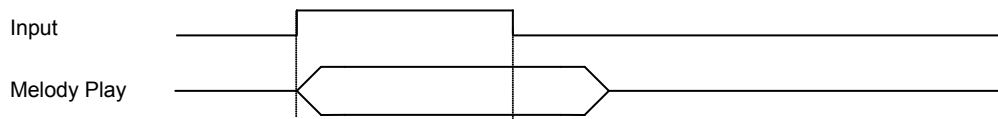
(a). Edge mode, Edge trigger



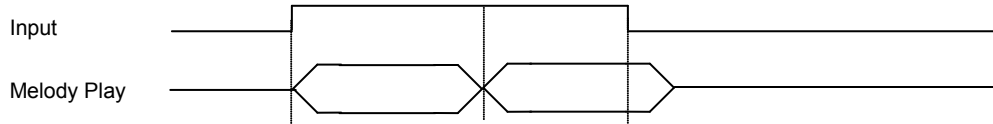
(b). Edge mode, Level trigger



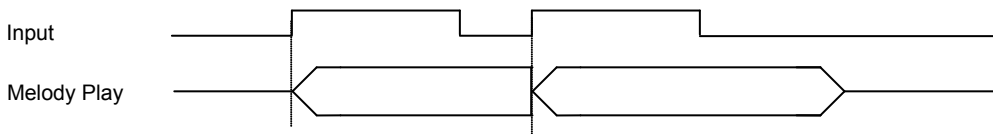
(c). Level mode, Edge trigger



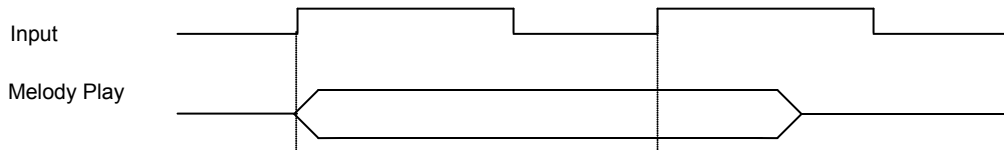
(d). Level mode, Level trigger



(e). Retrigger mode



(f). Irretrigger mode



(5) Input Priority



※ Priority: IO1 > POP (Power-On-Play)

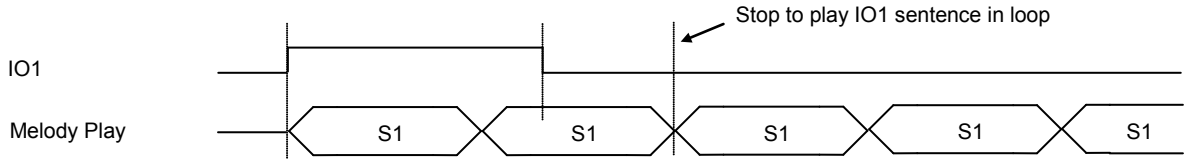
(6) Advanced Operation

(a). Internal-Feedback Function (IO1 is fixed as input)

IO1 sentence can assign an Internal-Feedback Path to play a fixed sentence after IO1's sentence stop.

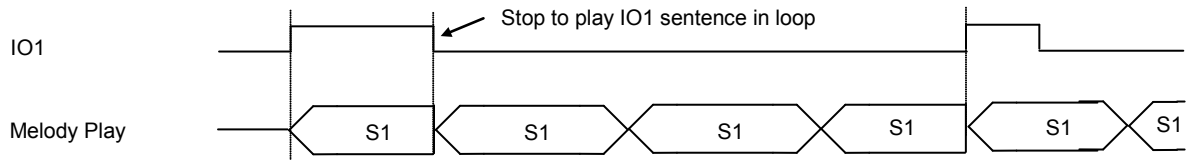
(a-1) IO1 (L/U/I) = S1, Internal-Feedback Path = IO1

If S1 is optioned with Internal-Feedback Path,



(a-2) IO1 (E/H/R) = S1, Internal-Feedback Path = IO1

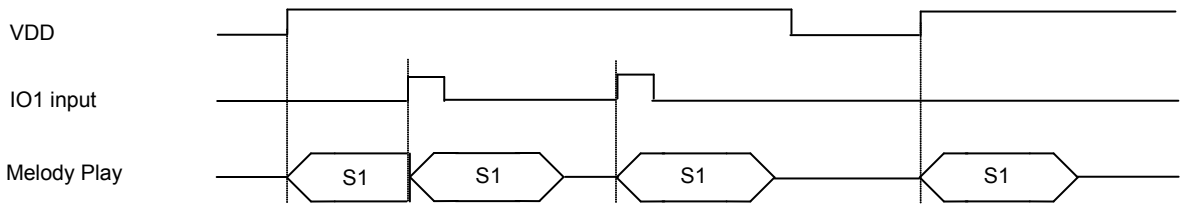
If S1 is optioned with Internal-Feedback Path,



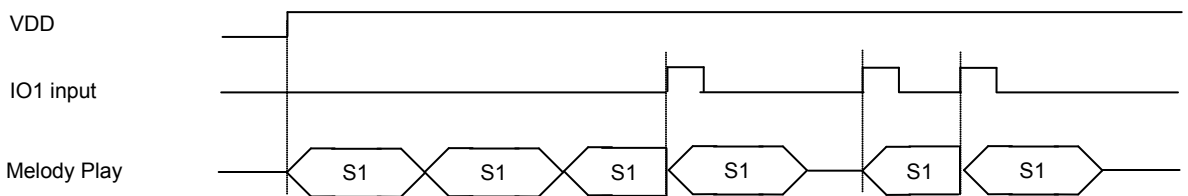
(b). Power-On-Play (POP) Function

The trigger mode of Power-On-Play is fixed as E/U/R, other trigger signal will stop POP's Melody immediately and play the interrupted trigger's Melody. POP can cooperate with Power-On-Loop function to play POP Sentence in loop.

(b-1) IO1 (E/U/I) = S1, POP (E/U/R) =S1, Power-On-Loop is disabled.

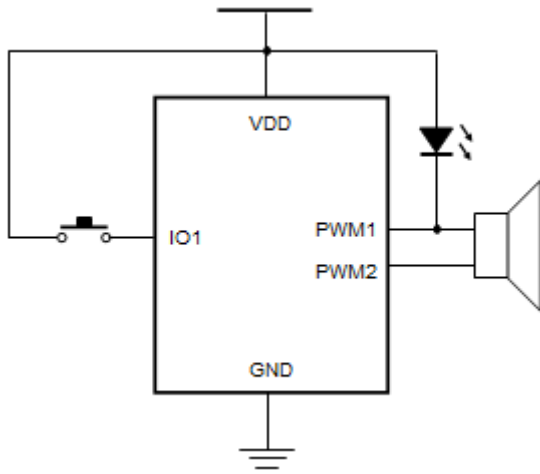


(b-2) IO1 (E/U/R) = S1, POP (E/U/R) =S1, Power-On-Loop is enabled.

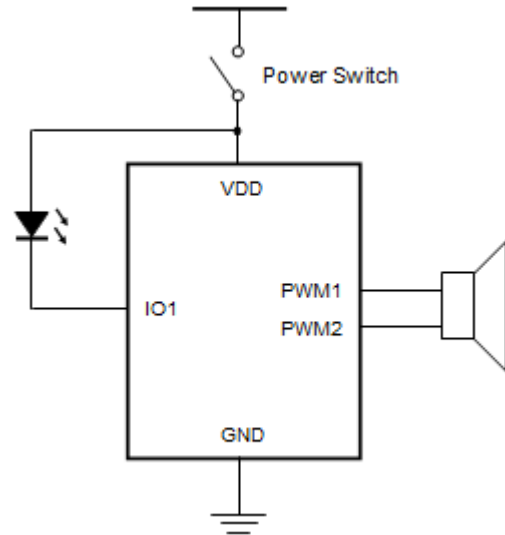


9. APPLICATION

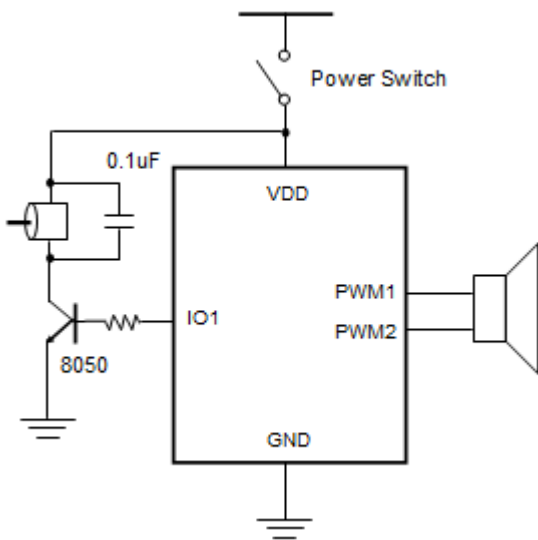
(1) 1 trigger with 1 LED (Sink)



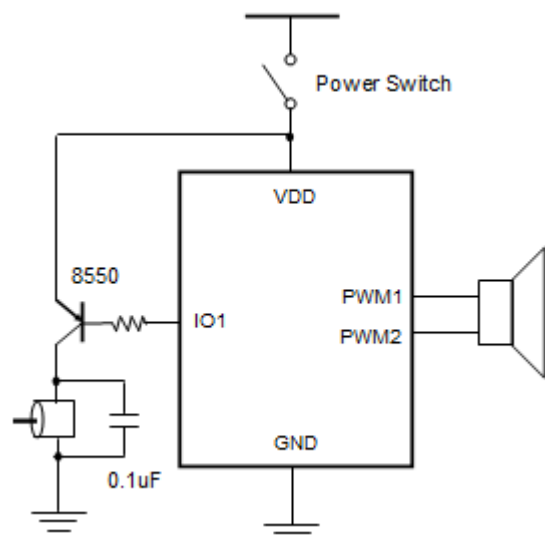
(2) POP trigger with 1 LED (Sink)



(3) POP trigger with 1 motor (Drive)

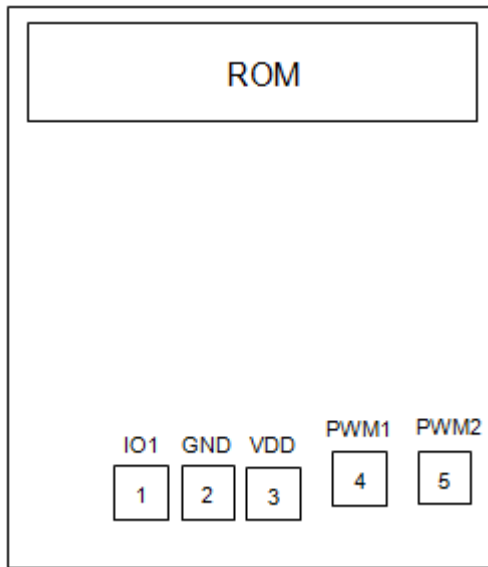


(4) POP trigger with 1 motor (Sink)



*** 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.