NIPPON PRECISION CIRCUITS INC.

SM1155 series
Melody LSIs

OVERVIEW

The SM1155 series are CMOS melody LSIs that, together with a battery and piezoelectric buzzer, operate in one of 3 melody modes determined by bonding options. They also feature an oscillator stop function in non-play mode and a variable pull-down resistance function that responds to input levels in order to reduce power consumption, reduce cost, and extend battery life, making them ideal in a wide range of applications including the hold sound for telephones and toys.

FEATURES

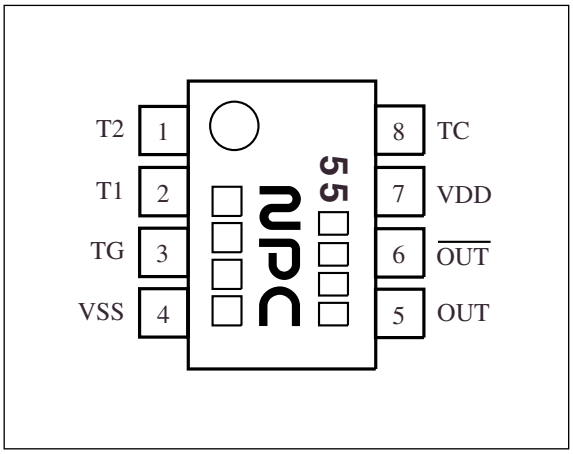
- Requires few external components
- 1.2 to 3.6V wide operating voltage range
- Low power consumption
- 3 melody modes (bonding option)
- Oscillator stop function in non-play mode
- Power saving pull-down resistor built-in
- RC oscillator circuit
- Power-ON initialization function
- Wide pitch dynamic range (G_3 to D_7)
- 8-pin SOP package

ORDERING INFORMATION

Device	Package
SM1155×××1S	8-pin SOP
SM1155×××2S	
SM1155×××3S	

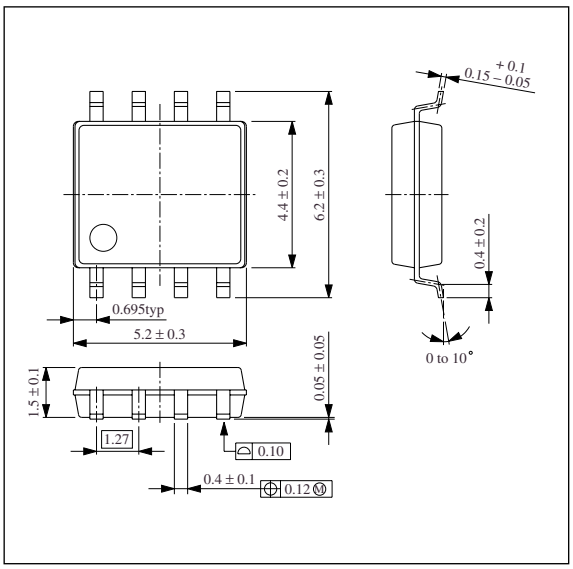
PINOUT

(Top view)



PACKAGE DIMENSIONS

(Unit: mm)



PAD DESCRIPTION

Number	Name	i/o	Function
1	T2	–	Test pins (must be open)
2	T1		
3	TG	ip[1]	Melody mode control input H: SM1155×××1S – Level hold 1 H: SM1155×××2S – Level hold 2 H: SM1155×××3S – One-shot L/open: SM1155×××1S/ 2S/ 3S – Non-play
4	VSS	–	Ground
5	OUT	o	Piezoelectric speaker driver outputs. Both pins are LOW in non-play mode. OUT is LOW and $\overline{OUT}$ is HIGH during output for a musical rest note. Both pins are HIGH during the gap between musical notes.
6	$\overline{OUT}$		
7	VDD	–	Supply. The rear surface of the chip is V_{DD} level.
8	TC	–	Test pins (must be open)

1. Built-in pull-down resistor (the resistance of the pull-down resistor varies with the applied voltage, as described in the Electrical Characteristics).

SPECIFICATIONS

Absolute Maximum Ratings

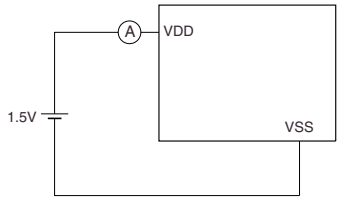
Parameter	Symbol	Condition	Rating	Unit
Supply voltage range	$V_{DD} - V_{SS}$		–0.3 to 5.0	V
Input voltage range	V_{IN}		$V_{SS} - 0.2$ to $V_{DD} + 0.2$	V
Operating temperature range	T_{opr}		–20 to 80	°C
Storage temperature range	T_{stg}		–55 to 125	°C

Electrical Characteristics

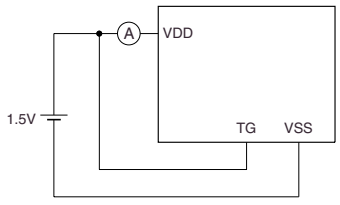
$T_a = 25°C$, $V_{SS} = 0V$, $V_{DD} = 1.5V$

Parameter	Symbol	Condition	Rating			Unit
			min	typ	max	
Operating voltage	V_{DD}		1.2	1.5	3.6	V
Current consumption[1]	I_{DD1}	Non-play mode	–	0.01	0.3	µA
Current consumption[2]	I_{DD2}	Melody modes: OUT, $\overline{OUT}$ open	–	25	50	µA
TG LOW-level input voltage	V_{IL}		–	–	$V_{SS} + 0.2$	V
TG HIGH-level input voltage	V_{IH}		$V_{DD} - 0.2$	–	–	V
TG LOW-level input current	I_{IL}	$V_{IL} = 0.4V$	1.4	3.0	6.0	µA
TG HIGH-level input current	I_{IH}	$V_{IH} = 1.5V$	1.4	3.0	6.0	µA
OUT, $\overline{OUT}$ LOW-level output current	I_{OL}	$V_{OL} = 0.75V$	2.0	–	–	mA
OUT, $\overline{OUT}$ HIGH-level output current	I_{OH}	$V_{OH} = 0.75V$	2.0	–	–	mA
Internal oscillator frequency	f_{OSC}	$f_0 = 50kHz$	–20	–	+20	%

1. Measurement circuit



2. Measurement circuit



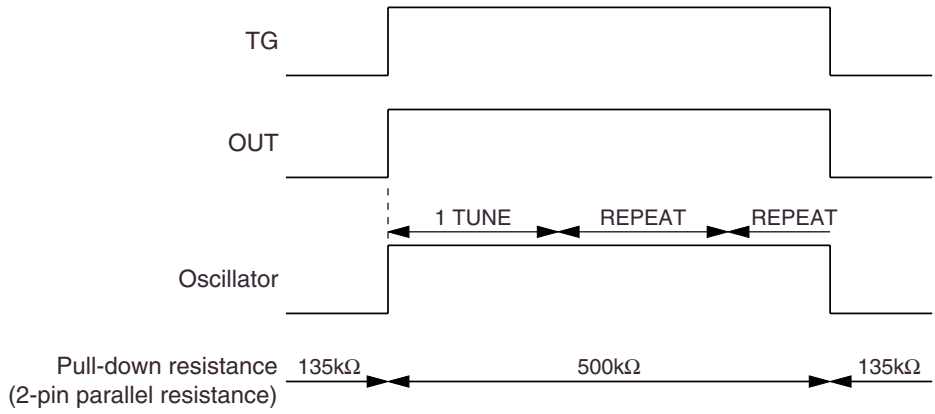
FUNCTIONAL DESCRIPTION

Melody Modes

When TG goes HIGH (V_{DD}), melody play starts.

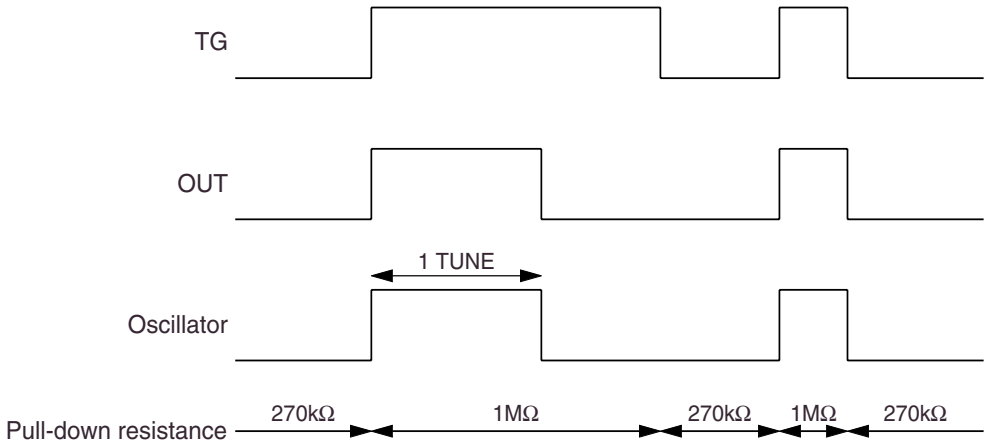
Level hold 1 (SM1155×××1S)

When TG goes HIGH, melody play starts and continues while TG is held HIGH. When TG goes open circuit or LOW, melody play stops, even if during mid melody.



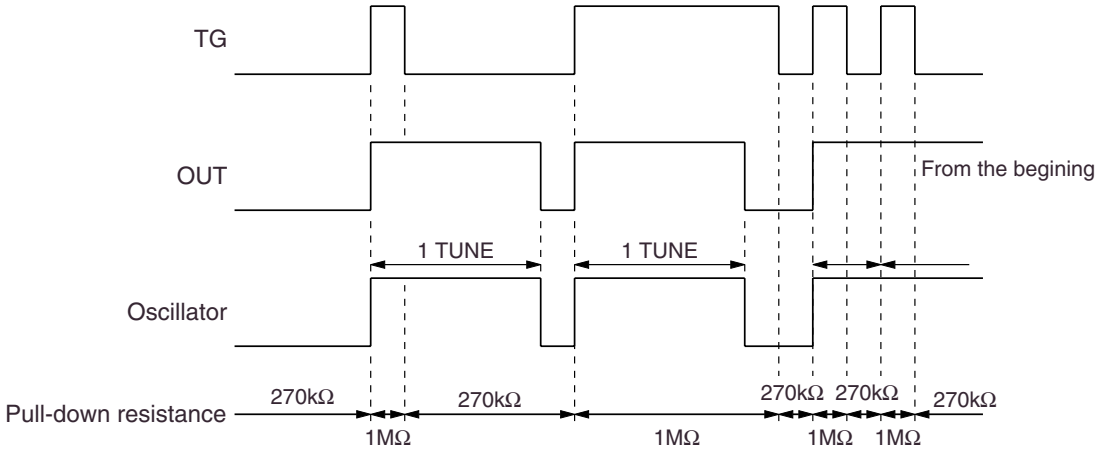
Level hold 2 (SM1155×××2S)

When TG goes HIGH, a single melody play starts. Melody play continues until the single melody ends or TG goes open circuit or LOW, whichever occurs first.



One-shot (SM1155×××3S)

When TG goes HIGH, a single melody play starts. Melody play continues until the melody ends, even if TG goes open circuit or LOW mid melody. However, if the TG input goes HIGH again during melody play, the melody play restarts from the beginning.



Power-save Function

As shown in the preceding timing diagrams, the oscillator stops during non-play mode and the pull-down resistance value changes in response to both HIGH-level and LOW-level inputs (power-save pull-down resistor) to reduce power consumption and extend battery life.

Non-play oscillator stop function

When melody play ends, regardless of the state of TG, the internal oscillator stops and is placed in a standby state. In this state, the current consumption, including input pin pull-down resistor current (I_{IH} max), does not exceed 3.3μA.

Power-save pull-down resistor

The resistance of the TG input pull-down resistor changes in response to the input voltage. The pull-down resistance is 500kΩ when the input is HIGH, and the pull-down resistance is 135kΩ when the input is LOW.

Furthermore, if a light-dependent resistor (CdS) cell is employed as a switch (the pull-down resistance is maximum when the CdS resistance is minimum (light) and the pull-down resistance is minimum when the CdS resistance is maximum (dark)), the combined resistance can be increased, decreasing current consumption.

Musical Specifications

Maximum program steps

A maximum of 64 steps can be programmed into internal mask-programmable ROM. Each step represents either a note (sound pitch and length), a rest note, or a jump. The maximum number of jumps is 7.

Note length (including rests)

Eight rhythm values, from sixteenth note to half note, for notes and rests can be programmed, as shown in the following table.

Type	Code							
	0	1	2	3	4	5	6	7
Note	𝅘𝅥𝅯	𝅘𝅥𝅮	𝅘𝅥𝅮.	𝅘𝅥	𝅘𝅥+𝅘𝅥𝅯	𝅘𝅥.	𝅘𝅥..	𝅗𝅥
Rest	𝄿	𝄾	𝄾.	𝄽	𝄽+𝄿	𝄽.	𝄽..	𝄻

Also, notes and rests longer than half notes and rests can be created using a tie to connect the notes. This requires 2 program steps in ROM.

Tempo

The tempo for the standard quarter note can be selected from the following 16 options.

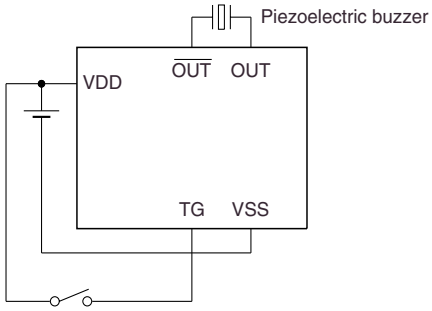
Code	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
♩=	697	348	232	174	139	116	99.4	87	77.3	69.6	63.3	58	53.5	49.7	46.4	43.5

Pitch and scale

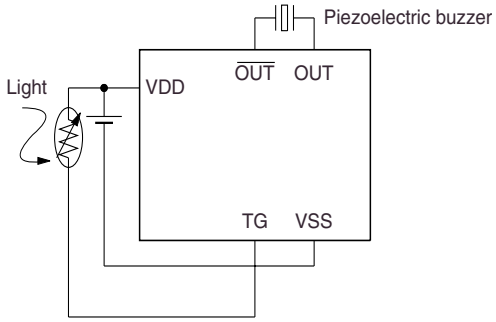
The SM1155 series devices support 3.5 octaves ranging from G_3 to D_7, from which 15 notes can be selected to form a scale.

TYPICAL APPLICATION

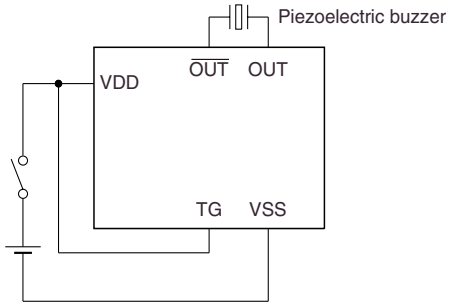
The circuits below represent the standard connections for SM1155 series devices.



Circuit 1



Circuit 3



Circuit 2

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