# SM1125ABV

Multimelody IC for Pagers

## OVERVIEW

The SM1125ABV is melody IC fabricated in NPC's Molybdenum-gate CMOS for use in mobile telecommunications equipment.

## FEATURES

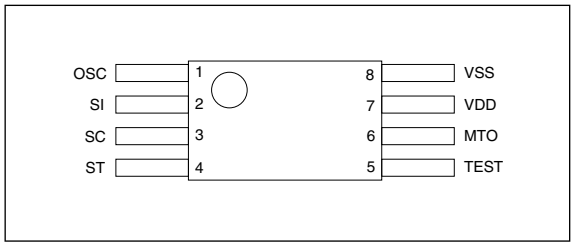
- 12 melodies selectable
- Level hold playback mode
- Built-in oscillator circuit
  - Oscillator frequency: 38.4kHz
- 2-pin serial data melody selection and 1-pin melody playback control
- Power save function
  - Oscillator stopped in no-play modes
- Molybdenum-gate CMOS process
- 8-pin plastic VSOP package

## ORDERING INFORMATION

| Device | Package |
|---|---|
| SM1125ABV | 8-pin VSOP |

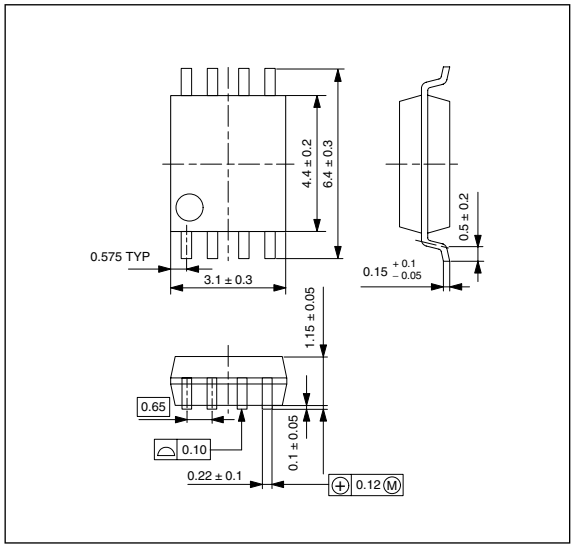
## PINOUT

(Top view)

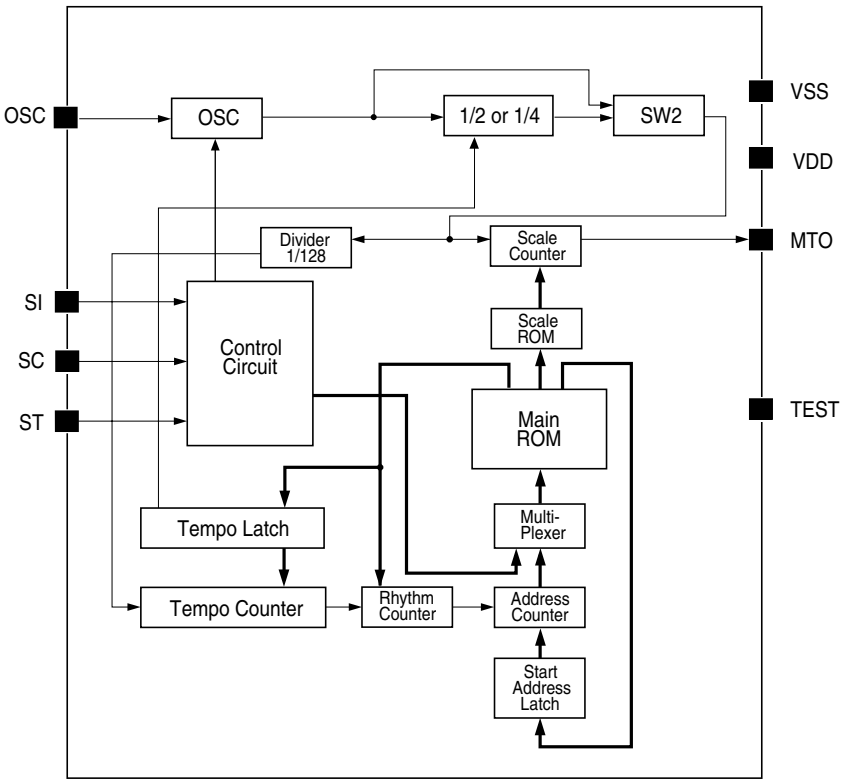



## PACKAGE DIMENSIONS

(Unit: mm)



## BLOCK DIAGRAM




## PIN DESCRIPTION

| Number | Name | I/O | Function |
|---|---|---|---|
| 1 | OSC | I | External resistor and capacitor connection pins |
| 2 | SI | I | Playback control serial interface data input |
| 3 | SC | I | Playback control serial interface clock input |
| 4 | ST | I | Playback start/stop control signal input |
| 5 | TEST | I | Test input pin. Leave open or tie to VSS. (pull-down resistance built-in) |
| 6 | MTO | O | Playback melody signal output |
| 7 | VDD | – | Supply pin (+) |
| 8 | VSS | – | Ground pin |

# 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 |
| Power dissipation | $P_D$ | | 100 | mW |
| Storage temperature range | $T_{stg}$ | | – 40 to 125 | °C |

## Recommended Operating Conditions

$V_{SS}$ = 0V

| Parameter | Symbol | Condition | Rating | Unit |
|---|---|---|---|---|
| Supply voltage | $V_{DD}$ | | 2.0 to 3.6 | V |
| Operating temperature | $T_{opr}$ | | –20 to 70 | °C |

## DC Characteristics

Unless otherwise noted Ta = –20 to 70°C, $V_{SS}$ = 0V, $V_{DD}$ = 2.0 to 3.6V

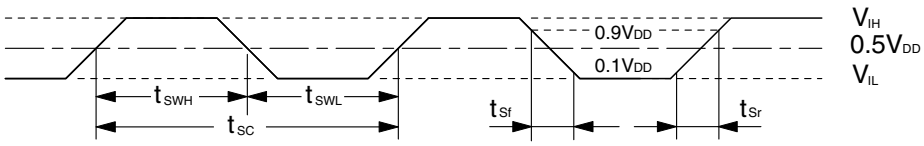
| Parameter | Symbol | Condition | Rating | | | Unit |
|---|---|---|---|---|---|---|
| | | | min | typ | max | |
| Supply voltage | $V_{DD}$ | | 2.0 | 3.0 | 3.6 | V |
| Current consumption (1) | $I_{DD1}$ | Non-playback mode, Ta = 25°C | – | – | 0.5 | µA |
| Current consumption (2) | $I_{DD2}$ | Playback mode, MTO pin open | – | 215 | 600 | µA |
| Input voltage | $V_{IH}$ | ST, SI, SC pins | $V_{DD}$ – 0.2 | – | $V_{DD}$ | V |
| | $V_{IL}$ | | $V_{SS}$ | – | $V_{SS}$ + 0.2 | V |
| Input current (1) | $I_{IH1}$ | ST, SI, SC pins, $V_{IH} = V_{DD}$, Ta = 25°C | – | – | 0.5 | µA |
| | $I_{IL1}$ | ST, SI, SC pins, $V_{IL}$ = 0 V, Ta = 25°C | – | – | 0.5 | µA |
| Input current (2) | $I_{IH2}$ | TEST pin, $V_{IH} = V_{DD}$ | – | – | 200 | µA |
| Open voltage | $V_{OPN}$ | TEST pin | – | – | 0.1 | V |
| Output voltage | $V_{OH}$ | MTO pin, $I_{OH}$ = 1mA | $V_{DD}$ – 0.4 | – | $V_{DD}$ | V |
| | $V_{OL}$ | MTO pin, $I_{OL}$ = 1mA | $V_{SS}$ | – | $V_{SS}$ + 0.4 | V |
| Oscillator frequency | $f_{OSC}$ | NPC test board measurement, $R_O$ = 91kΩ, $C_O$ = 200pF, $V_{DD}$ = 2.0 to 3.6V | 34.5 | 38.4 | 42.5 | kHz |
| Frequency stability | Δf/f | | – | 0.1 | – | %/0.1V |
| Oscillator start voltage | $V_{DOB}$ | | – | – | 1.6 | V |
| Oscillator stop voltage | $V_{DOS}$ | | – | – | 1.6 | V |

## AC Characteristics

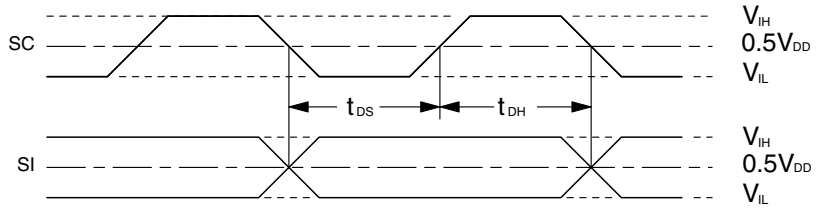
Unless otherwise noted Ta = –20 to 70°C, $V_{SS}$ = 0V, $V_{DD}$ = 2.0 to 3.6V

| Parameter | Symbol | Condition | Rating | | | Unit |
|---|---|---|---|---|---|---|
| | | | min | typ | max | |
| SC pulse cycle | $t_{SC}$ | "SC input pulse" timing | 5.0 | – | – | µs |
| SC HIGH-level pulsewidth | $t_{SWH}$ | | 2.0 | – | – | µs |
| SC LOW-level pulsewidth | $t_{SWL}$ | | 2.0 | – | – | µs |
| SC pulse rise time | $t_{Sr}$ | | – | – | 200 | ns |
| SC pulse fall time | $t_{Sf}$ | | – | – | 200 | ns |
| SI-SC setup time | $t_{DS}$ | "SC-SI serial input pulse" timing | 2.0 | – | – | µs |
| SI-SC hold time | $t_{DH}$ | | 2.0 | – | – | µs |

### SC input pulse




### SC-SI serial input pulse



# FUNCTIONAL DESCRIPTION

## Control Functions

### Reference clock

SM1125ABV has built-in RC oscillator circuit (oscillation frequency: 38.4kHz typ).

### Power-saving function

The built-in RC oscillator is stopped when not in playback mode (when ST is LOW), preventing unwanted current flow.

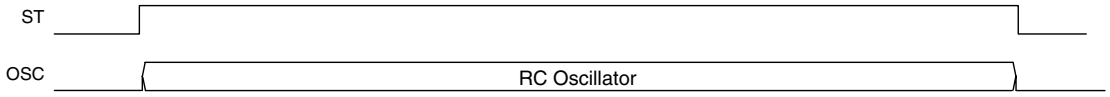
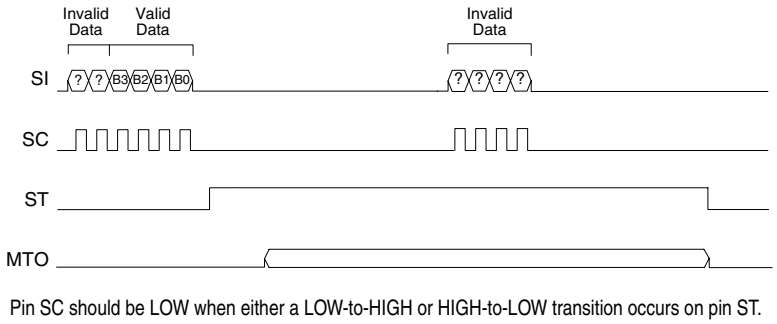



Figure 1. Oscillator circuit operation

### Playback control

The ST pin controls the start of playback. While ST is HIGH, the melody is played repeatedly, and when ST goes LOW, playback stops. Melodies are selected by input serial data on pins SI and SC, as shown in table 1. The final 4 serial data bits in any input data string form the valid selection data, and this data is retained even after playback. If serial data is input during playback, the data is ignored and playback continues.




Pin SC should be LOW when either a LOW-to-HIGH or HIGH-to-LOW transition occurs on pin ST.

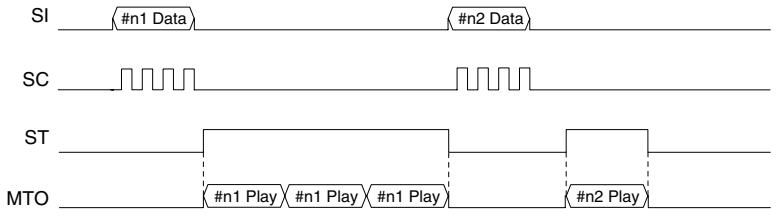
Figure 2. Serial data input timing

#### Serial data selection

Table 1. Serial data melody select

| B3 | B2 | B1 | B0 | ST | Melody |
|---|---|---|---|---|---|
| L | L | L | L | L → H | 1st melody |
| L | L | L | H | L → H | 2nd melody |
| L | L | H | L | L → H | 3rd melody |
| L | L | H | H | L → H | 4th melody |
| L | H | L | L | L → H | 5th melody |
| L | H | L | H | L → H | 6th melody |

| B3 | B2 | B1 | B0 | ST | Melody |
|---|---|---|---|---|---|
| L | H | H | L | L → H | 7th melody |
| L | H | H | H | L → H | 8th melody |
| H | L | L | L | L → H | 9th melody |
| H | L | L | H | L → H | 10th melody |
| H | L | H | L | L → H | 11th melody |
| H | L | H | H | L → H | 12th melody |




Melody plays repeatedly when ST is HIGH, and stops immediately when ST goes LOW.

Figure 3. Melody repetition timing

## Playback timing diagrams

### Playback start

Playback starts 128 ± 1 OSC clock cycles after ST goes HIGH.

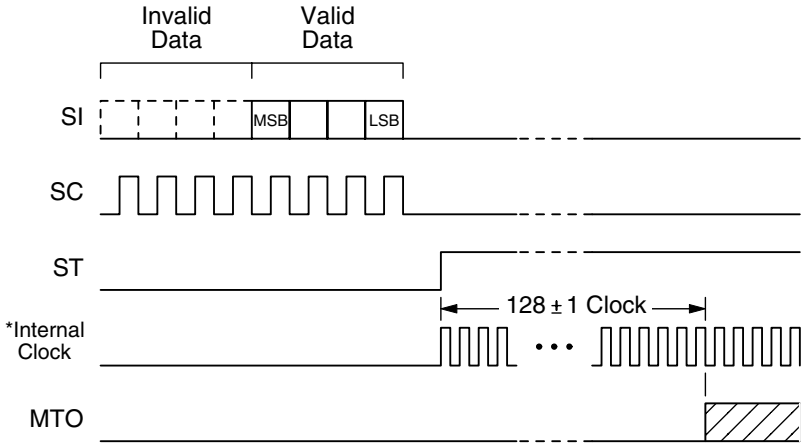



Figure 4. Start timing

### Playback stop

Playback stops immediately and the oscillator also stops when ST goes LOW.

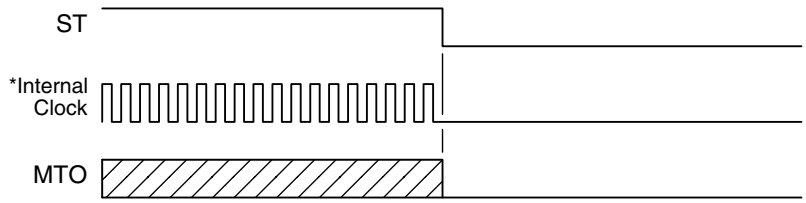
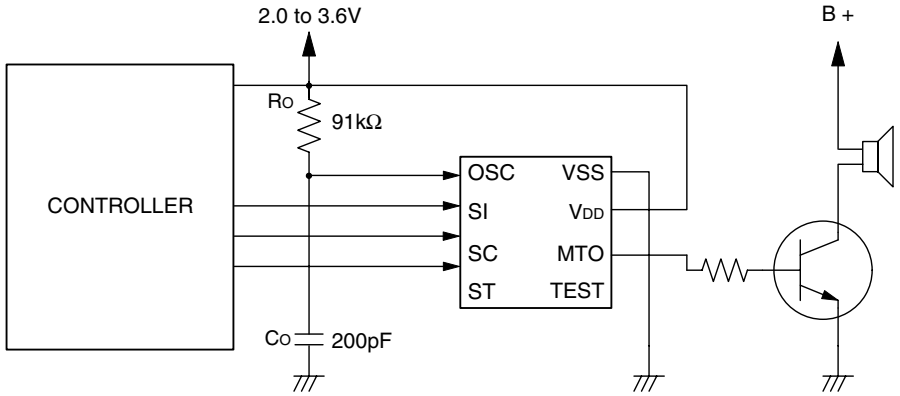



Figure 5. Stop timing

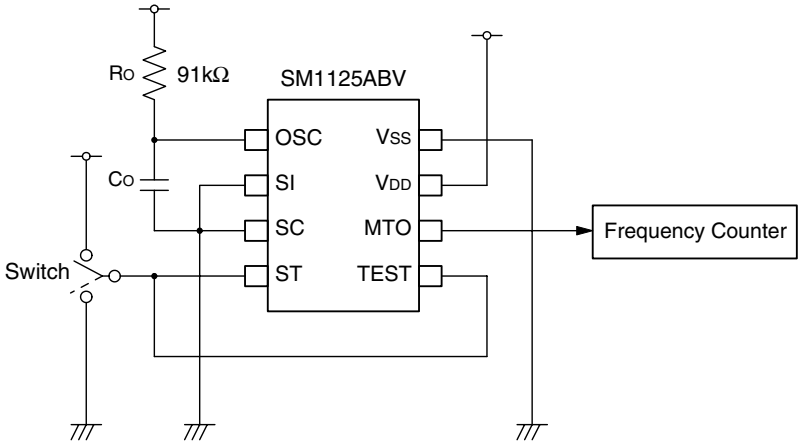
## TYPICAL APPLICATION




## OSCILLATOR FREQUENCY MEASUREMENT

The measurement circuit below shows a SM1125ABV with built-in RC oscillator circuit and external RC oscillator components capacitor $C_O$ and resistor $R_O$.

When ST is switched to $V_{DD}$, the oscillator starts and outputs a pulse on MTO. The output pulse is counted using a frequency counter.




Note that the board mounting and wiring will marginally affect the output frequency, even for equivalent values for $R_O$ and $C_O$.

## SONG LIST

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### SM1125ABV

| Number | Song Title | Composer | Time [s] |
|---|---|---|---|
| 1 | Departure | Komuro Tetsuya | 8.46 |
| 2 | Mirai yosouzu II | Yoshida Miwa | 19.4 |
| 3 | Roman hikou | Komekome club | 13.68 |
| 4 | Namonaki uta | Sakurai Kazutoshi | 21.03 |
| 5 | Last Christmas | Michael George | 18.14 |
| 6 | We wish you a merry Christmas | – | 9.78 |
| 7 | Jingle Bells | – | 15.56 |
| 8 | Happy Birthday to you | Hill Mildred Junius Welch/Hill Patty Smith | 12.17 |
| 9 | Green Sleeves | – | 17.63 |
| 10 | Jesu joy of mans desiring | – | 20.18 |
| 11 | Mickey Mouse March | Dodd Jimmie | 5.89 |
| 12 | It's a small world | Sherman Richard M/Sherman Robert B | 12.99 |

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