

MSM9836-xxx**Voice Synthesis IC with Built-in Mask ROM****GENERAL DESCRIPTION**

The MSM9836 is a PCM voice synthesis IC with built-in 3-Mbit mask ROM, D/A converter, and low-pass filter (LPF).

The MSM9836 is specifically designed for applications that use a microcontroller.

For this reason, functional support for standalone mode and RC oscillation has been omitted from the MSM9805, and the ROM capacity and the number of phrases have been increased.

By using Oki's Sound Analysis and Editing Tool, ROM data such as Phrase Control Table can be easily set, created, edited, and evaluated.

The following table lists the functional differences between the MSM9836 and the MSM9805.

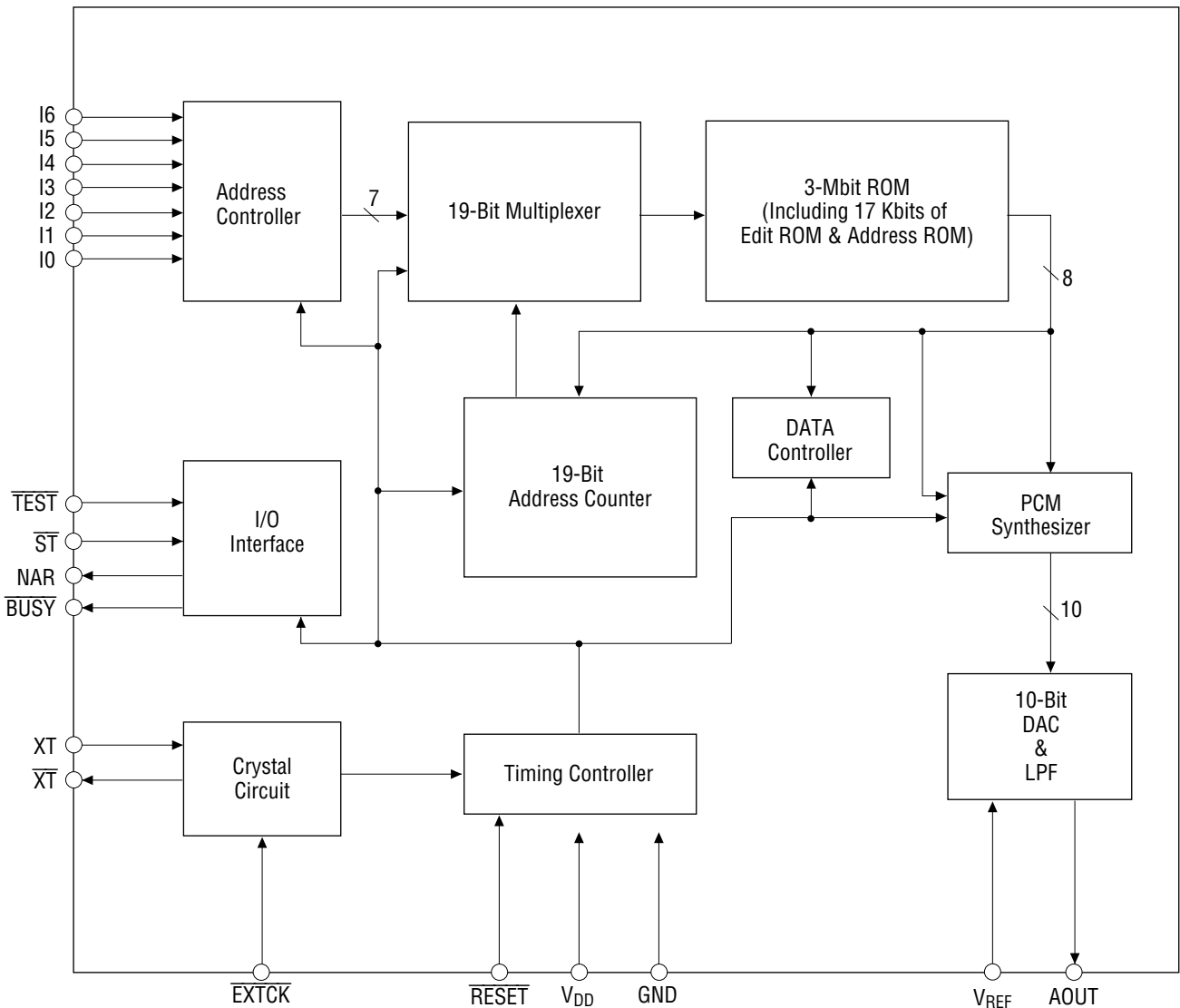
| | MSM9836 | MSM9805 |
|---------------------------|---|--|
| ROM Capacity | 3 Mbits | 2 Mbits |
| Interface | Microcontroller | Microcontroller/Standalone |
| Oscillation | Ceramic | Ceramic/RC |
| Maximum Number of Phrases | 127 | 63 |
| Status Signal | NAR/ $\overline{\text{BUSY}}$ simultaneous output | Only NAR output when operating in microcontroller interface mode |

FEATURES

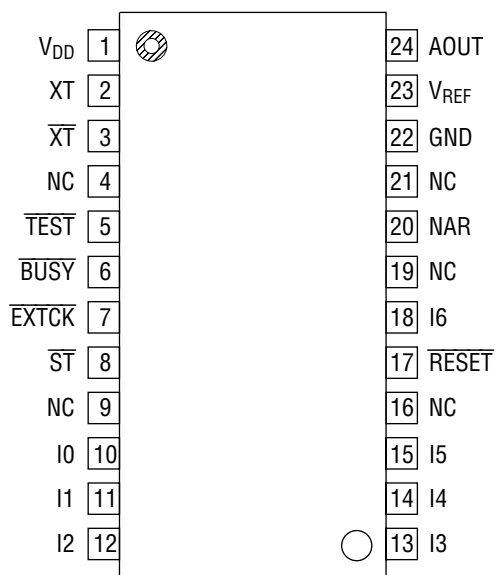
- 8-bit OKI nonlinear PCM method/8-bit Straight PCM method
- Sampling frequency : 4.0 kHz/5.3 kHz/6.4 kHz/8.0 kHz/10.6 kHz/12.8 kHz/
(Can be set for each phrase) 16.0 kHz
- ROM capacity : 3 Mbits
- Maximum playback time : 97.7 sec ($f_{\text{SAM}} = 4.0 \text{ kHz}$)
73.7 sec ($f_{\text{SAM}} = 5.3 \text{ kHz}$)
61.0 sec ($f_{\text{SAM}} = 6.4 \text{ kHz}$)
48.8 sec ($f_{\text{SAM}} = 8.0 \text{ kHz}$)
- Master clock frequency : 4.096 MHz
(Ceramic oscillation/external clock input)
- Edit ROM function
- Maximum number of phrases : 127
- Built-in current mode 10-bit D/A converter
- Built-in low-pass filter
- Power supply voltage : +2.0 to +5.5 V
- Package :
24-pin plastic SOP (SOP24-P-430-1.27-K) (Product name: MSM9836-xxxGS-K)
xxx indicates code number.

Chip

BLOCK DIAGRAM



PIN CONFIGURATION (TOP VIEW)



NC : No connection

24-Pin Plastic SOP

PIN DESCRIPTIONS

| Pin | Symbol | Type | Description |
|-----------|---------------------------|------|--|
| 17 | $\overline{\text{RESET}}$ | I | The IC enters the standby state if this pin is set to "L" level. At this time, oscillation stops and AOUT output becomes GND level, then the IC returns to the initial state. Apply a "L" pulse upon power-on. This pin has an internal pull-up resistor. |
| 20 | NAR | O | Signal output pin that indicates whether the 7-bit LATCH (see Block Diagram) is idle. NAR at "H" level indicates that the LATCH is empty and $\overline{\text{ST}}$ input is enabled. |
| 7 | $\overline{\text{EXTCK}}$ | I | Ceramic oscillator input/external clock input switching pin. Set to "H" level if ceramic oscillation is used. Set to "L" level if external clock is used. |
| 23 | V _{REF} | I | Volume setting pin. If this pin is set to GND level, the maximum current is forced in, and if set to V _{DD} level, the minimum current is forced in. An approx. 10 k Ω pull-down resistor is internally connected to this pin during operation. |
| 24 | AOUT | O | Voice output pin. The voice signals are output as current changes. A "L" level signal is output through this pin in standby state. |
| 22 | GND | — | Ground pin. |
| 1 | V _{DD} | — | Power supply pin. Insert a bypass capacitor of 0.1 μF or more between this pin and the GND pin. |
| 2 | XT | I | Ceramic oscillator connection pin when ceramic oscillation is selected. Input from this pin if external clock is used. |
| 3 | $\overline{\text{XT}}$ | O | Ceramic oscillator connection pin when ceramic oscillation is selected. Leave this pin open if external clock is used. A "L" level signal is output through this pin in standby state. |
| 5 | $\overline{\text{TEST}}$ | I | Normally leave this pin open. This pin is used only for testing the internal circuit. |
| 8 | $\overline{\text{ST}}$ | I | Voice synthesis starts at fall of $\overline{\text{ST}}$, and addresses I0 to I6 are fetched at rise of $\overline{\text{ST}}$. Input $\overline{\text{ST}}$ when NAR, the status signal, is at "H" level. This pin has internal pull-up resistor. |
| 10-15, 18 | I0 - I6 | I | Phrase input pins corresponding to playback sound. |
| 6 | $\overline{\text{BUSY}}$ | O | This pin is at "H" level after reset is input. A "L" level signal is output through this pin for the time during which voice is being played. |

ABSOLUTE MAXIMUM RATINGS

(GND=0V)

| Parameter | Symbol | Condition | Rating | Unit |
|----------------------|-----------|--------------------------|------------------------|--------------------|
| Power Supply Voltage | V_{DD} | $T_a=25^{\circ}\text{C}$ | -0.3 to +7.0 | V |
| Input Voltage | V_{IN} | | -0.3 to $V_{DD} + 0.3$ | V |
| Storage Temperature | T_{STG} | — | -55 to +150 | $^{\circ}\text{C}$ |

RECOMMENDED OPERATING CONDITIONS

(GND=0 V)

| Parameter | Symbol | Condition | Range | | | Unit |
|--------------------------------|-----------|--------------------------|------------|-------|------|--------------------|
| Power Supply Voltage | V_{DD} | — | 2.0 to 5.5 | | | V |
| Operating Temperature | T_{op} | — | -40 to +85 | | | $^{\circ}\text{C}$ |
| Original Oscillation Frequency | f_{OSC} | When crystal is selected | Min. | Typ. | Max. | MHz |
| | | | 3.5 | 4.096 | 4.5 | |

ELECTRICAL CHARACTERISTICS

DC Characteristics (1)

($V_{DD}=5.0\text{ V}$, GND=0 V, $T_a=-40$ to $+85^{\circ}\text{C}$, unless otherwise specified)

| Parameter | Symbol | Condition | Min. | Typ. | Max. | Unit |
|------------------------------------|------------|---|------|------|------|------------------|
| "H" Input Voltage | V_{IH} | — | 4.2 | — | — | V |
| "L" Input Voltage | V_{IL} | — | — | — | 0.8 | V |
| "H" Output Voltage | V_{OH} | $I_{OH}=-1\text{ mA}$ | 4.6 | — | — | V |
| "L" Output Voltage | V_{OL} | $I_{OL}=2\text{ mA}$ | — | — | 0.4 | V |
| "H" Input Current 1 | I_{IH1} | $V_{IH}=V_{DD}$ | — | — | 10 | μA |
| "H" Input Current 2 | I_{IH2} | Applies to XT pin only. $V_{IH}=V_{DD}$ | — | — | 15 | μA |
| "L" Input Current 1 | I_{IL1} | $V_{IL}=\text{GND}$ | -10 | — | — | μA |
| "L" Input Current 2 (*1) | I_{IL2} | Internal pull-up resistor | -200 | -90 | -30 | μA |
| Dynamic Supply Current 1 (*2) | I_{DD1} | $V_{REF}=V_{DD}$, AOUT voltage=0V | — | 0.4 | 1 | mA |
| Dynamic Supply Current 2 (*3) | I_{DD2} | At maximum output current $V_{REF}=\text{GND}$, AOUT voltage=0V | — | — | 16 | mA |
| Standby Current | I_{DS} | $T_a=-40$ to $+70^{\circ}\text{C}$ | — | — | 10 | μA |
| | | $T_a=-40$ to $+85^{\circ}\text{C}$ | — | — | 50 | μA |
| AOUT Output Current | I_{AOUT} | At maximum output current $V_{REF}=V_{DD}$, AOUT voltage=0V | 6 | 9.5 | 15 | mA |
| V_{REF} Pin Pull-Down Resistance | R_{VREF} | — | 7 | 10 | 13 | $\text{k}\Omega$ |

*1 Applicable to $\overline{\text{RESET}}$, $\overline{\text{ST}}$

*2 Dynamic supply current excluding DAC output current

*3 Dynamic supply current at maximum output current

DC Characteristics (2)

(V_{DD}=3.1 V, GND=0 V, Ta=-40 to +85°C, unless otherwise specified)

| Parameter | Symbol | Condition | Min. | Typ. | Max. | Unit |
|---|-------------------|--|------|------|------|------|
| "H" Input Voltage | V _{IH} | — | 2.7 | — | — | V |
| "L" Input Voltage | V _{IL} | — | — | — | 0.5 | V |
| "H" Output Voltage | V _{OH} | I _{OH} =-1 mA | 2.6 | — | — | V |
| "L" Output Voltage | V _{OL} | I _{OL} =2 mA | — | — | 0.4 | V |
| "H" Input Current 1 | I _{IH1} | V _{IH} =V _{DD} | — | — | 10 | μA |
| "H" Input Current 2 | I _{IH2} | Applies to XT pin only. V _{IH} =V _{DD} | — | — | 15 | μA |
| "L" Input Current 1 | I _{IL1} | V _{IL} =GND | -10 | — | — | μA |
| "L" Input Current 2 (*1) | I _{IL2} | Internal pull-up resistor | -100 | -30 | -10 | μA |
| Dynamic Supply Current 1 (*2) | I _{DD1} | V _{REF} =V _{DD} , AOUT voltage=0V | — | 0.15 | 0.5 | mA |
| Dynamic Supply Current 2 (*3) | I _{DD2} | At maximum output current V _{REF} =GND, AOUT voltage=0V | — | — | 5.5 | mA |
| Standby Current | I _{DS} | Ta=-40 to +70°C | — | — | 5 | μA |
| | | Ta=-40 to +85°C | — | — | 20 | μA |
| AOUT Output Current | I _{AOUT} | At maximum output current V _{REF} =V _{DD} , AOUT voltage=0V | 1.4 | 3.2 | 5 | mA |
| V _{REF} Pin Pull-Down Resistance | R _{VREF} | — | 7 | 10 | 13 | kΩ |

*1 Applicable to $\overline{\text{RESET}}$, $\overline{\text{ST}}$

*2 Dynamic supply current excluding DAC output current

*3 Dynamic supply current at maximum output current

AC Characteristics

(V_{DD}=5.0 V, GND=0 V, f_{OSC}=4.096 MHz, T_a=-40 to +85°C)

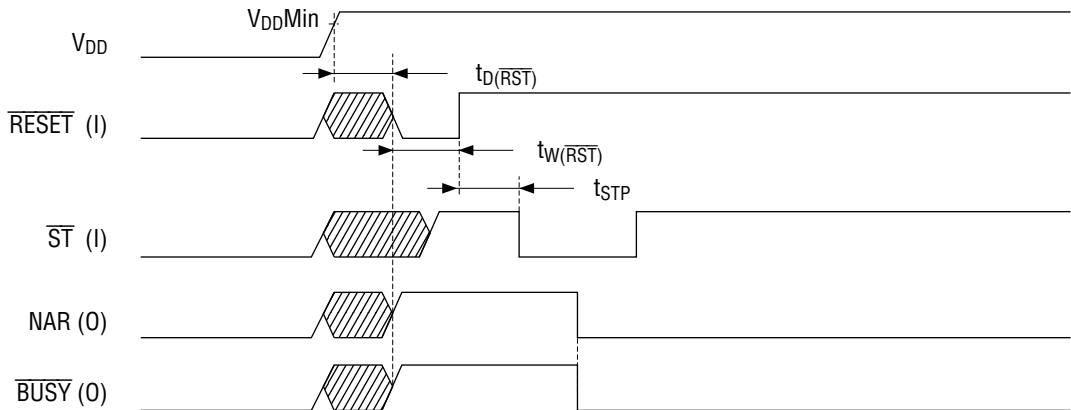
| Parameter | Symbol | Condition | Min. | Typ. | Max. | Unit |
|---|-------------------------------------|----------------------------------|------|------|------|------|
| Master Clock Duty Cycle | f _{duty} | — | 40 | 50 | 60 | % |
| RESET Input Pulse Width | t _{w(RST)} | — | 10 | — | — | μs |
| RESET Input Time After Power-on | t _{D(RST)} | — | 0 | — | — | μs |
| ST Signal Setup Time | t _{STP} | At power-on | 1 | — | — | μs |
| ST Input Pulse Width | t _(ST) | — | 0.35 | — | 2000 | μs |
| The ST-ST Pulse Interval | t _{SS} | Upon entering the stop code (*4) | 40 | — | — | μs |
| Data Setup Time | t _{DW} | — | 1 | — | — | μs |
| Data Hold Time | t _{WD} | — | 1 | — | — | μs |
| NAR Output Time 1 | t _{SNS} | f _{SAM} =8 kHz | — | — | 10 | μs |
| NAR Output Time 2 | t _{NAA} | f _{SAM} =8 kHz (*4) | 350 | 375 | 400 | μs |
| NAR Output Time 3 | t _{NAB} | f _{SAM} =8 kHz (*4) | 315 | 440 | 500 | μs |
| NAR Output Time 4 | t _{NAC} | f _{SAM} =8 kHz (*4) | 350 | 375 | 500 | μs |
| BUSY Output Time 1 | t _{SBS} | f _{SAM} =8 kHz | — | — | 10 | μs |
| BUSY Output Time 2 | t _{BSYA} | f _{SAM} =8 kHz (*4) | 350 | 375 | 400 | μs |
| D/A Converter Change Time | t _{DAR} , t _{DAF} | — (*4) | 60 | 64 | 68 | ms |
| Standby Transition Time (at end of voice output) | t _{STB} | — (*4) | 200 | 250 | 300 | ms |
| Silence Time Between Phrases | t _{BLN} | f _{SAM} =8 kHz (*4) | 350 | 375 | 500 | μs |

*4 Proportional to master the periods of oscillation frequency f_{OSC1} and f_{OSC2}.

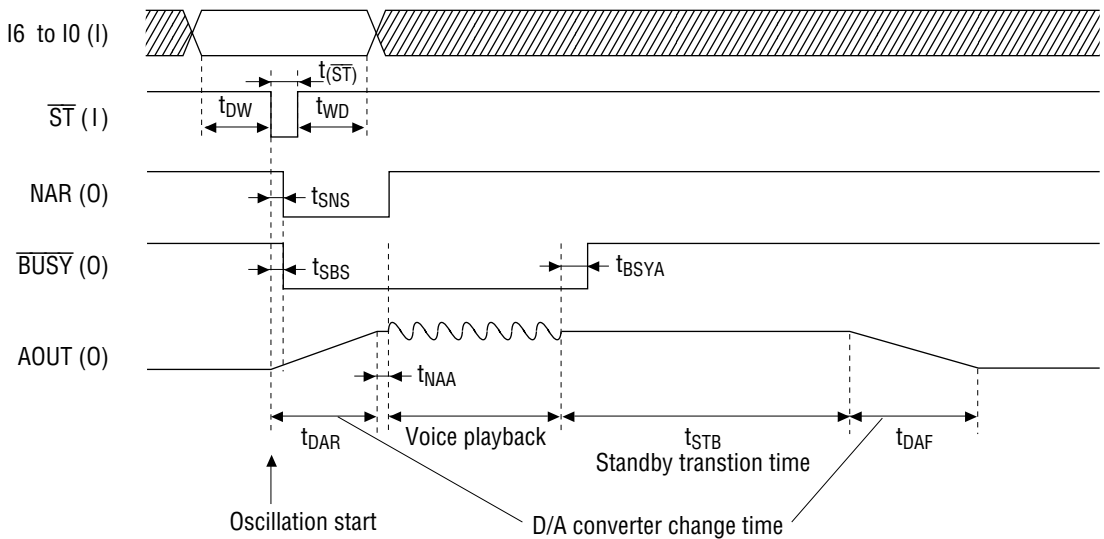
The rated values show values when the standard master oscillation frequency is used.

TIMING DIAGRAMS

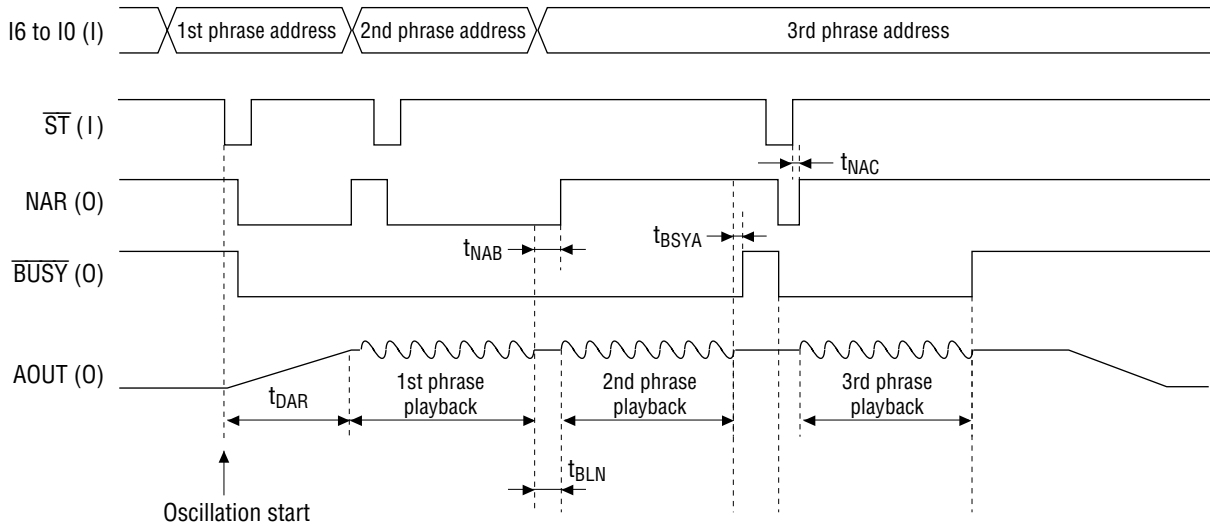
1. AC Characteristics at Power-On



2. AC Characteristics in Standby Status and when the IC is Activated

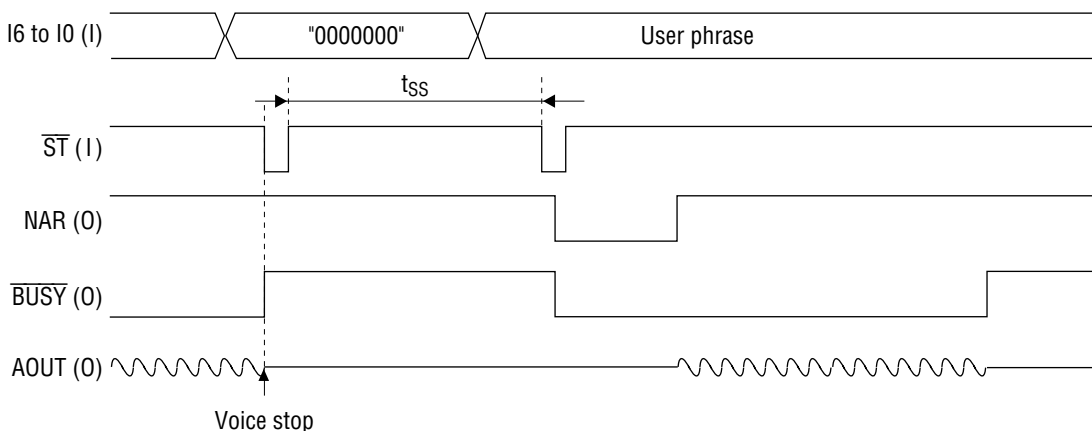


3. Playback Timing



The pins I6 to I0 are used to enter the address of a phrase subject to voice synthesis. Voice synthesis starts by entering the \overline{ST} signal during addressing.

4. Stop Code Input Timing



When I6-I0 are set to "0000000" during voice playback (during the output of "L" level at the $\overline{\text{BUSY}}$ pin), and a $\overline{\text{ST}}$ signal is input, playback stops regardless of whether NAR is at "H" or "L" level and AOUT becomes $1/2 I_{\text{AOUT}}$. Stop code becomes valid at the falling edge of $\overline{\text{ST}}$.

The stop code does not initialize internal units but only stops playback. To initialize an internal register, use the RESET pin.

1. Sampling Frequency

As shown in Table 1.1, 7 sampling frequencies are available.

A sampling frequency can be selected and assigned to each phrase in ROM data.

Table 1.1 Sampling Frequency

| Sampling Frequency (At standard oscillation frequency) | Frequency diving ratio |
|--|------------------------|
| 4.0 kHz | $f_{OSC1}/1024$ |
| 5.3 kHz | $f_{OSC1}/768$ |
| 6.4 kHz | $f_{OSC1}/640$ |
| 8.0 kHz | $f_{OSC1}/512$ |
| 10.6 kHz | $f_{OSC1}/384$ |
| 12.8 kHz | $f_{OSC1}/320$ |
| 16.0 kHz | $f_{OSC1}/256$ |

2. Recording/Playback Time

Figure 2.1 below shows memory allocation of the on-chip Mask ROM. About 17 Kbits of data area is allocated for the Phrase Control Table, Phrase Data Control and Test Data.

Therefore, actual data area for storing sound data equals the total Mask ROM capacity minus 17 Kbits.

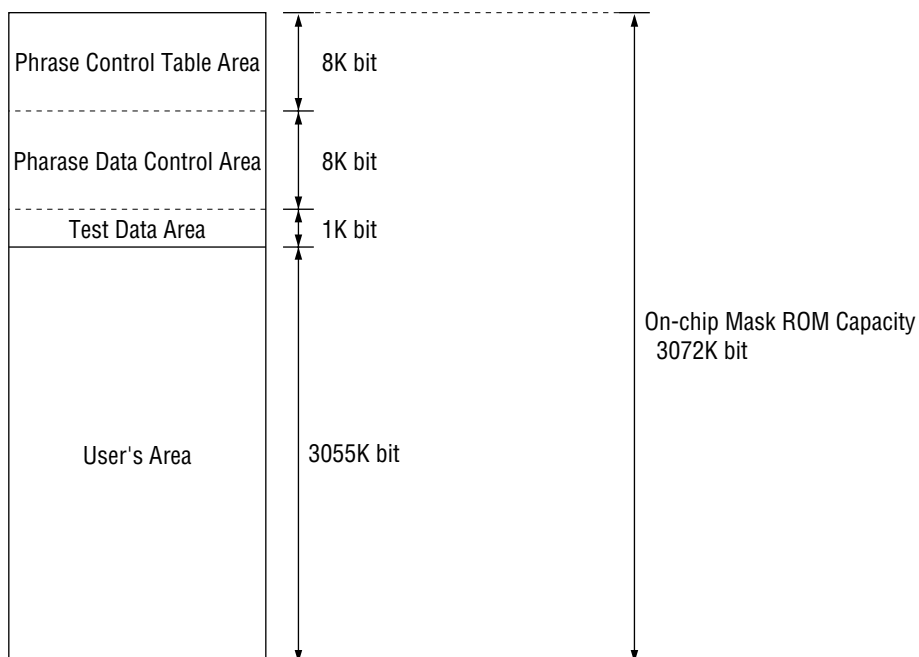


Figure 2.1 Memory Allocation of On-chip Mask ROM

The playback time is obtained by dividing the memory capacity by the bit rate.
The playback time for 8-bit PCM algorithm is obtained by using the following equation.

$$\text{Playback time [sec]} = \frac{\text{Memory capacity [bit]}}{\text{Bit rate [bps]}} = \frac{\text{Memory capacity [bit]}}{\text{Sampling frequency [Hz]} \times 8 [\text{bit}]}$$

For example, if all phrases are stored in the MSM9836 at 8 kHz sampling frequency, the maximum playback time is as follows.

$$\text{Playback time} = \frac{(3072-17) \times 1024 [\text{bit}]}{8000 [\text{Hz}] \times 8 [\text{bit}]} \approx 48.8 [\text{sec}]$$

Table 2.1 Maximum playback time

| Model | ROM capacity | User's area | Maximum playback time (sec) | | | |
|---------|--------------|-------------|-----------------------------|--------------------------|--------------------------|---------------------------|
| | | | f _{SAM} =4.0kHz | f _{SAM} =6.4kHz | f _{SAM} =8.0kHz | f _{SAM} =16.0kHz |
| MSM9836 | 3M bit | 3055K bit | 97.7 | 61.0 | 48.8 | 24.4 |

3. Playback Method

This IC provides two kinds of playback methods, non-linear PCM algorithm and straight PCM algorithm. When the 8-bit non-linear PCM algorithm is selected, sound quality can be improved because a resolution equivalent to 10-bit straight PCM is available around the waveform center. You can select either non-linear PCM algorithm or straight PCM algorithm for each phrase. Table 3.1 shows the relationship between playback methods and applicable sounds. It is recommended to evaluate the sound quality before actual use.

Table 3.1 Relationship between playback methods and applicable sounds

| Playback method | Applicable sound |
|--------------------------------|--------------------------|
| 8-bit non-linear PCM algorithm | Human voice |
| 8-bit straight PCM algorithm | BEEP tone, sound effects |

4. Phrase Control Table

Because the LSI contains the Phrase Control Table, it is possible to play back multiple phrases in succession by a single easy control operation like controlling a single regular phrase playback. Up to 8 combined phrases including a silence can be registered in a single address in the Phrase Control Table.

Further, you can use the maximum memory space for data storage because it is not required to have the same phrase data.

To show an example, let's assume that your application needs to speak two similar sentences, "It is fine today" and "It is rainy today." The two sentences have the common words "it", "is" and "today". What you have to do is to prepare these common sound data, not in sentences but in words, and to store each combined phrase data in Phrase Control Table as shown in Table 4.1 and Figure 4.1

Multiple phrases can be played continuously merely by specifying a desired phrase using an X address. For an example from Table 4.1, when address "01" is specified, "It is fine today" is played, and when address "02" is specified, "It is rainy" is played.

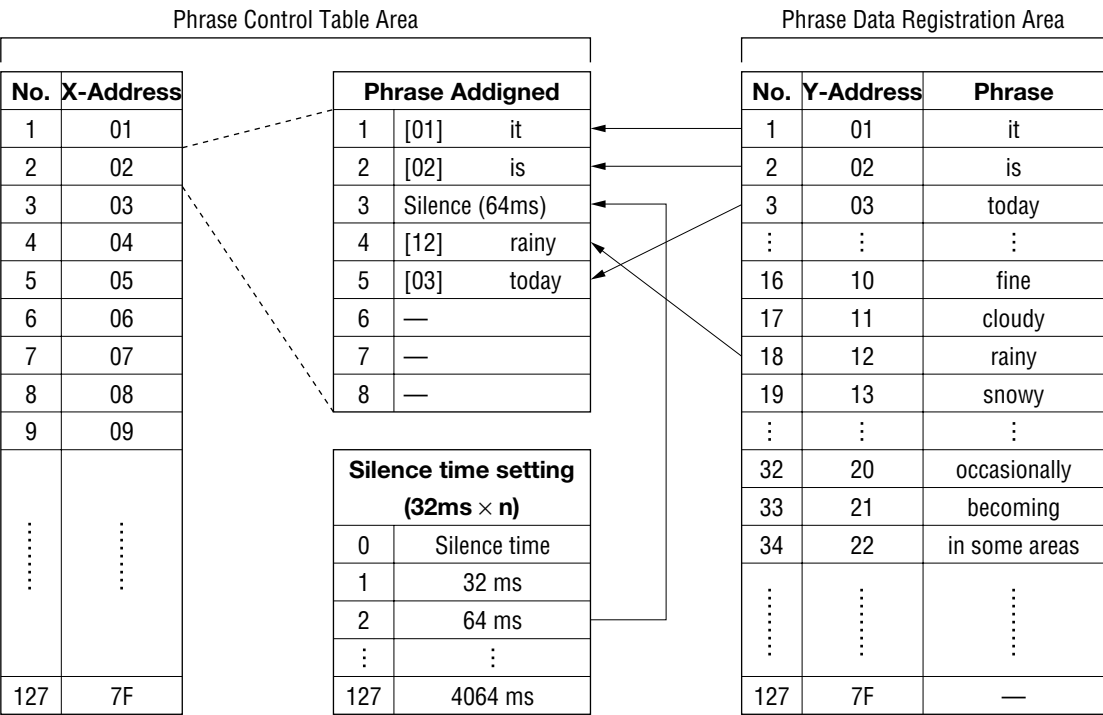
Phrase Control Table, a silence can be inserted without using the User's Area.

| | |
|----------------------------------|---------|
| Minimum time for silence | 32 ms |
| Maximum time for silence | 4064 ms |
| Time unit for setting up silence | 32 ms |

Table 4.1 Matrix of the Phrase Control Table

| No. | X-Address (HEX) | Y-Address (Up to 8 phrases) | | | | | | | | Sound Data |
|-----|--------------------|--------------------------------|------|---------|------|------|------|------|------|--|
| 1 | 01 | [01] | [02] | Silence | [10] | [03] | | | | It is (silence) fine today. |
| 2 | 02 | [01] | [02] | Silence | [12] | [03] | | | | It is (silence) rainy today. |
| 3 | 03 | [01] | [02] | [10] | [21] | [11] | [12] | [22] | [03] | It is fine becoming cloudy, rainy in some areas today. |
| ⋮ | ⋮ | | | | | | | | | ⋮ |
| 126 | 7E | | | | | | | | | |
| 127 | 7F | | | | | | | | | |

Figure 4.1 Phrase Combination Matrix for Phrase Control Table



5. Oscillation and Clock Input

5. 1 Ceramic oscillation

Figure 2 shows an external circuit using a ceramic oscillator.

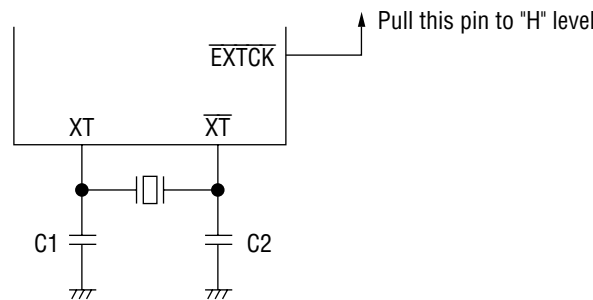


Figure 2 External Circuit Using a Ceramic Oscillator

For example, the following table shows the optimum load capacitances, power supply voltage ranges, and operating temperature ranges when ceramic oscillators made by Murata MFG Co., Ltd., and TDK Co., Ltd. are used.

| Ceramic oscillator | | | Optimal load capacity | | supply voltage range (V) | Operating temperature range (°C) |
|--------------------|-------------|--------------------|-----------------------|----------|-----------------------------|--|
| Maker | Type | Frequency (MHz) | C1 (pF) | C2 (pF) | | |
| Murata MFG. | CSA4.09MGU | 4.09 | 30 | 30 | 2.0 to 5.5 | -40 to +85 |
| | CST4.09MGWU | 4.09 | Built in | Built in | 2.0 to 5.5 | |
| TDK | CCR4.00MC3 | 4.0 | Built in | Built in | 2.4 to 5.5 | -40 to +85 |

(Note) When a 4 MHz ceramic oscillator is used, the playback speed of MSM9802/03/05 is slower by 2 percent than that of an analysis tool or a demonstration board.

5. 2 External clock input

Figure 3 shows a circuit for external clock input.

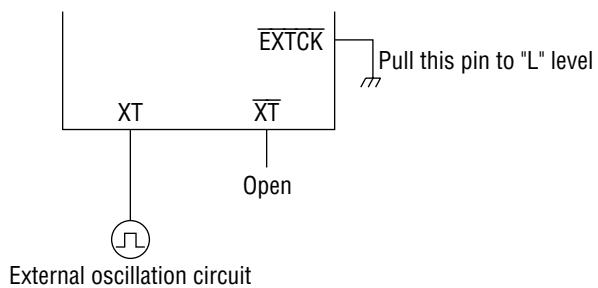


Figure 3 Circuit for External Clock Input

6. Low-Pass Filter

In this IC, all voice outputs are through the built-in low-pass filter (LPF). Figure 4 and Table 4 show the LPF frequency characteristics and LPF cutoff frequency respectively. Only the voice output through LPF is enabled in this IC.

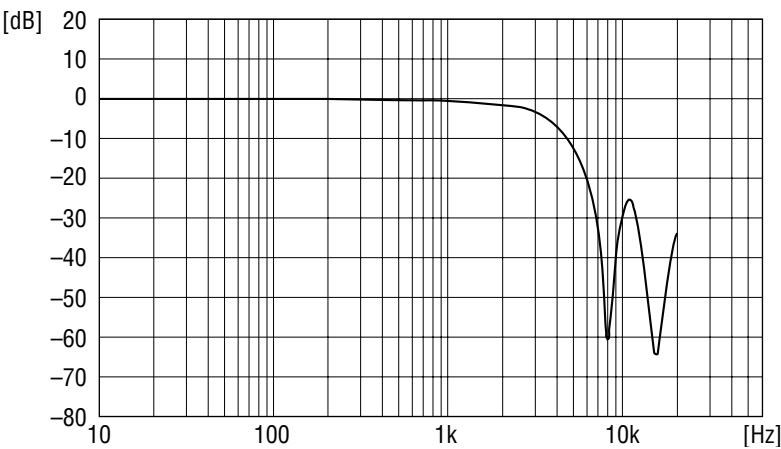


Figure 4 LPF Frequency Characteristics ($f_{\text{SAM}}=8\text{ kHz}$)

Table 4 LPF Cutoff Frequency

| Sampling Frequency (kHz) (f_{SAM}) | Cutoff Frequency (kHz) (f_{CUT}) |
|--|--|
| 4.0 | 1.2 |
| 5.3 | 1.6 |
| 6.4 | 2.0 |
| 8.0 | 2.5 |
| 10.6 | 3.2 |
| 12.8 | 4.0 |
| 16.0 | 5.0 |

7. Standby Transition

When playback of a phrase is finished, if playback of the next phrase does not start up within t_{STB} (0.25 sec. typ.), the IC enters standby status and the entire operation stops.

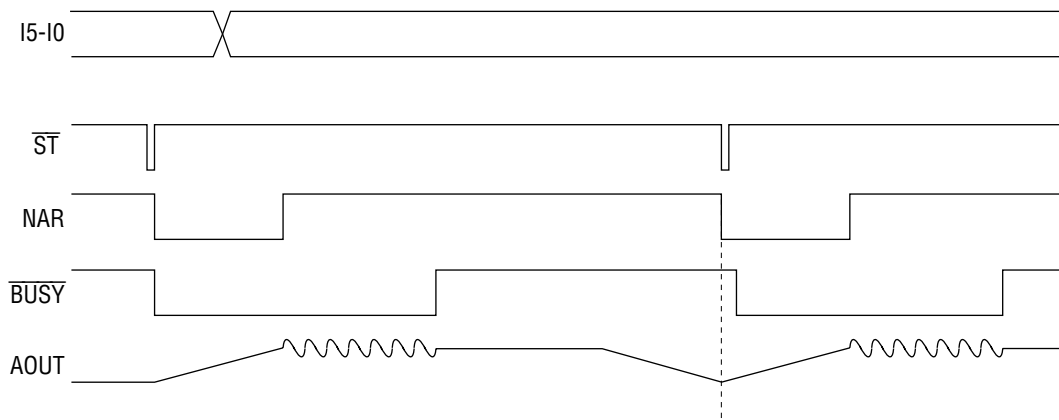
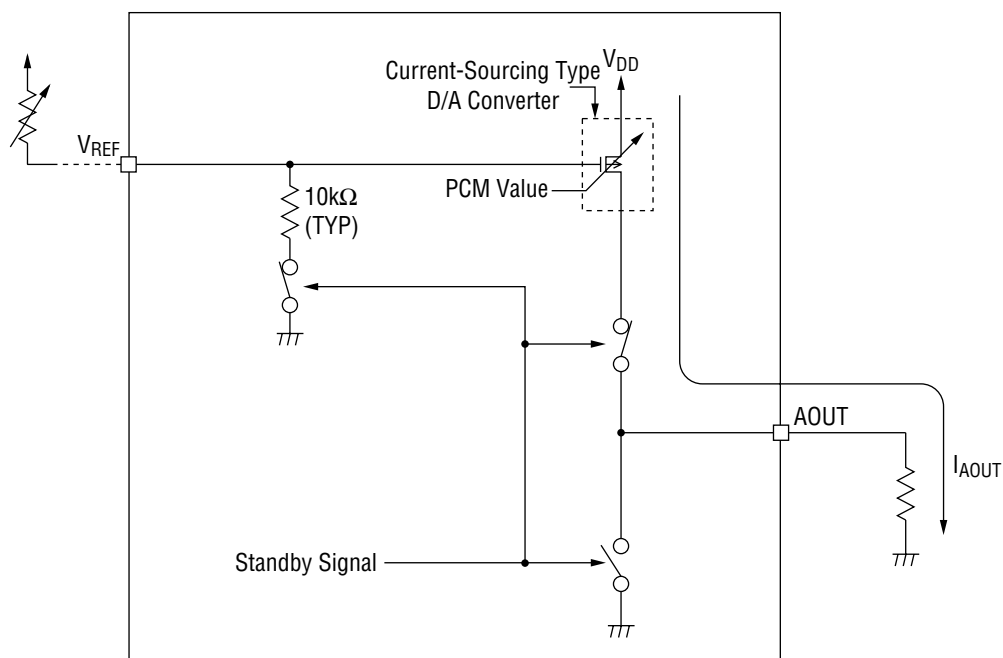


Figure 5 Voice Playback Timing during D/A Converter Change Time

If playback is attempted during D/A converter change time as shown in Figure 5, the IC exits from standby status and the output from the D/A converter begins going to the $1/2 I_{AOUT}$ level. When the output reaches $1/2 I_{AOUT}$, voice playback starts.

8. Voice Output Unit Equivalent Circuit (AOUT, F_{REF} Pins)

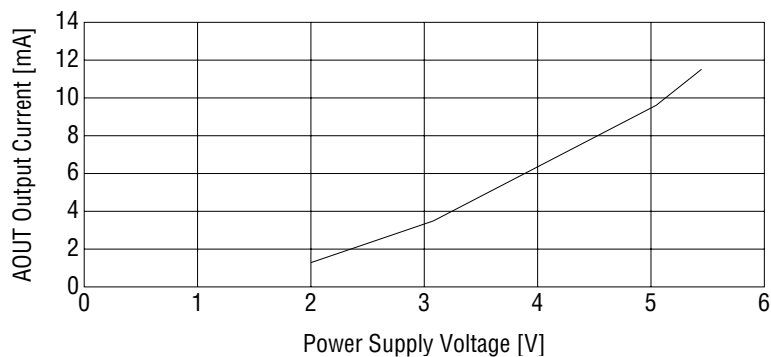


(The above switch positions show those when the circuit is active.)

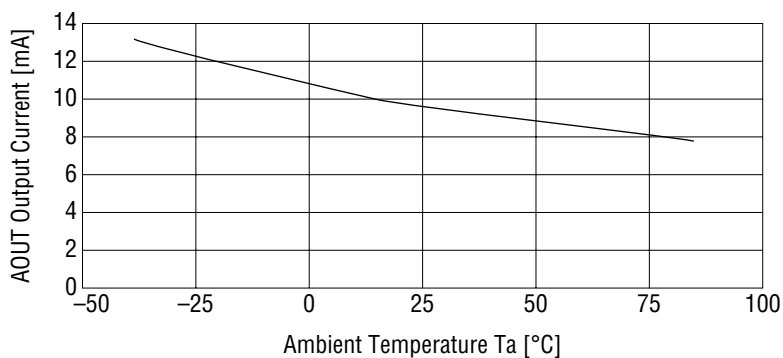
Figure 8.1 Voice Output Unit Equivalent Circuit

D/A CONVERTER OUTPUT CURRENT CHARACTERISTICS

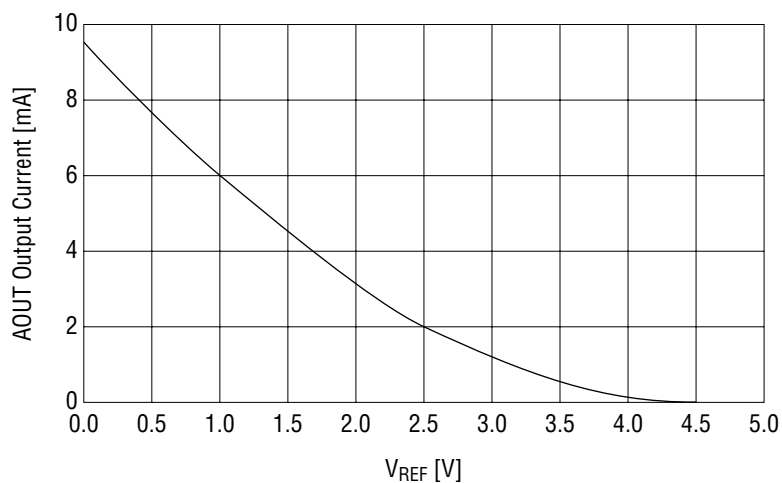
Power Supply Voltage vs. Output Current Characteristics ($T_a=25^\circ\text{C}$, $V_{AOUT}=0\text{V}$)



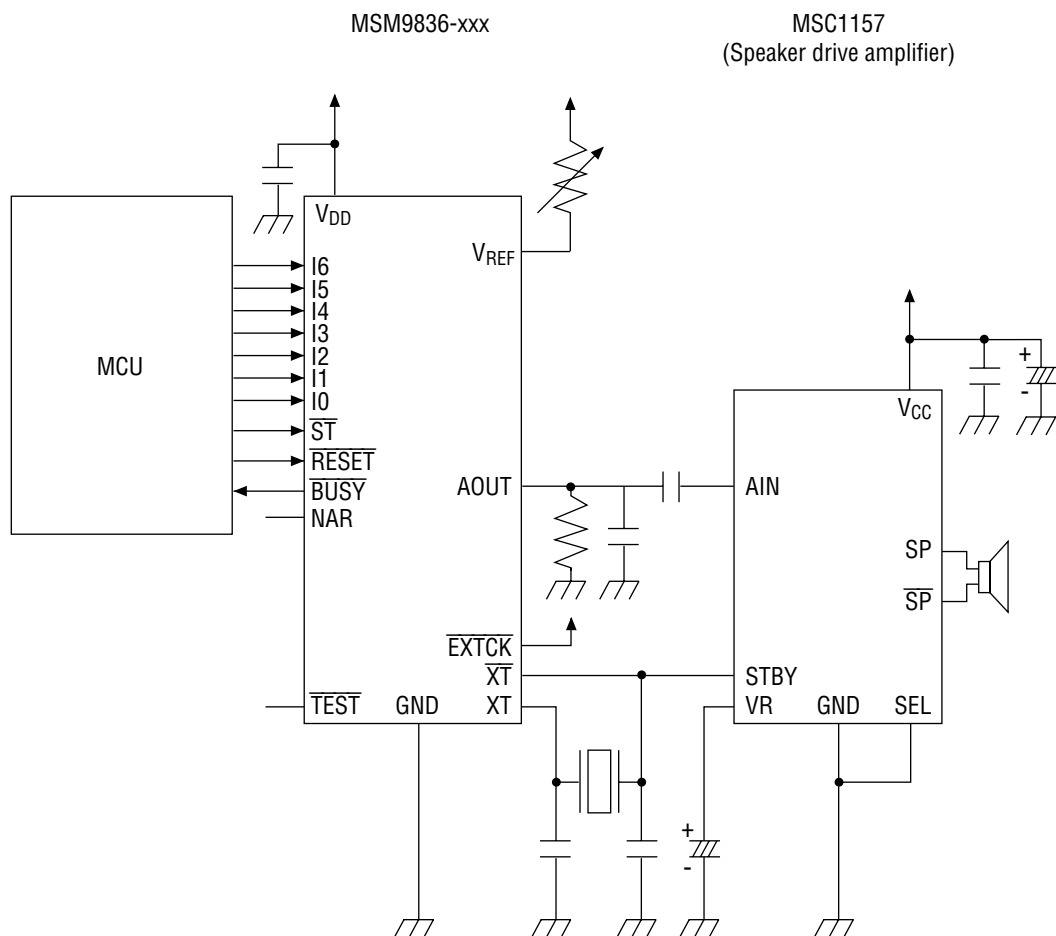
Temperature vs. Output Current Characteristics ($V_{DD}=5\text{V}$, $V_{AOUT}=0\text{V}$)



V_{REF} Voltage vs. Output Current Characteristics ($T_a=25^\circ\text{C}$, $V_{DD}=5\text{V}$, $V_{AOUT}=0\text{V}$)



APPLICATION CIRCUIT

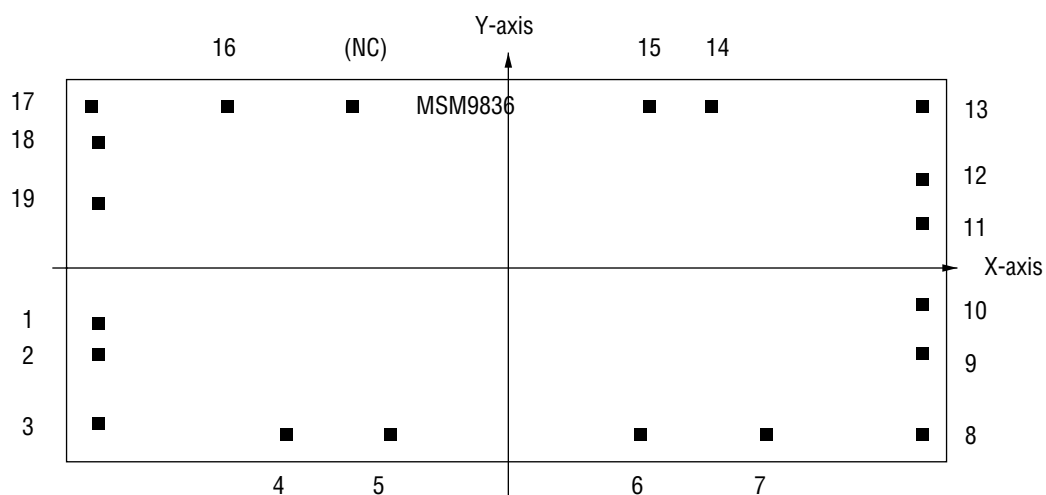


PAD CONFIGURATION

Pad Layout

Chip size X=7.65mm Y=3.32mm
 Chip thickness $350\mu\text{m} \pm 30\mu\text{m}$
 Pad size $110\mu\text{m} \times 110\mu\text{m}$
 Substrate potential GND

Chip and pad number



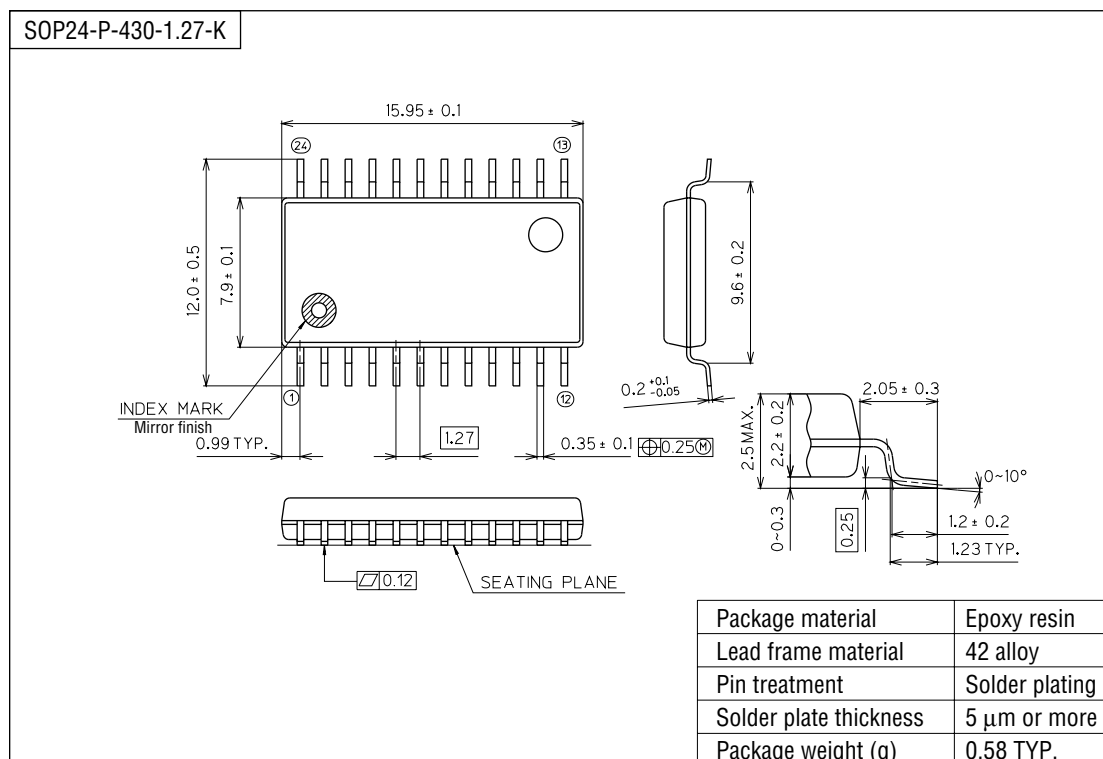
Pad coordinates (Chip center is located at X=0 and Y=0)

(Unit: μm)

| PAD No. | PAD Name | X-axis | Y-axis | PAD No. | PAD Name | X-axis | Y-axis |
|---------|---------------------------|--------|--------|---------|---------------------------|--------|--------|
| 1 | V _{DD} | -3620 | -452 | 11 | I3 | 3673 | 415 |
| 2 | XT | -3623 | -742 | 12 | I4 | 3673 | 816 |
| 3 | $\overline{\text{XT}}$ | -3623 | -1349 | 13 | I5 | 3673 | 1460 |
| 4 | $\overline{\text{TEST}}$ | -1932 | -1460 | 14 | $\overline{\text{RESET}}$ | 1778 | 1460 |
| 5 | $\overline{\text{BUSY}}$ | -1044 | -1455 | 15 | I6 | 1260 | 1458 |
| 6 | $\overline{\text{EXTCK}}$ | 1163 | -1453 | 16 | NAR | -2443 | 1460 |
| 7 | $\overline{\text{ST}}$ | 2234 | -1455 | 17 | GND | -3665 | 1460 |
| 8 | I0 | 3673 | -1432 | 18 | V _{REF} | -3623 | 1136 |
| 9 | I1 | 3673 | -754 | 19 | AOUT | -3623 | 585 |
| 10 | I2 | 3673 | -312 | | | | |

PACKAGE DIMENSIONS

(Unit : mm)



Notes for Mounting the Surface Mount Type Package

The SOP, QFP, TSOP, TQFP, LQFP, SOJ, QFJ (PLCC), SHP, and BGA are surface mount type packages, which are very susceptible to heat in reflow mounting and humidity absorbed in storage. Therefore, before you perform reflow mounting, contact Oki's responsible sales person on the product name, package name, pin number, package code and desired mounting conditions (reflow method, temperature and times).

NOTICE

1. The information contained herein can change without notice owing to product and/or technical improvements. Before using the product, please make sure that the information being referred to is up-to-date.
2. The outline of action and examples for application circuits described herein have been chosen as an explanation for the standard action and performance of the product. When planning to use the product, please ensure that the external conditions are reflected in the actual circuit, assembly, and program designs.
3. When designing your product, please use our product below the specified maximum ratings and within the specified operating ranges including, but not limited to, operating voltage, power dissipation, and operating temperature.
4. Oki assumes no responsibility or liability whatsoever for any failure or unusual or unexpected operation resulting from misuse, neglect, improper installation, repair, alteration or accident, improper handling, or unusual physical or electrical stress including, but not limited to, exposure to parameters beyond the specified maximum ratings or operation outside the specified operating range.
5. Neither indemnity against nor license of a third party's industrial and intellectual property right, etc. is granted by us in connection with the use of the product and/or the information and drawings contained herein. No responsibility is assumed by us for any infringement of a third party's right which may result from the use thereof.
6. The products listed in this document are intended for use in general electronics equipment for commercial applications (e.g., office automation, communication equipment, measurement equipment, consumer electronics, etc.). These products are not authorized for use in any system or application that requires special or enhanced quality and reliability characteristics nor in any system or application where the failure of such system or application may result in the loss or damage of property, or death or injury to humans. Such applications include, but are not limited to, traffic and automotive equipment, safety devices, aerospace equipment, nuclear power control, medical equipment, and life-support systems.
7. Certain products in this document may need government approval before they can be exported to particular countries. The purchaser assumes the responsibility of determining the legality of export of these products and will take appropriate and necessary steps at their own expense for these.
8. No part of the contents contained herein may be reprinted or reproduced without our prior permission.
9. MS-DOS is a registered trademark of Microsoft Corporation.

Copyright 1999 Oki Electric Industry Co., Ltd.