

# OKI Semiconductor

## MSM6295

### 4-CHANNEL MIXING ADPCM VOICE SYNTEHSIS LSI

#### GENERAL DESCRIPTION

The Oki MSM6295 is a 4-channel mixing ADPCM voice synthesis LSI which is fabricated using Oki's low power CMOS silicon gate technology.

The MSM6295 can access an external ROM, where speech or sound effects data is stored. The maximum external ROM size is 256K

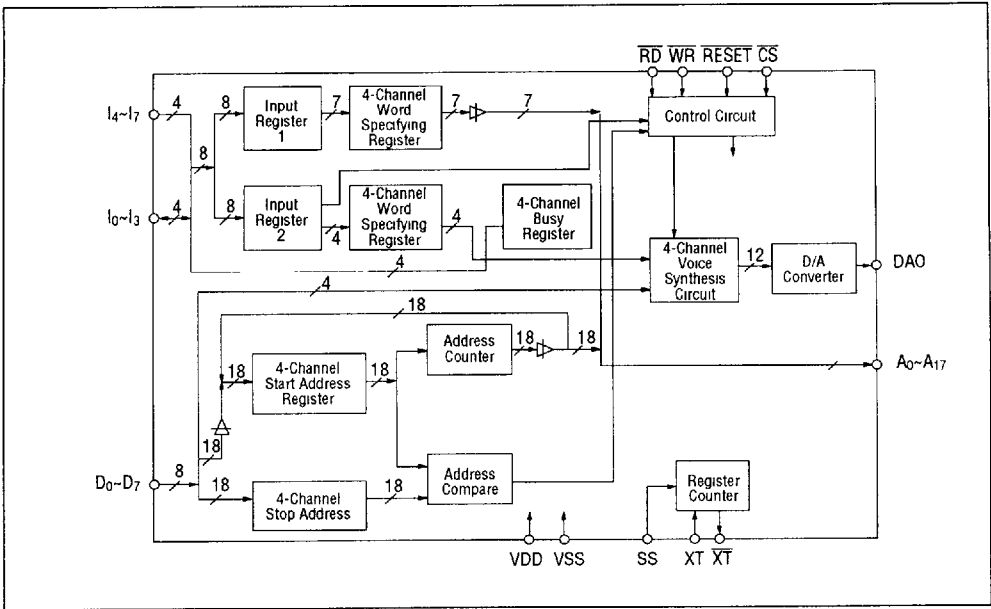
bytes.

The MSM6295 has a 4-channel synthesis stage which allows the simultaneous playback of four different channels. It is used to have a voice with BGM (Back Ground Music) effect, instrumental sound, echo etc.

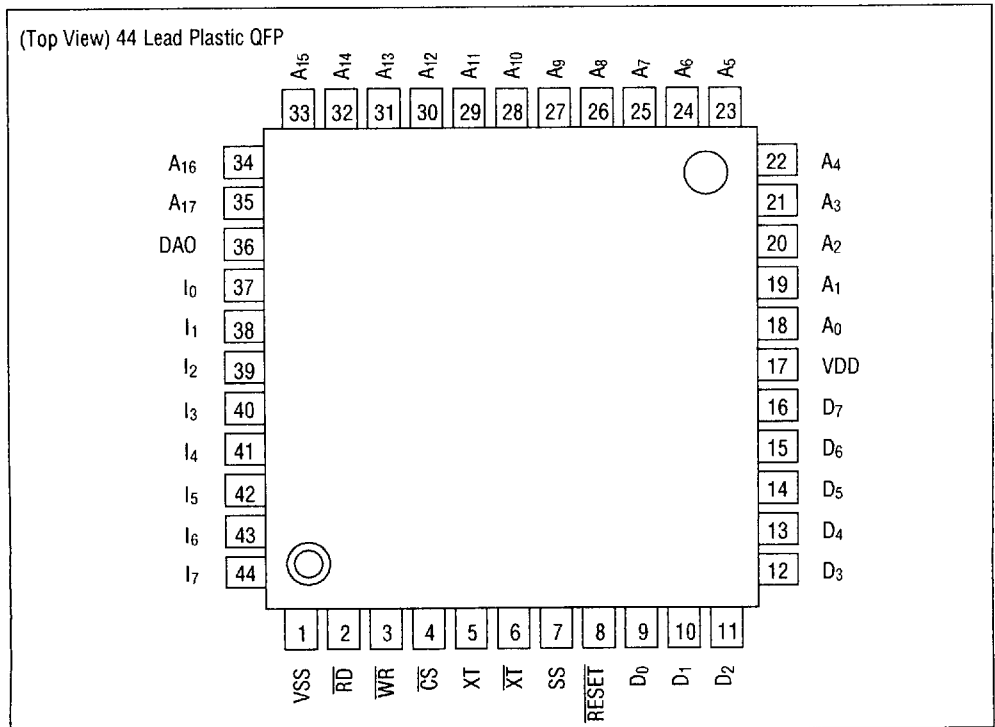
#### FEATURES

- Oki straight ADPCM algorithm
- Number of bits/sample: 4
- 18 address lines for external ROM
- 8-bit control bus for mode setting
- External memory capacity 2Mbit
- Interface with common CPU and MPU
- Clock frequency: 1 MHz to 5 MHz
- Sampling frequency:
  - 6.5 kHz and 8 kHz (@1.056 MHz clock)
  - 25.6 kHz and 32 kHz (@4.224 MHz clock)
- Number of words: 127 maximum
- Vocalization time: 60 sec maximum (@8 kHz, straight)
- Built-in DA converter: 12-bit
- DA output format: A-class
- Voice level attenuation: 0dB ~ -24dB on each channel (9 steps) -3dB/step
- Low power CMOS process
- 5 V single power supply
- 44-pin plastic QFP (QFP44-P-910-V1K) (QFP44-P-910-K)
- 42-pin plastic DIP (DIP42-P-600)

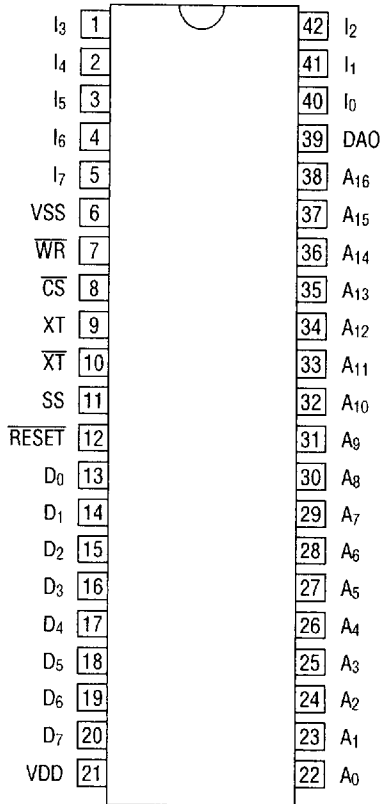
**BLOCK DIAGRAM**



**PIN CONFIGURATION**



(Top View) 42 Lead Plastic DIP



## ELECTRICAL CHARACTERISTICS

## • Absolute Maximum Ratings

Parameter	Symbol	Conditions	Value	Unit
Power supply voltage	VDD	Ta = 25°C	-0.3 ~ +7.0	V
Input voltage	V <sub>IN</sub>	Ta = 25°C	-0.3 ~ VDD + 0.3	V
Storage temperature	T <sub>stg</sub>	—	-55 ~ +150	°C

## • Recommended Operating Conditions

Parameter	Symbol	Conditions	Value	Unit
Power supply voltage	VDD	VSS = 0V	4.5 ~ +5.5	V
Operating temperature	T <sub>op</sub>	VSS = 0V	-40 ~ +85	°C
Oscillation frequency	f <sub>osc</sub>	VSS = 0V	1 ~ 5	MHz

## • DC Characteristics

(VDD = 4.5~5.5V, VSS = 0V, Ta = -40 ~ +85°C)

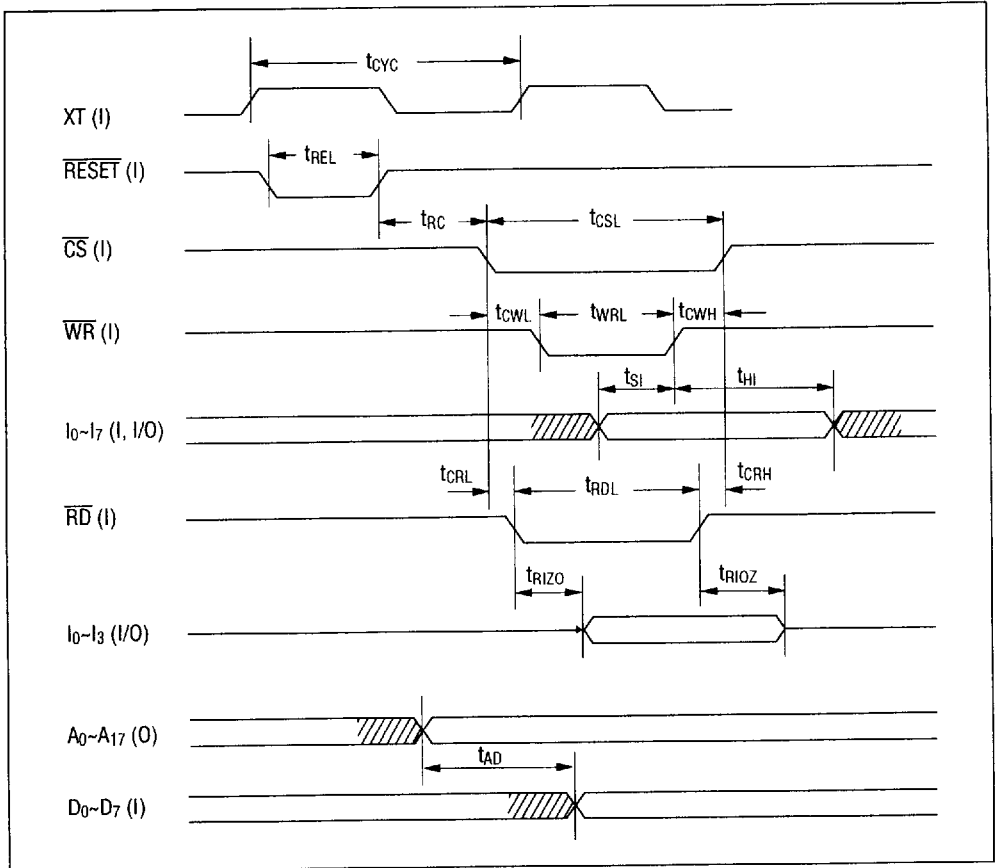
Parameter	Symbol	Conditions	Limits			Unit
			Min.	Typ.	Max.	
"L" input current	I <sub>IL</sub>	V <sub>IL</sub> = VSS	-10	—	—	μA
"H" input current	I <sub>IH</sub>	V <sub>IH</sub> = VDD	—	—	10	
"L" input voltage	V <sub>IL</sub>	—	—	—	0.8	V
"H" input voltage	V <sub>IH</sub>	—	2.4	—	—	
"L" output voltage	V <sub>OL</sub>	I <sub>OL</sub> = 0.8 mA	—	—	0.45	V
"H" output voltage	V <sub>OH</sub>	I <sub>OH</sub> = -40 μA	3.7	—	—	
Output leakage current	I <sub>LO</sub>	VSS ≤ V <sub>OUT</sub> ≤ VDD	-10	—	10	μA
Operating current	I <sub>DD</sub>	f <sub>osc</sub> = 5.0MHz	—	5	10	mA
DA output relative error	V <sub>DAE</sub>	No load	—	—	20	mV
DA output impedance	R <sub>DAOUT</sub>	—	—	15	—	kΩ

• AC Characteristics

(VDD = 4.5~5.5V, VSS = 0V, Ta = -40 ~ +85°C)

Parameter	Symbol	Min.	Typ.	Max.	Unit
Clock cycle	t <sub>CYC</sub>	200	-	-	ns
Clock duty cycle	f <sub>DUTY</sub>	40	50	60	%
RESET pulse width	t <sub>REL</sub>	100	-	-	ns
CS pulse width	t <sub>CSL</sub>	250	-	-	ns
WR pulse width	t <sub>WRL</sub>	200	-	-	ns
RD pulse width	t <sub>RDL</sub>	300	-	-	ns
RESET fall to CS fall	t <sub>RC</sub>	250	-	-	ns
CS fall to WR fall	t <sub>CWL</sub>	50	-	-	ns
WR raise to CS raise	t <sub>CWH</sub>	0	-	-	ns
Data set up time of I <sub>0</sub> -I <sub>7</sub> in respect to WR raise	t <sub>SI</sub>	80	-	-	ns
Data hold time of I <sub>0</sub> -I <sub>7</sub> in respect to WR raise	t <sub>HI</sub>	80	-	-	ns
RD fall to stable output of I <sub>0</sub> -I <sub>3</sub>	t <sub>RIZO</sub>	-	-	120	ns
RD raise to flow status output of I <sub>0</sub> -I <sub>3</sub>	t <sub>RIOZ</sub>	0	-	120	ns
CS fall to RD fall	t <sub>CRL</sub>	20	-	-	ns
RD raise to CS raise	t <sub>CRH</sub>	0	-	-	ns
Address stable (A <sub>0</sub> -A <sub>17</sub> ) to data input of D <sub>0</sub> -D <sub>7</sub>	t <sub>AD</sub>	-	-	5•t <sub>CYC</sub> +90	ns

• Timing Chart



**PIN DESCRIPTION**

Pin Name	Pin No.	I/O	Function		
I <sub>0</sub>	37	I/O	Instruction bus and condition outputs		
I <sub>1</sub>	38	I/O	These pins are inputs for phrase specification. Maximum number of phrases is 127. I <sub>0</sub> ~I <sub>3</sub> pins are also outputs of the operating state, busy state, for channels 1~4 and are further used to select the channel attenuation rate.		
I <sub>2</sub>	39	I/O			
I <sub>3</sub>	40	I/O			
I <sub>4</sub>	41	I			
I <sub>5</sub>	42	I			
I <sub>6</sub>	43	I			
I <sub>7</sub>	44	I			
$\overline{WR}$	3	I	Write enable input Data is written on the data bus of I <sub>0</sub> ~I <sub>7</sub> . The data is written when $\overline{WR}$ goes low.		
$\overline{RD}$	2	I	Read enable input The output busy state of channels 1~4 on the data bus of I <sub>0</sub> ~I <sub>3</sub> can be read using this input. A high level indicates busy.		
$\overline{CS}$	4	I	Chip select input Input "L" level either when $\overline{WR}$ signal is input or when $\overline{RD}$ signal is input.		
RESET	8	I	Reset input Reset condition is available by inputting "L" level. All functions are suspended during reset.		
A <sub>0</sub>	18	I	Address outputs These pins are to address the external ROM in which voice data is stored.		
A <sub>17</sub>	35	I			
D <sub>0</sub>	9	I	Voice data inputs		
D <sub>7</sub>	16	I			
SS	7	I		Sampling frequency select input When oscillation frequency is 1.056 MHz or 4.224 MHz, the following choices are available by inputting "H" level or "L" level to SS.	
				SS = "H"	SS = "L"
			Oscillation frequency 1.056 MHz	8 kHz	6.5 kHz
			Oscillation frequency 4.224 MHz	32 kHz	25.6 kHz
DAO	36	O	Voice synthesis output Voice synthesized analog signal is output from this pin.		
XT	5	I	Crystal oscillator pin		
$\overline{XT}$	6	O	Crystal oscillator pin		
VDD	17	-	Power supply pin		
VSS	1	-	Ground		

## FUNCTION EXPLANATION

## 1. Phrase Selection

Phrases are specified and read into the 2 byte data which consists of  $I_0 \sim I_7$  data bus.

The phrase selection data is latched when  $\overline{WR}$  goes high while  $\overline{CS}$  is low (L).

The format of the phrase specification input is as follows.

	$I_7$	$I_6$	$I_5$	$I_4$	$I_3$	$I_2$	$I_1$	$I_0$
1st Byte	1	Phrase selection data						
2nd Byte	Channel specification				Reduction specification			

As shown in the above chart,  $I_7$  of the first 1 data byte is always 1.  $I_0 \sim I_6$  of the first 1 data byte specifies the phrase. Phrase selection data has a selection of 127 phrases which corresponds to 0000001~1111111. The

phrase selection data is used for to  $A_3 \sim A_9$  address outputs, and they specify both start and stop address which are stored in the external ROM.

## Relation between Phrase Selection Data and ROM Address

Phrase selection data	-	$I_6$	$I_5$	$I_4$	$I_3$	$I_2$	$I_1$	$I_0$	-	-	-
External ROM address	$A_{17} \sim A_{10}$	$A_9$	$A_8$	$A_7$	$A_6$	$A_5$	$A_4$	$A_3$	$A_2$	$A_1$	$A_0$
Selection Not valid	0~0	0	0	0	0	0	0	0	0	0	0
Phrase 1	0~0	0	0	0	0	0	0	1	0	0	0
Phrase 2	0~0	0	0	0	0	0	1	0	0	0	0
Phrase 3	0~0	0	0	0	0	0	1	1	0	0	0
Phrase 127	0~	1	1	1	1	1	1	1	0	0	0

\* Phrases cannot be specified with all inputs = "0"



The second byte of data specifies the synthesis operation channel as well as specific channel reduction of the synthesized playback. The channel selection format is shown below.

It is not possible to specify multiple channels at the same time. For example, it is not possible to specify channel 1 and channel 3 simultaneously.

**Channel Specification**

Channel	$I_7$	$I_6$	$I_5$	$I_4$
1	0	0	0	1
2	0	0	1	0
3	0	1	0	0
4	1	0	0	0

### REDUCTION SELECTION

All 0's is considered as 0 dB of the analyzed sound itself. The reduction is made through

9 levels from about 0 dB to - 24 dB with the steps of about - 3 dB. Reduction format is shown below.

**Reduction Specification**

Attenuation level	$I_3$	$I_2$	$I_1$	$I_0$
0 dB	0	0	0	0
-3.2 dB	0	0	0	1
-6.0 dB	0	0	1	0
-9.2 dB	0	0	1	1
-12.0 dB	0	1	0	0
-14.5 dB	0	1	0	1
-18.0 dB	0	1	1	0
-20.5 dB	0	1	1	1
-24.0 dB	1	0	0	0

## 2. Voice Synthesis Channel Suspension

Voice synthesis operation of any channel can be suspended. Channel suspension is controlled by bits  $I_3 \sim I_6$  of data bytes  $I_0 \sim I_7$ . To suspend a channel, make  $I_7=0$ , while  $I_3 \sim I_6$  represent the channels which should be sus-

pending.

Channel suspension occurs even if multiple channels are selected. For example, if  $I_3 \sim I_6$  are all 1 and  $I_7=0$ , then channels 1-4 are suspended simultaneously.

Suspended channel	$I_7$	$I_6$	$I_5$	$I_4$	$I_3$	$I_2$	$I_1$	$I_0$
1	0	0	0	0	1	X	X	X
2	0	0	0	1	0	X	X	X
3	0	0	1	0	0	X	X	X
4	0	1	0	0	0	X	X	X

## 3. Data ROM

### 1) ADDRESS DATA

This specifies start and stop address of ADPCM speech data. One phrase start and end address consists of 8 bytes. The first 3

bytes show start address while the last 3 bytes show stop address. The other 2 bytes are empty.

By selecting the first address in which the start address is stored, the selected speech data is played back.

Address 0	$SA_1$
1	$SA_2$
2	$SA_3$
3	$EA_1$
4	$EA_2$
5	$EA_3$
6	EMPTY
7	EMPTY

Start addresses ( $SA_1 \sim SA_3$ ) and stop addresses ( $EA_1 \sim EA_3$ ) are stored according to the chart

shown below.

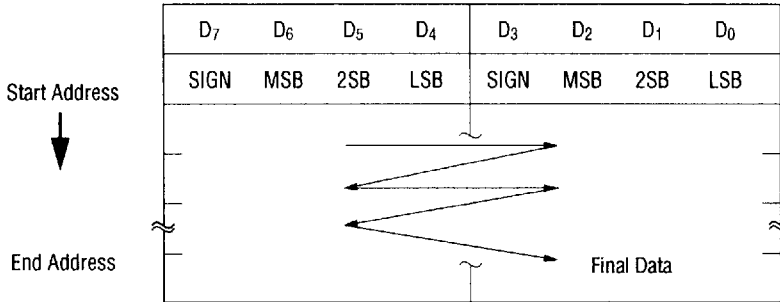
	$D_7$	$D_6$	$D_5$	$D_4$	$D_3$	$D_2$	$D_1$	$D_0$
$SA_1/EA_1$	0	0	0	0	0	0	$A_{17}$	$A_{16}$
$SA_2/EA_2$	$A_{15}$	$A_{14}$	$A_{13}$	$A_{12}$	$A_{11}$	$A_{10}$	$A_9$	$A_8$
$SA_3/EA_3$	$A_7$	$A_6$	$A_5$	$A_4$	$A_3$	$A_2$	$A_1$	$A_0$

2) ADPCM SPEECH DATA

ADPCM speech data consists of (2) 4-bit samples. So, 1 byte stores 2 samples. Data arrangement proceeds from higher rank bits ( $D_4 \sim D_7$ ) to lower rank bits ( $D_0 \sim D_3$ ). The storage of speech data should always be

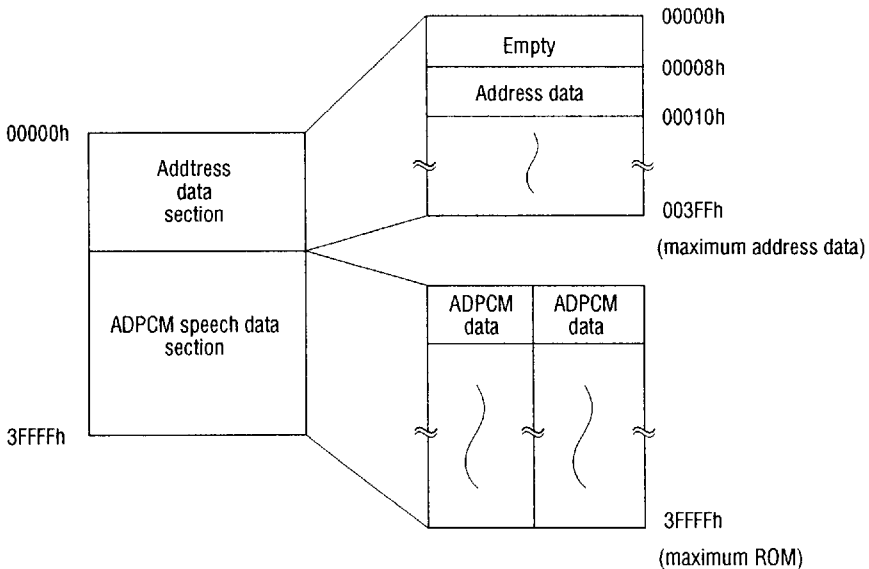
ended with the lower rank bit. So, always store an even number of samples.

Speech data is produced by Speech Development Tool AR76-202.



3) DATA ROM STRUCTURE

The following chart shows the memory map of the source data ROM.



When the maximum 127 phrases are selected in address data section, the data is written up to ROM address 003FFh.

When 1 phrase is selected, address data is written from ROM address 00008h to 0000Fh, and the rest is used as the ADPCM data section.

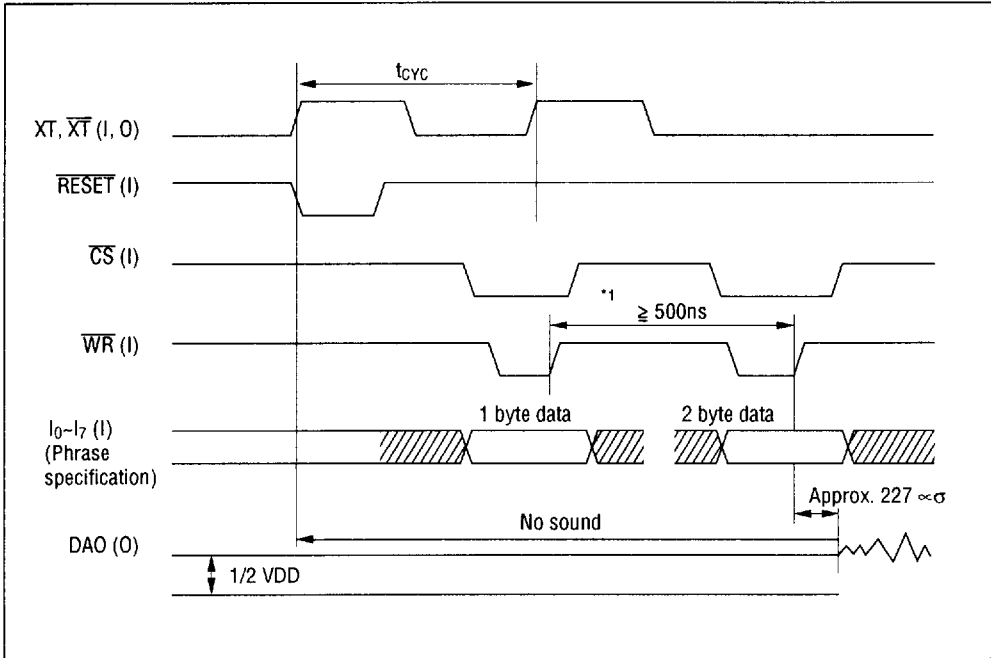
**FUNCTIONAL DESCRIPTION**

**1. Phrase Selection Input**

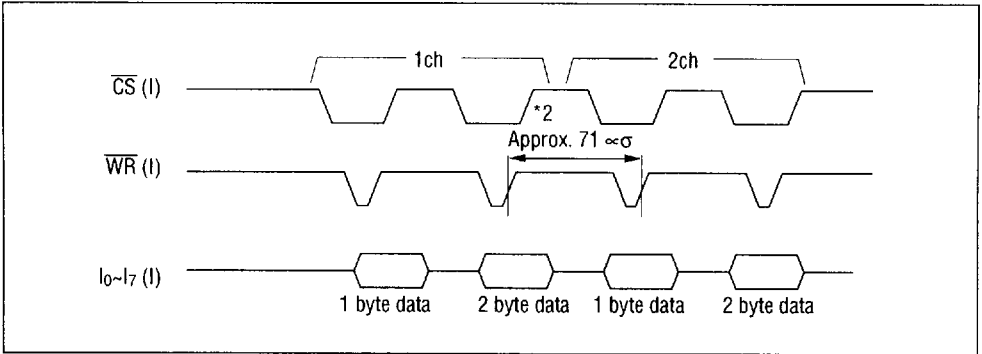
This procedure is to input phrase selection data onto the data bus inputs  $I_0-I_7$ . The data is latched internally when  $\overline{WR}$  rises from "L"

to "H", while  $\overline{CS}$  remains "L".

Voice synthesis operation does not start till the second byte is fully latched.



**Note:** Phrase selection is from channel 1 to channel 4 continuously.  
 \*1 An interval of 75  $T_{CYC}$  (max.) is needed between phrases.

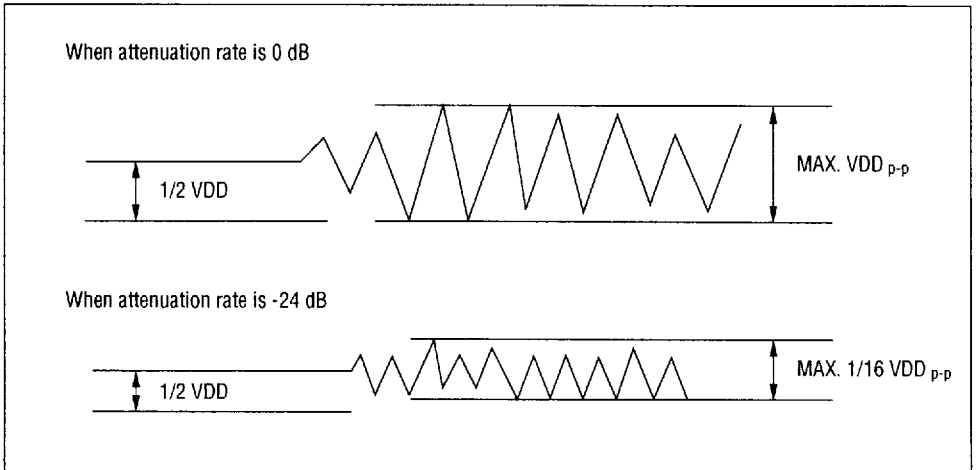


**Note:** \*2 Oscillation frequency = 1 056 MHz SS = "L"

Voice synthesis playback can be started from any channel, 1 to 4. The arrangement of each channel can be in any order.

The second byte of the phrase selection data contains the phrase attenuation data in bits D0 - D3. Synthesized data is attenuated in -3 dB steps from 0 dB to -24 dB.

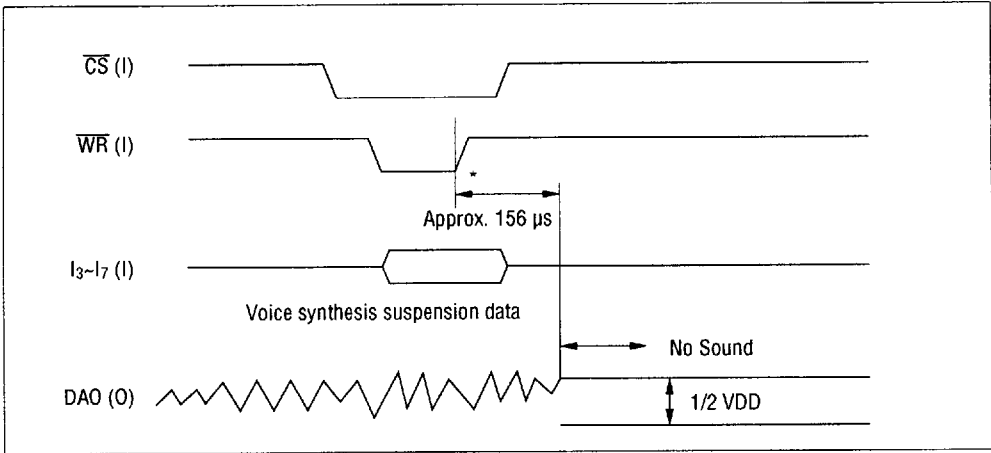
**2. Attenuation of Synthesized Speech**



### 3. Speech Synthesis Channel Suspension

This is accomplished by writing synthesis channel suspension data onto data bus inputs  $I_3 \sim I_7$ . The data is latched internally when  $\overline{WR}$  goes from "L" to "H" while  $\overline{CS}$

remains active (L). Since synthesis suspension data is 1 byte data, synthesis operation is suspended right after the rising edge of  $\overline{WR}$ . Multiple channels can be specified, making it possible to suspend channels 1~4 simultaneously.

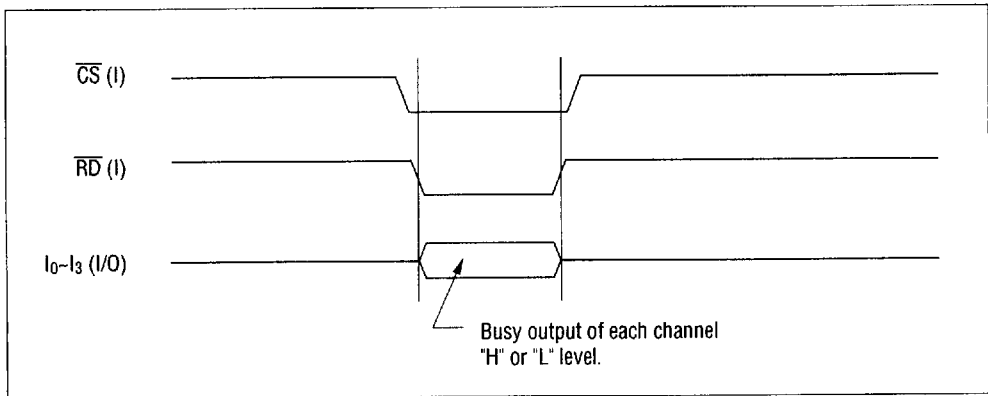


**Note:** \* Oscillation frequency = 1.056 MHz SS = "L"

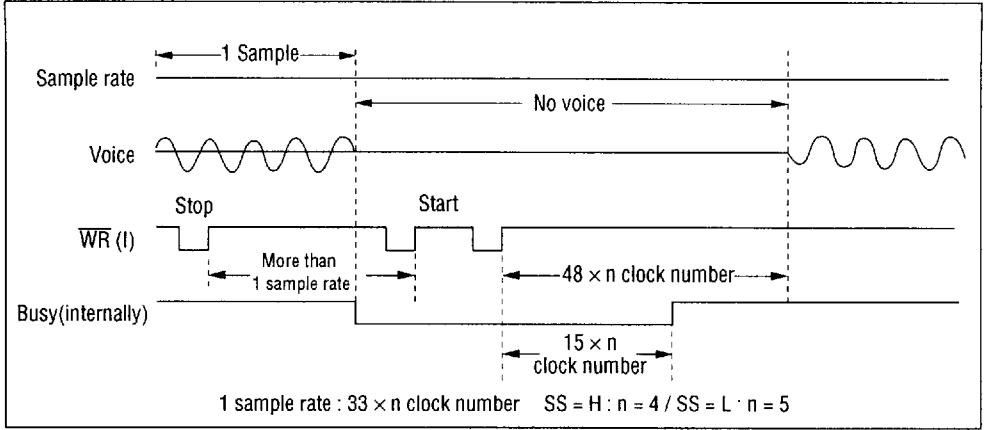
### 4. Reading the Busy Status

While  $\overline{CS}$  is "L" and  $\overline{RD}$  is "L", each operation

state, the busy state of channels 1~4 is output on  $I_0 \sim I_3$ . "H" is output during synthesized playback.



5. Start and Stop of 1 Channel

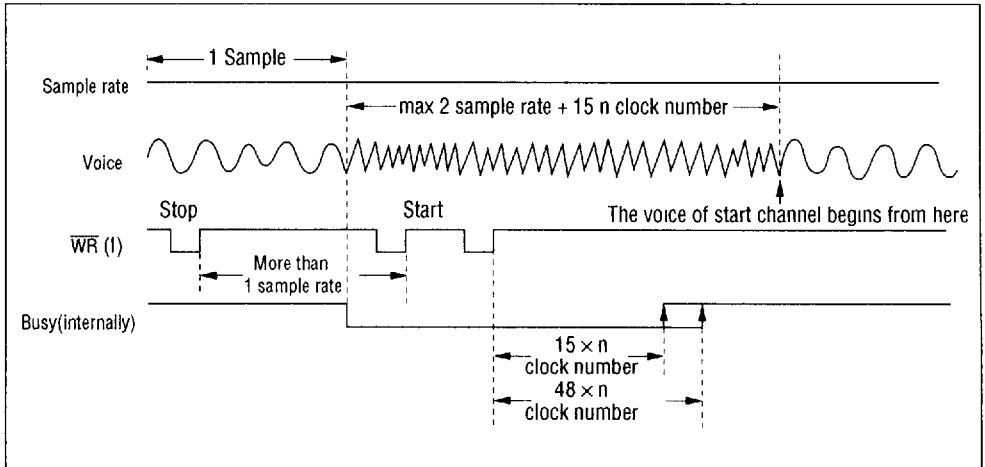


**Start and Stop of Signal Channel**

When a single channel (either of channels 1-4) starts again after it has stopped, the first write for start must be input with a delay of more than one sample rate from the stop write as shown in the figure above. When stop is entered, voice playback stops all the

next sample and BUSY becomes "L".

When start is entered again, voice is output after  $48 \times n$  clock from the second byte write. BUSY becomes "H" after  $15 \times n$  clock internally.



**Start and Stop in Plural Channels**

When channels are operating, the first byte write for start must be input with a delay of more than one sample rate from stop write.

input is output after a maximum 2 samples =  $15 \times n$  clocks from the preceding sample point.

The channel where stop was input, stops at every sample.

BUSY becomes "H" during the  $48 \times n$  clock time.

Voice off the channel where stop was again

6. Application Circuit

