M50805-XXXP,FP/M50806-XXXP,FP

SINGLE-CHIP CMOS SPEECH SYNTHESIZER

DESCRIPTION

The M50805-XXXP, FP/M50806-XXXP, FP, are single chip C-MOS PARCOR speech synthesizers and contain a speech data, ROM, a clock generator, a D-A converter and a speaker drive circuit.

The differences among the M50805-XXXP, FP/M50806-XXXP, FP are shown in the following table. The M50805-XXXP will be discussed below.

Type	Operating supply voltage range	Outline
M50805-XXXP	V_{CC}=3.0~5.5V	22 pin, plastic DIP
M50805-XXXFP	V_{CC}=3.0~5.5V	24 pin, plastic DIP
M50806-XXXP	V_{CC}=2.1~3.5V	22 pin, plastic DIP
M50806-XXXFP	V_{CC}=2.1~3.5V	24 pin, plastic DIP

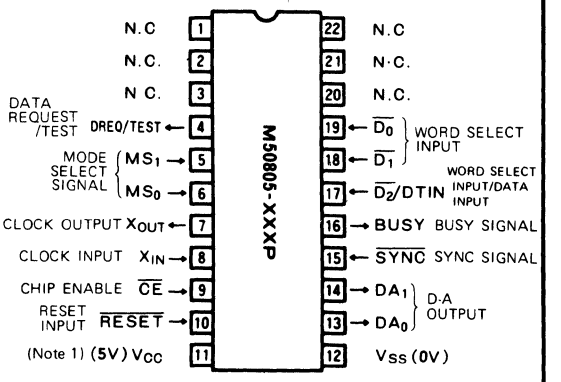
FEATURES

- Speech synthsis time . . . . . 5 seconds (max)
- Number of words selection . . . . . 8 (max)
- Melody generation possible . . . . . 20 seconds (max)
- Automatic power down function
- Built-in speaker drive circuit
- Built-in D-A converter . . . . . ±6 bits PWM method
- Low power dissipation due to C-MOS process
  - Supply current in operating . . . 2mA (max)
  - in standby . . . . 10μA (max)
- Built-in clock generator

APPLICATION

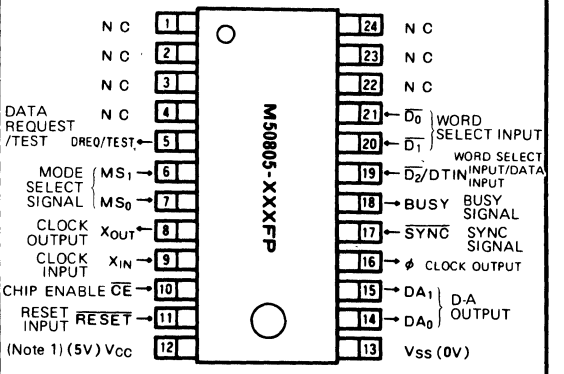
- Home appliances
- Toys
- Watches, cameras, desk-top calculators
- Alarms

PIN CONFIGURATION (TOP VIEW)



Outline 22P4 (M50805-XXXP)
(M50806-XXXP)

Note 1 For M50806-XXXP, FP the value is 3V



Outline 24P2W (M50805-XXXFP)
(M50806-XXXFP)

NC NO CONNECTION

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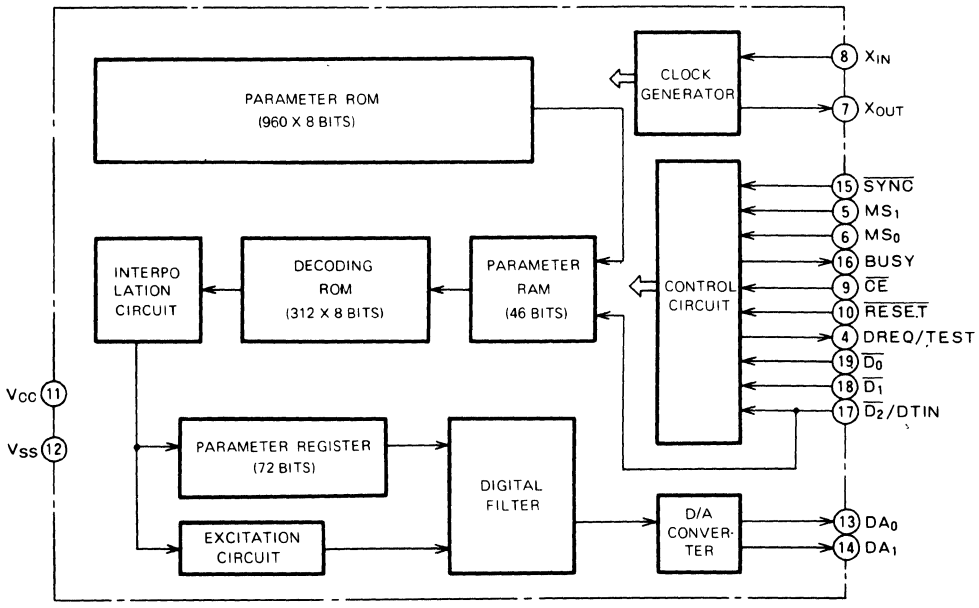
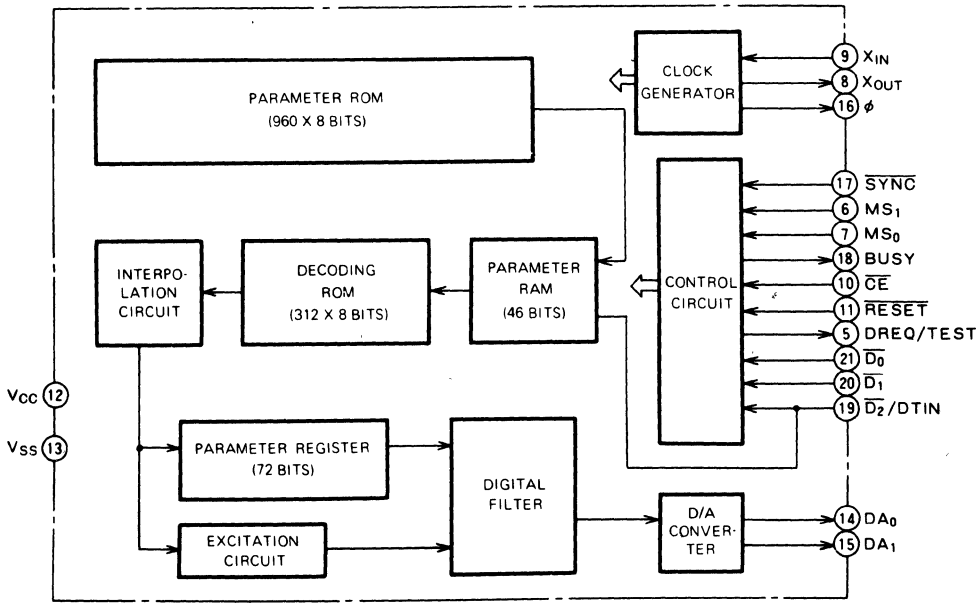
BLOCK DIAGRAM

M50805-XXXP/M50806-XXXP



M50805-XXXFP/M50806-XXXFP



PIN DESCRIPTION

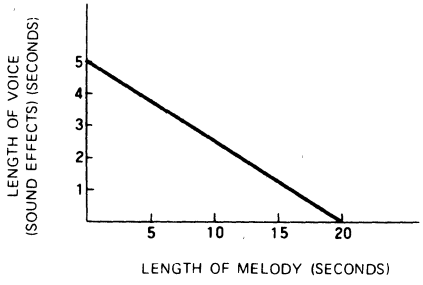
Pin	Name	Input or output	Pull-up resistor Yes/No	Function
V_{CC}	Supply voltage input	Input		Positive voltage supply pin
V_{SS}	Supply voltage input	Input		Ground pin
MS_0, MS_1	Mode select signal	Input		Depending on the MS_0, MS_1 signal there are 4 modes that may be selected, key input mode, microcomputer control mode, external memory mode and test mode
$\overline{D_0}$, $\overline{D_1}$	Word select input	Input	Option	When in the key input mode, voice generation begins whenever $\overline{D_0}$, $\overline{D_1}$, or $\overline{D_2}$ becomes low-state A maximum of 7 words may be designated When in the microcomputer control mode, a maximum of addresses for 8 words may be designated with $\overline{D_0}$, $\overline{D_1}$, $\overline{D_2}$ When in the external memory mode, speech parameters are inputted via DTIN
$\overline{D_2}$/DTIN	Word select input/data input			
$\overline{SYNC}$	Synchronous signal	Input	Option	When in microcomputer control mode, the SYNC signal initiates $\overline{D_0} \sim \overline{D_2}$ address read, starting voice generation When in external memory mode, voice generation is started
BUSY	Busy signal	Output		Output signal pin for indicating that voice generation is in progress
$\overline{CE}$	Chip enable	Input		When the pin CE is high-level, the internal power supply is off and, when low-level, the internal power supply is on
DA_0, DA_1	D-A output	Output		±6 bit PWM output
X_{IN}	Clock input	Input		These pins are for connection to a ceramic resonator for the clock generator, or they can be connected to an external resistance R for CR clock generation When using an external clock input, connect the oscillator source to X_{IN} pin and open X_{OUT}
X_{OUT}	Clock output	Output		
DREQ/TEST	Data request/test	Output		This is the data request signal output pin for external memory During test mode this is the test output pin
$\overline{RESET}$	Reset input	Input	Yes	When power input is first applied the internal registers are cleared and D-A output is muted
ϕ (M50805-XXXFP, M50806-XXXFP)	Clock output	Output		160kHz clock output pin

BASIC FUNCTION BLOCKS

Parameter ROM

A 960 word x 8 bit constructed mask ROM, it stores speech parameters.

There is enough memory storage for about 5 seconds of voice and sound effects and in the case of melody about 20 seconds. Voice, sound effects and melody can be stored together. In this case each length of time can be calculated by the following diagram.



Parameter RAM

This has 46 bit capacity for temporary storage of one frame of speech parameters (amplitude, pitch, and K-parameters)

Decoding ROM

Decodes the speech parameters that had been coded by the parameter RAM. It has 312 word x 8 bit construction.

Interpolation Circuit

Provides a linear interpolation of K-parameters, pitch and amplitude every 2.5ms.

Exitation Circuit

Having both a pulse generator and a white noise generator, it generates voiced and unvoiced sounds.

Parameter Register

A register used to temporarily store data which has been linearly interpolated.

Digital Filter

It is a 12 bit 8 stage lattice digital filter.

Control Circuit

According to the external input, it controls LSI operation.

Mode Select Signal MS_0, MS_1

Depending on MS_0, and MS_1, four kinds of mode may be selected as shown in the following diagram.

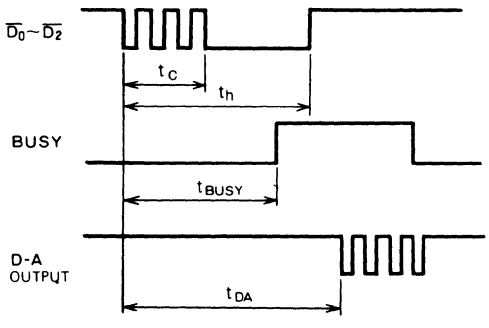
Mode	MS_0	MS_1	Use
Key input mode	H	L	Suitable for use when not editing phrases is necessary
Microcomputer control mode	L	L	Suitable for use when the editing of phrases is necessary
External memory mode	L	H	For use when an external memory such as EPROM and RAM is used
Test mode	H	H	For test purposes

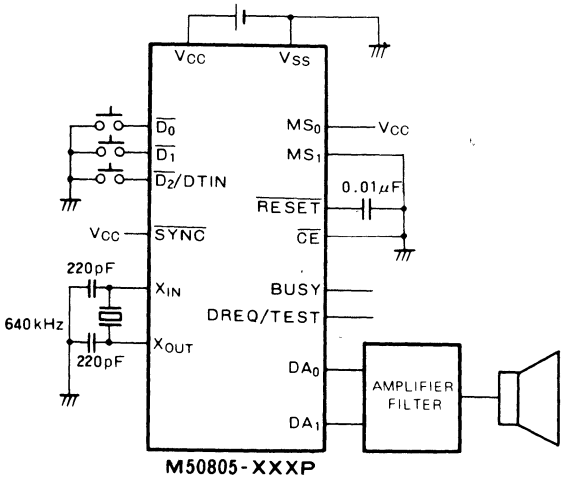
(1) Key Input Mode

Pin conditions

- Mode select signal pins . . . . . MS_0 is connected to V_{CC} and MS_1 to V_{SS}.
- $\overline{SYNC}$ pin . . . . . connects to V_{CC}.
- $\overline{CE}$ pin . . . . . connects to V_{SS}.
- $\overline{D_0} \sim \overline{D_2}$ pins . . . . when any of these pins is low-level, speech generation begins automatically. Seven kinds of phases may be selected.

Input/output timing chart





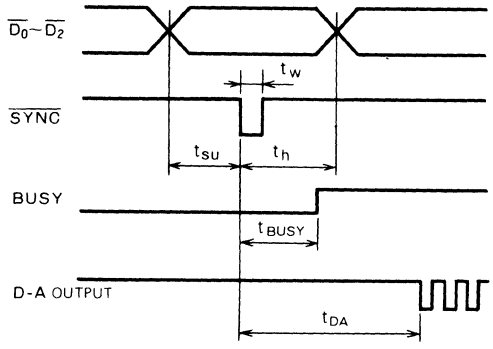
Symbol	Parameter	Min	Typ	Max	Unit
t_C	Key debounce protection time	5			ms
t_h	Data hold time	50			ms
t_{BUSY}	BUSY output delay	50			ms
t_{DA}	Speech output delay	100			ms

(2) Microcomputer Control Mode

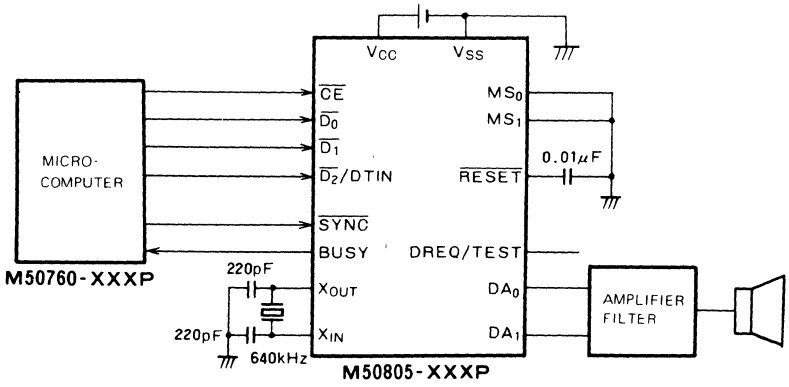
Pin conditions

- Mode select signal pins . . . Both MS_0 and MS_1 are connected to V_{SS}.
- $\overline{SYNC}$ signal . . . . When it becomes low-level for 18μs, data of both $\overline{D_0} \sim \overline{D_2}$ is latched and speech generation begins.
- $\overline{D_0} \sim \overline{D_2}$ pins . . . . Eight kinds of phrases may be selected.

Input output Timing chart



Symbol	Parameter	Min	Typ	Max	Unit
t_{su}	Data setup time	0			μs
t_h	Data hold time	25			μs
$t_{w(SYNC)}$	SYNC pulse width	18			μs
t_{BUSY}	BUSY output delay	12		25	μs
t_{DA}	Speech output delay	40		60	ms

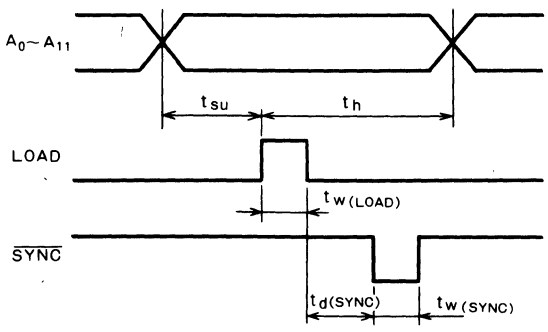


(3) External Memory Mode

Pin conditions

- Mode select signal pins . . . MS_0 is connected to V_{SS} and MS_1 to V_{CC}.
- $\overline{SYNC}$ pin . . . . . When it becomes low-level for more than 18μs, speech generation begins.
- $\overline{D_2}$/DTIN pin . . . . . Receives serial data from external ROM.
- DREQ/TEST pin . . . . . Outputs the read pulse for external ROM data
- $\overline{D_0}$, $\overline{D_1}$ pins . . . . . Connected to V_{CC}.

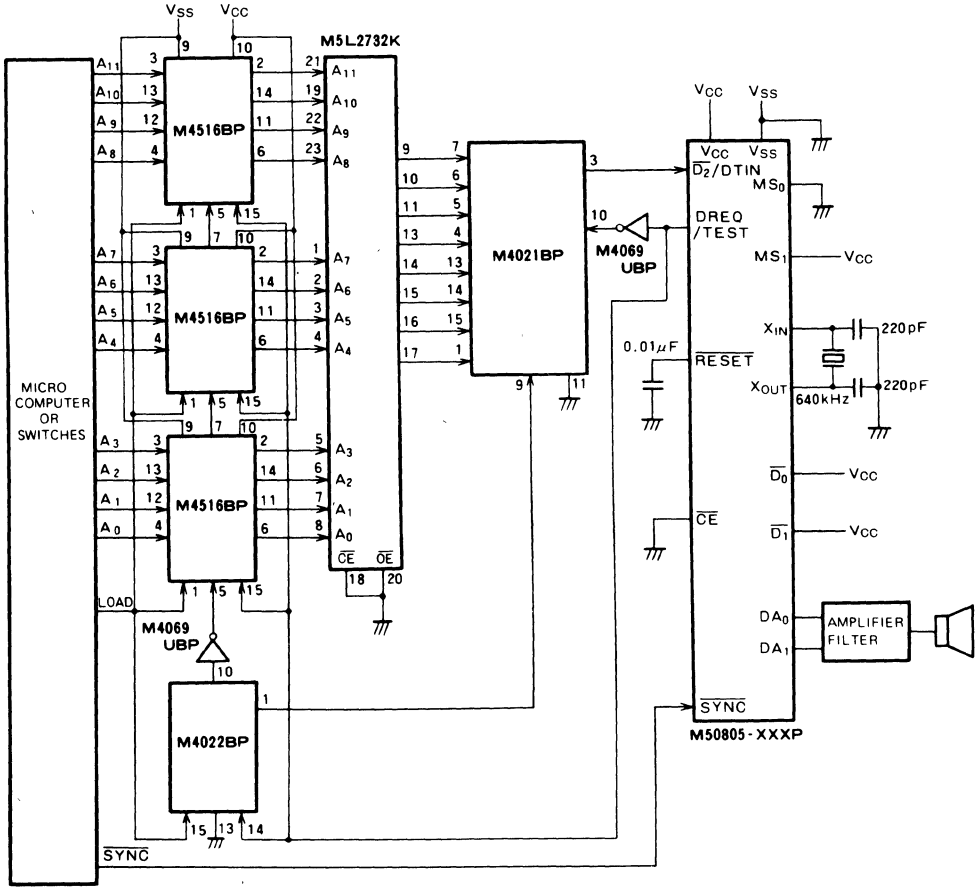
Input timing chart



Timing Requirement

Symbol	Parameter	Min	Typ	Max	Unit
t_{su}	Data set up time	1			μs
t_h	Data hold time	2			μs
$t_{w(LOAD)}$	LOAD pulse width	1			μs
$t_{d(SYNC)}$	SYNC delay time	0			μs
$t_{w(SYNC)}$	SYNC pulse width	18			μs

Application Example in the External Memory Mode



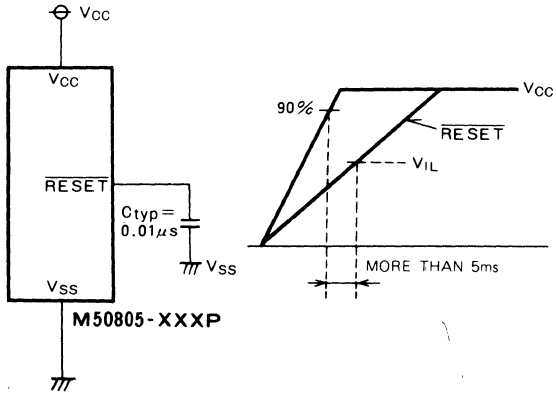
Input/Output Pins

Chip enable pin (CE)

$\overline{CE}$	Mode	Function
H	All modes	When input is high-level, internal power supply is turned off and device enters standby condition In standby, both DA_0 and DA_1 become high-level
L	Microcomputer control mode/ external memory mode	When input is low-level, internal power supply is turned on At this time a reset signal is automatically generated and device enters power on-initialization sequence
	Key input mode	The internal power supply is turned on after receiving key input At this time a reset signal is automatically generated and device enters power on-initialization sequence After voice generation has ceased, automatic power down circuit operates and device enters key input waiting state While in the waiting state, BUSY becomes low-level and both DA_0 and DA_1 become high-level

Reset Pin ($\overline{RESET}$)

The reset pin must become low-level in more than 5ms after power has been applied and the supply voltage has reached 90%.

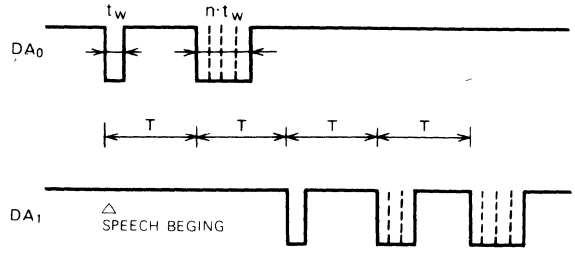


Busy Pin (BUSY)

Mode	BUSY output
Microcomputer control mode External memory mode	The output of this pin becomes high-level during each of the following Voice generation, power-on-initialization and standby It is necessary to ensure that the BUSY signal is low-level prior to generating the voice start signal If the BUSY signal is high-level, the voice generation start signal has no effect
Key input mode	The output of this pin becomes high-level during voice generation and low-level during power-on-initialization and while in the waiting condition It is necessary to ensure that the BUSY signal is low-level prior to generating the voice start signal If the BUSY signal is high-state, the voice start signal has no effect

D-A Output Circuit (DA_0, DA_1)

D-A output is PWM (pulse width modulation) and outputted from pin DA_0 when positive and pin DA_1 when negative.



T SAMPLING PERIOD 100μs (Typ)
t_w MINIMUM PULSE WIDTH 1 56μs (Typ) f_{OSC}=640kHz

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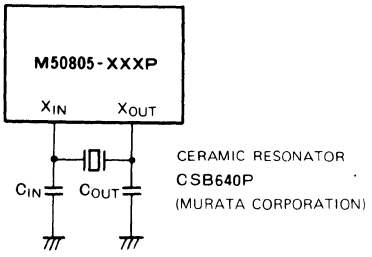
Clock Generator

The device contains a clock generator which can generate a clock signal when either a ceramic resonator or resistor is connected externally between the clock output and input pins (X_{IN}, X_{OUT}).

When a clock signal from an external source is being used, connect the source of the clock oscillator to pin X_{IN} and open pin X_{OUT}. Designate whether or not a ceramic resonator or a resistor will be used in the clock oscillator circuit as a mask option.

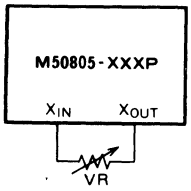
Circuit examples are given below.

Externally connected ceramic resonator circuit



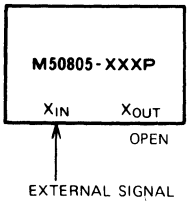
	M50805-XXXP/FP	M50806-XXXP/FP
C_{IN}	220pF	100pF
C_{OUT}	220pF	100pF

Externally connected resistor



VR : 200kΩ

External clock input circuit



EXTERNAL CLOCK INPUT CIRCUIT

MASK OPTION

The following mask options are available, specifiable at the time of ordering maskings.

(1) Continuous/single voice generation selecting specification

Continuous voice generation:

Voice generation continues as long as $\overline{D_0} \sim \overline{D_2}$ is kept continuously low-level in the key input mode or $\overline{SYNC}$ is kept continuously low-level in the microcomputer control mode.

Single voice generation:

Voice generation occurs only once when the above conditions are met. To generate the voice again it is necessary to return either the $\overline{D_0} \sim \overline{D_2}$ or the $\overline{SYNC}$ to high-level one time and then to low-level again.

(2) Specifications concerning the inclusion or exclusion of pull-up resistors for the word select input pins $\overline{D_0}$, $\overline{D_1}$, $\overline{D_2}$, and the synchronous signal $\overline{SYNC}$.

(3) Specifications concerning whether or not a ceramic resonator or a resistor will be used in the oscillator circuit.

ELECTRICAL CHARACTERISTICS OF THE M50805-XXXP/M50805-XXXFP

ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Conditions	Ratings	Unit
V_{CC}	Supply voltage	With respect to the V_{SS} Pin	−0.3~7	V
V_I	Input voltage		−0.3~7	V
Pd	Maximum power dissipation	Ta=25°C	150	mW
Topr	Operating temperature		−10~70	°C
Tstg	Storage temperature		−40~125	°C

RECOMMENDED OPERATING CONDITIONS (Ta=−10~70°C, unless otherwise noted)

Symbol	Parameter	Limits			Unit
		Min	Typ	Max	
V_{CC}	Supply voltage	3	5	5.5	V
V_{SS}	Supply voltage	0	0	0	V
f_{OSC}	Oscillation frequency		640		kHz

ELECTRICAL CHARACTERISTICS (Ta=−10~70°C, f_{OSC}=640±20kHz, V_{CC}=3~5.5V, unless otherwise noted)

Symbol	Parameter	Test conditions	Limits			Unit
			Min	Typ	Max	
V_{OH}	High level output voltage BUSY, DREQ/TEST	I_{OH}=0.1mA	V_{CC}-0.8			V
V_{OL}	Low level output voltage BUSY, DREQ/TEST	I_{OL}=0.4mA			0.8	V
I_{OH}	High-level output current DA_0, DA_1	$V_{OH}=V_{CC}-0.4V$	1			mA
I_{OL}	Low level output current DA_0, DA_1	V_{OL}=0.4V	1.6			mA
I_{DA}	D/A output current	Resistor between DA_0 and DA_1 10Ω at V_{CC}=5V		45		mA
I_{OC}	Supply current (in operation)	Unloaded input/output			2	mA
I_{SC}	Supply current (standby)	Unloaded input/output			10	μA
I_{IL}	Input leak current	$V_I=0\sim V_{CC}$			±1	μA
R_I	Pull-up resistor $\overline{D_0}$~$\overline{D_2}$	$V_I=V_{SS}$, V_{CC}=5V		180		kΩ
R_I	Pull-up resistor $\overline{SYNC}$	$V_I=V_{SS}$, V_{CC}=5V		300		kΩ
V_{IH}	High-level input voltage	V_{CC}=4~5.5V	V_{CC}-1		V_{CC}	V
V_{IL}	Low level input voltage	V_{CC}=4~5.5V	0		1	V

ELECTRICAL CHARACTERISTICS OF THE M50806-XXXP/M50806-XXXFP

ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Conditions	Limits	Unit
V_{CC}	Supply voltage	With respect to the V_{SS} pin	−0.3~7	V
V_I	Input voltage		−0.3~7	V
P_d	Maximum power dissipation	Ta=25°C	150	mW
T_{opr}	Operating temperature		−10~70	°C
T_{stg}	Storage temperature		−40~125	°C

RECOMMENDED OPERATING CONDITIONS (Ta=−10~70°C, unless otherwise noted)

Symbol	Parameter	Limits			Unit
		Min	Typ	Max	
V_{CC}	Supply voltage	2.1	3	3.5	V
V_{SS}	Supply voltage	0	0	0	V
f_{OSC}	Oscillation frequency		640		kHz

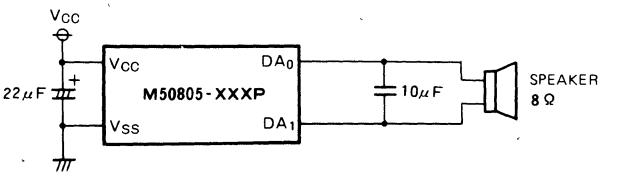
ELECTRICAL CHARACTERISTICS (Ta=−10~70°C, f_{OSC}=640±20kHz, V_{CC}=2.1~3.5V, unless otherwise noted)

Symbol	Parameter	Test conditions	Limits			Unit
			Min	Typ	Max	
V_{OH}	High-level output voltage BUSY, DREQ/TEST	I_{OH}=0.1mA	V_{CC}-0.8			V
V_{OL}	Low-level output voltage BUSY, DREQ/TEST	I_{OL}=0.4mA			0.8	V
I_{OH}	High-level output current DA_0, DA_1	$V_{OH}=V_{CC}-0.4V$	0.5			mA
I_{OL}	Low-level output current DA_0, DA_1	V_{OL}=0.4V	0.8			mA
I_{DA}	D/A output current	Resistor between DA_0 and DA_1 10Ω at V_{CC}=3V		20		mA
I_{OC}	Supply current (in operation)	Unloaded input/output			1	mA
I_{SC}	Supply current (standby)	Unloaded input/output			10	μA
I_{IL}	Input leak current	$V_I=0\sim V_{CC}$			±1	μA
R_I	Pull-up resistor $\overline{D_0}$~$\overline{D_2}$	$V_I=V_{SS}$, V_{CC}=3V		320		kΩ
R_I	Pull-up resistor $\overline{SYNC}$	$V_I=V_{SS}$, V_{CC}=3V		560		kΩ
V_{IH}	High-level input voltage		$\frac{3}{4}V_{CC}$		V_{CC}	V
V_{IL}	Low-level input voltage		0		$\frac{1}{4}V_{CC}$	V

APPLICATION CIRCUIT EXAMPLES

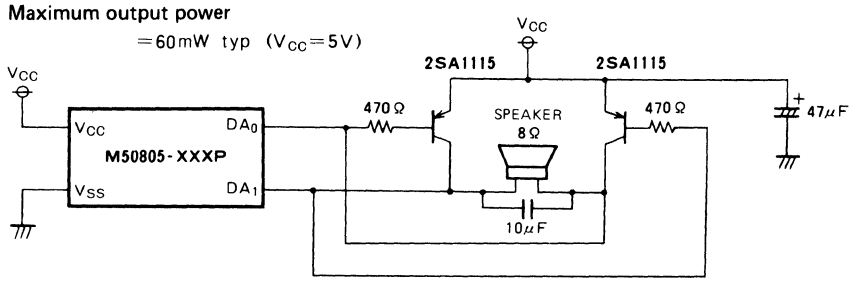
Speaker Drive Circuit

a) Direct drive
Maximum output power
=10mW typ (V_{CC}=5V)

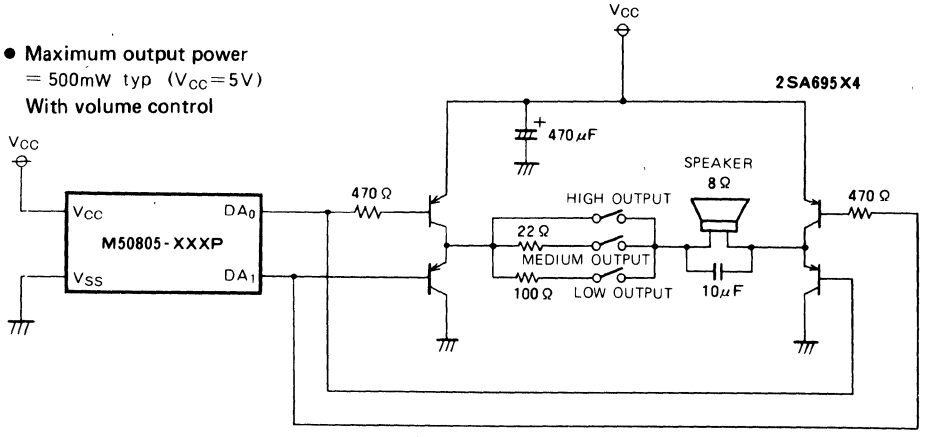


b) Using an amplifier

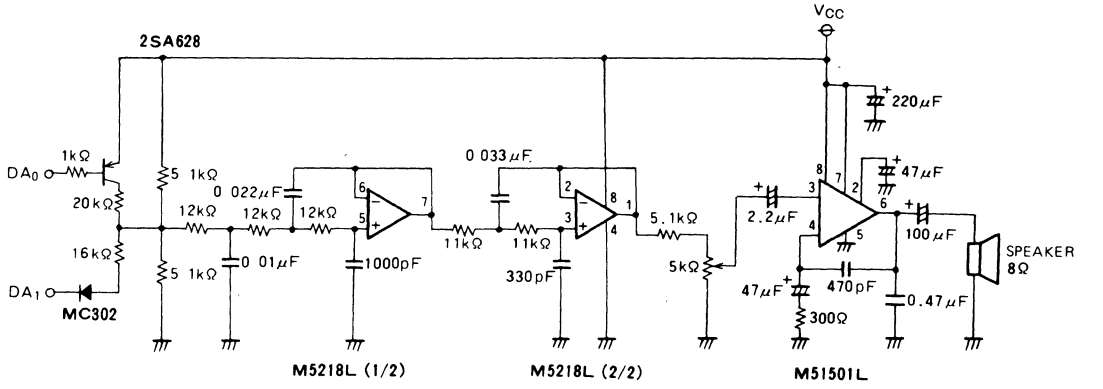
- Maximum output power
=60mW typ (V_{CC}=5V)



- Maximum output power
= 500mW typ (V_{CC}=5V)
With volume control



c) Filter amplifier circuit
Operational amplifier used as a filter amplifier circuit
Maximum output power = 200mW typ.(V_{CC}=5V)



METHOD OF ORDERING SPEECH ANALYSIS AND MASK ROM

Steps taken in ordering

(1) Decisions concerning specifications

Decide the specifications concerning the content of the speech, the language, the speaker, etc.

(2) Ordering

When ordering, ensure that the necessary information has been entered in both the speech Analysis Request Form and Speech List. Be sure to also include the musical score if a melody is necessary.

(3) Recording

A recording of the original speech is made in a studio using an experienced narrator. Attendance is permitted for either confirmation or giving speech instructions.

(4) Analysis

Speech parameters of the voice are analized through use of a voice analysis system centered on a MELCOM 70/40 mini-computer in the Mitsubishi Speech Center. The data is written on a EPROM, and along with the Analysis Approval Form and Masking Approval Form is forwarded to the customer.

(5) Sound evaluation

The delivered EPROM is inserted in either Mitsubishi's voice evaluation board or a similar device and the quality of the synthesized speech is confirmed. If the quality is found to be acceptable, the Analysis Approval Form and the Masking Approval Form are to be signed and returned to Mitsubishi.

(6) Mask production

A MASK ROM is produced from the EPROM data. An ES sample for the confirmation of electrical characteristics is sent along with an ES Approval Form to the customer.

(7) Sample evaluation

If results of ES sample evaluation prove to be acceptable the ES Approval Form is to be signed and returned to Mitsubishi.

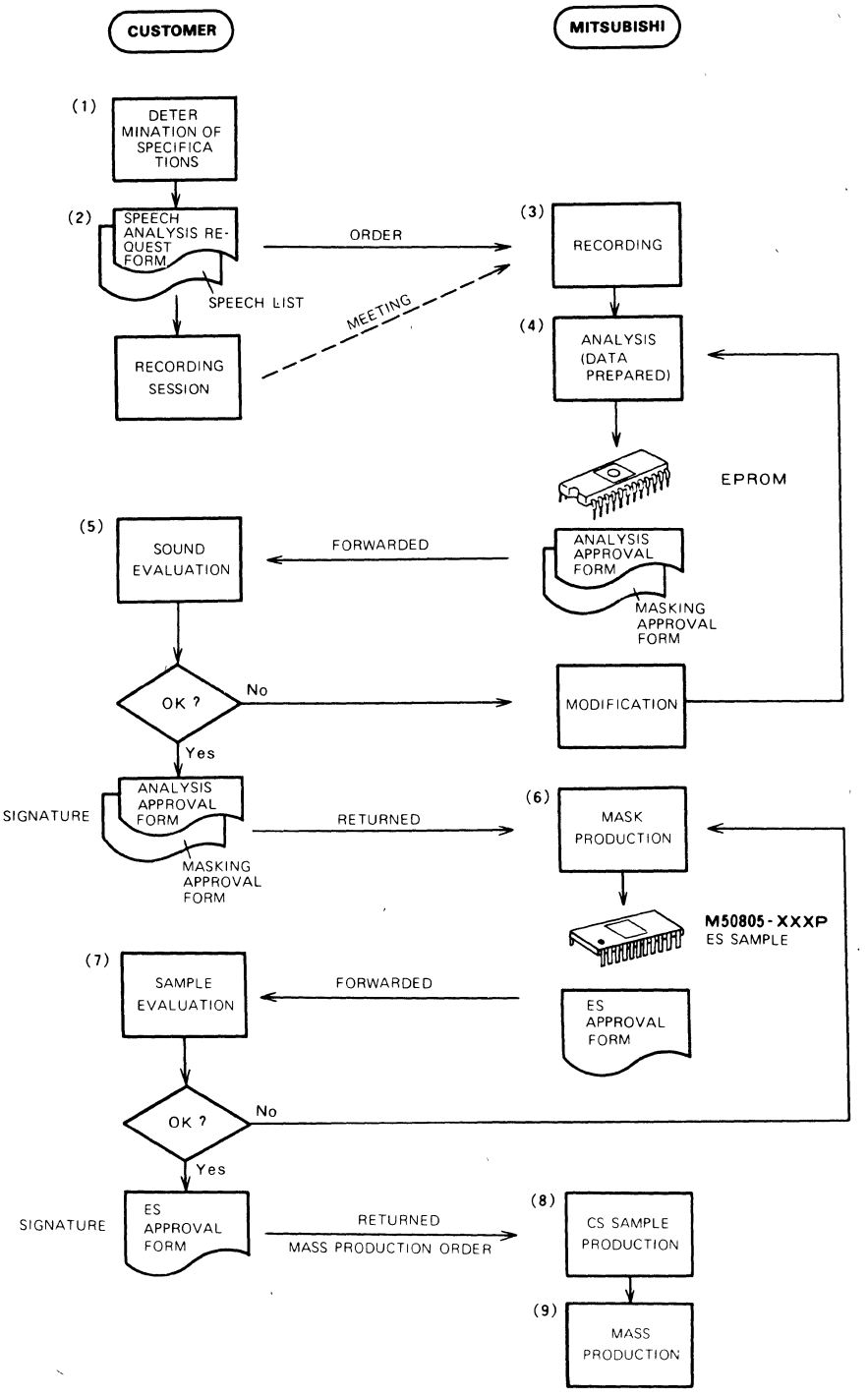
(8) CS sample production

This is a sample having the same characteristics as the mass produced device.

(9) Mass production

After production of the CS sample mass production is begun.

ORDERING FLOW CHART



MITSUBISHI SPEECH SYNTHESIZER LSI
M50805-XXXP, FP
M50806-XXXP, FP
SPEECH ANALYSIS REQUEST FORM

	Signature
Customer Company name _____ Company address _____ Tel _____ Company contact _____ Date _____	Prepared Approved

1. Specifications

Recording
(necessary/unnecessary)
└ Language _____ Sex _____

Analysis
(necessary/unnecessary)
- Length of speech _____ seconds
- Length of melody _____ seconds
- Voice evaluation board (necessary/unnecessary)

Mask
(necessary/unnecessary)

2. Schedule

	Recording →	Analysis completion →	Analysis and masking approval →	ES →	CS →	MP
Desired date (month/day)	(/)	(/)	(/)	(/)	(/)	(/)
		EPROM 1 set		_____ unit(s)	_____ unit(s)	_____ unit(s) /month
					Lot _____	unit(s)

Mitsubishi Entry Column

Parameter	Type	Order number	Amount	Cost	Order date	Completion date	Transfer of money
Recording	VOICE-SOFT	00-38-					
Analysis	VOICE-SOFT	00-38-					
Voice evaluation board	VOICE-SOFT	00-38-					
Mask	VOICE-MASK						

Notes

Mask ROM number	

M50805-XXXP, FP / M50806-XXXP, FP SPEECH LIST

No.	Address			Speech content	Notes
	$\overline{D_2}$	$\overline{D_1}$	$\overline{D_0}$		
1	H	H	L		
2	H	L	H		
3	H	L	L		
4	L	H	H		
5	L	H	L		
6	L	L	H		
7	L	L	L		
8	H	H	H		

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