Owners Manual

The Sweet Talker Phonetic Speech Synthesizer Interface

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Introduction

Electronic speech synthesis (ESS) is a very young and rapidly evolving technology. Synthesized speech represents another step in the continuing evolution of the interface between man and machine. Though we have managed quite well with mechanical I/O in the past, the artificial voice is becoming increasingly important and will eventually be indispensible.

The MICROMINT SWEET TALKER boards are revolutionary low cost voice synthesizers. Using phoneme synthesis in contrast to waveform digitization or linear predictive coding, SWEET TALKER allows the user to construct an unlimited vocabulary simply by sequentially pronouncing the individual phonemes that make up the English language.

SWEET TALKER Phonetic Speech Synthesizer interfaces use the VOTRAX SC-01 phonetic speech synthesizer chip and are produced in two forms. The Parallel SWEET TALKER (the words Phonetic Speech Synthesizer may be silk screened on the board) interface contains input/output buffering, clock, filter, and amplifier. It is designed to connect to virtually any computer via a parallel I/O port.

THE APPLE II SWEET TALKER (APPLE II SWEET TALKER is silk screened on the board) is designed to be bus compatible with the APPLE II computer and plug into any peripheral slot number 1 thru 7. The interface is addressed as an I/O peripheral port and speech is accomplished through PEEK and POKE commands. Since the APPLE II SWEET TALKER is designed for a particular computer, a special demonstration and exercise program is also included with these units.

Each interface will be explained in detail but first we will review speech synthesizers in general and the SC-01 in particular.

A Review of Speech Synthesis Techniques

There are three major techniques presently employed to synthesize the human voice. They are formant synthesis, linear predictive coding (LPC), and waveform digitization. The differences between them are primarily the numbers of bits per second of data required to construct a word.

Formant synthesis is essentially a modeling of the natural resonances of the vocal tract. The bands of resonant frequencies defined are called formants. In an electronic synthesizer, these frequencies are generated by excitation sources passing through filters.

One form of the formant technique is called phoneme synthesis in which the spectral parameters are derived from basic word sounds. A phoneme generator is used to reproduce these sounds. In such a circuit, each phoneme is given a code and the synthesizer module (or chip) utters the phoneme sound corresponding to the code when it is activated. Creation of speech therefore is simply a matter of stringing the phoneme codes together. The electronic voice generated is quite intelligible but may have a slightly "mechanical" quality about it. Continuous speech using phoneme synthesis can generally be accomplished with less than 100 bits/second data rate.

Linear-predictive coding is very similar to formant synthesis. Both are based on the frequency domain and use similar hardware to model the vocal tract. Rather than a simple phoneme code however, the stored LPC parameters are filter coefficients, gains, and excitation frequencies. LPC refers to the programmed activities of the multistage lattice filters that produce the desired formants. Continuous speech can generally be achieved with data rates of 1200-2400 bits/sec. This synthesis technique is used by Texas Instruments in a series of products including the Speak-and-Spell and the TI 99/4 Text to Speech Translator. It is also used in the General Instruments VSM 2032 Voice Synthesis Module.

The third method is waveform digitization. This technique produces speech by generating a waveform with the amplitude characteristics of voice. The simplest form is uncompressed digital data recording called pulse-code modulation (PCM).

In digital recording, the analog speech waveform is sampled at twice the frequency of the highest voice component and converted to digital format through an analog to digital converter. Once stored, the digital signal can be played back through a digital to analog converter and a low-pass filter. Since it is in essence a recorded voice, the reproduced speech retains the inflections and accents of the original voice. It is not only possible to have a speech synthesizer with male and female voices but one with Japanese or midwestern accents.

Unfortunately, one problem in using waveform digitization is that it requires very high data rates and due to data storage restrictions, vocabulary is usually limited. The National Semiconductor Digi-Talker DT-1050 speech synthesis chip set uses data compressed digitized speech (the Digi-Talker chip set is used in the MICROMINT MICROMOUTH Speech Synthesizer interface).

The VOTRAX SC-01 Phoneme Synthesizer Chip

The 22 pin VOTRAX SC-01 integrated circuit is described in Figures 1a thru 1c. It consists of a digital code translator and an electronic model of the vocal tract. The phoneme controller translates a 6 bit phoneme and 2 bit pitch code into a matrix of spectral parameters which in turn adjusts the vocal tract model to synthesize the phonemes.

In the first part of the vocal tract section there is a pair of variable frequency oscillators for simulating vocal cord produced periodic sounds and a pseudorandom (pink noise) signal generator that simulates the sound of rushing air. The outputs of these sources are shaped by a bank of four analog bandpass filters that simulate the vocal cavities. The filter outputs in turn are directed through a preamplifier to an external amplifier and speaker.

The SC-01 phoneme synthesizer is a CMOS (complimentary metal oxide semiconductor) integrated circuit which should be operated within the range of 7-14 volts (Vp). The phoneme input lines (P0-P5) are 5 volt (LSTTL with an external pull-up) compatible and self latching. The two pitch control lines on the other hand, must have external latches and switch at the same input voltage as the SC-01. Handshaking with external control circuitry is accomplished through two strobe (STB) and acknowledge/request (A/R) lines. The STB line can be either CMOS or 5 volt level while the A/R line is CMOS level only.

The output pitch of the phonemes is controlled by the frequency of the clock signal applied from an external source or set internally with a resistor and capacitor combination. The clock frequency is nominally 720 KHz but subtle variations of pitch are induced through "automatic inflection" to prevent the synthesized voice from sounding too monotonous or "robotlike". Two independent pitch control lines, I1 and I2, are available for gross variations in pitch so that the chip can emulate more than one voice. Referred to as manual inflection controls, they operate in addition to the automatic inflection system already present. In most cases, the 6 bit phoneme code alone is sufficient and the two pitch control lines can be ignored.

Listed in Table 1 are the 64 phonemes defined for the English language (three produce no sounds). The phoneme sound is generated when a 6 bit phoneme code is placed on the control register input lines (P0-P5) and latched by pulsing the strobe (STB) input. Each phoneme is internally timed and has a duration of 47-250 msec depending on the particular phoneme selected and the clock frequency. The A/R line goes from a logic 1 to a logic 0 when a phoneme is sounding. The general connection configuration is shown in figure 2.

Both versions of the SWEET TALKER use the computer system directly to time the transmission of phoneme codes to the SC-01. The computer sends phoneme codes to the synthesizer chip through a latched parallel output port (the latched port is contained on the APPLE II SWEET TALKER) and monitors the synthesizer's activities (the A/R line) through an input port or interrupt line.

Speaking in Phonemes

Table 1 lists the 64 phonemes of the English language. At first glance it appears complicated but it is easy to understand and use. Take the word "call" for example. It is comprised of three distinct phonemes and can be dissected as follows:

```
                                K,  AW,  L     phonemes
        " CALL" ------
                                19  3D  18     hex codes
```

similarly, the word "disk" is:

```
                                D,  I1,  S,  K  phonemes
        " DISK" ------
                                1E   0B   1F   19  hex codes
```

Speaking either of these words is simply a matter of sending the hex codes sequentially to the speech synthesizer board. This is most easily done through a parallel port and exercised in BASIC. Typically, if the synthesizer were connected to port 0 on your computer, the program for saying "call" would be as follows:

```
100 DATA 25, 61, 24 :REM Decimal Phoneme codes for CALL
110 FOR A=1 TO 3 : READ P(A) :NEXT A
120 REM
130 FOR A=1 TO 3
140 OUT 0,P(A) :REM Latch Phoneme code into SC-01
150 IF INP(0)=0 THEN GOTO 150 :REM Continue if A/R NOT BUSY
160 NEXT A
170 OUT 0,63 :REM Send STOP code to SC-01
180 END
```

Essentially any word or series of words can be spoken using this method. It isn't necessary for you to become a linguist to use a phonetic speech synthesizer because many lists of word and phoneme equivalents are available. Table 2 is a sample list of some common words. A more extensive list is available from the MICROMINT.

The Parallel SWEET TALKER Speech Synthesizer Board

The schematic of the Parallel SWEET TALKER board is shown in Figure 3. The phoneme codes are sent in parallel to the SC-01 (IC 3) and buffered through IC 1. Pull-up resistors assure that a logic 1 input to the SC-01 will be at least 4 volts as required. Unless the board is being externally addressed, the Enable input line (J1 pin 12) should be grounded.

The two manual inflection inputs are also buffered through IC 1. The SC-01 cannot store these signals, and storage must be provided externally. A 74LS74 (IC 2) is configured as a two bit latch. It is clocked synchronously with the SC-01's strobe input. Unlike the phoneme inputs however, the inflection lines are not 5 volt compatible. Two sections of a 7416 (IC 4) open collector inverter are used with pull-ups to level shift these data inputs to CMOS levels. The automatic inflection is generally adequate and the manual inflection inputs (J1 pins 16 and 20) can be left open or grounded when not in use.

The SC-01 can have either an internal or external clock. External clock signals are applied through IC 3 pin 15 while pin 16 is grounded (SWEET TALKER uses the internal clock generator only). The clock frequency is determined by an RC combination attached to pins 15 and 16. The frequency is adjusted through potentiometer R8 and nominally set for 720 KHz. Slight adjustments to this control will vary the pitch of the output speech. While precisely preset at the factory, the easiest way to set this pot is by ear. Simply output a sequence of phonemes to the SC-01 and a set R8 for the most pleasent sounding voice.

The actual phoneme sound begins when the 6 bit phoneme code is latched into the SC-01 control register (latching occurs on the rising edge of the STB input line, pin 7). It will continue to make the same sound until another phoneme or stop code is loaded. Using two more sections of IC 4, the phonetic speech synthesizer board can be jumpered to trigger from either a high or low level strobe pulse.

When using a high strobe pulse (strobe line is normally low and pulses high), the SC-01 requires some set up time before the strobe. The data on P0-P5 must be stable for 450 nanoseconds before the rising edge of the strobe. This is most easily accomplished by using an external data latch (an output port).

The SC-01 can also be triggered by a low level strobe (strobe line is normally high and pulses low, the positive edge in this instance is the low to high transition at the conclusion of the pulse period). When using a negative pulse however, the strobe input line must remain low for at least 72 clock periods (approximately 100 microseconds) before rising. When driving the synthesizer board through a parallel port with logic high to low "data available" (DAV) strobe, it may be necessary to add a one shot to stretch this signal out to the required length. Typically, microprocessor DAV strobes are less than a microsecond.

Approximately 500 nanoseconds after the rising edge of the strobe pulse, the A/R line (pin 8) of the SC-01 goes to a logic 0 indicating that the synthesizer chip is busy "speaking". Q1 and IC 4 convert the CMOS output of pin 8 to LSTTL levels. The A/R output can be monitored in either of two ways: directly through an input port or connected to an interrupt line. In either case, when the A/R line returns to the logic 1 level, the SC-01 is ready to receive another phoneme code.

The remaining components on the phonetic speech synthesizer board comprise the amplifier and filter sections. C1, C2, R5, and R6 form a simple low pass filter. The audio signal is then amplified by an LM386 1 watt amplifier (IC 5) to directly drive an 8 Ohm speaker. Potentiometer R7 controls the volume and the speaker connects to the 2 pin header provided.

The board operates on +5 volts and Vp. Vp can be any voltage between +7 and +14 volts. +12 volts is recommended. Power can be applied either through the edge connector or the 4 pin power header. The power header is compatible with the low cost MICROMINT Universal Power Supply (+5V at 300 Ma, +12V at 50 Ma, and -12V at 50 Ma).

Attaching the Parallel SWEET TALKER to a Parallel Printer Port

It just so happens that many computers already have an output port in the form of a Centronics compatible parallel printer port. This connection is available on all TRS-80 Model III and expanded Model I systems as well as many others. By connecting the Phonetic Speech Synthesizer board as shown in Figure 4, it is possible to fool the computer into thinking the SWEET TALKER board is a printer and use LPRINT statements to drive it. The machine language routine that communicates ASCII character strings from BASIC to the printer will also work with the SWEET TALKER synthesizer.

As far as LPRINT is concerned, any ASCII characters between the quotes will be transmitted (except the quotation mark itself and perhaps a few control codes) whether they spell out something coherent or not. As Table 1 illustrates, all of the phonemes have ASCII characters which produce the equivalent 6 bit code (lower case letters a-z correspond to hex codes 21 through 3A). It is possible therefore to type an "@" for the EH3 (00 hex) phoneme or a ">" for PA1 (3E hex). Using this technique, the program for saying "call" would be:

```
100 LPRINT "Y=X" :REM - CALL -
```

It's a good idea to add a stop phoneme (ASCII "?") after the end of the word to cancel the last phoneme and stop the voice at the end of the word. The line becomes as follows:

```
100 LPRINT "Y=X";"?";
```

The Speech Synthesizer attaches and handshakes with the computer in the same manner that a printer would. The A/R output is connected to the BUSY input and the UNIT SELECT line is grounded to simulate printer attachment. The computer's LPRINT driver routine sends one character to the printer (Parallel SWEET TALKER in this case) and then checks the BUSY line before sending another. When the BUSY line is high again the next character (phoneme) is sent.

The only area for concern is the pulse width of the data strobe (attached to J1 pin 21 with jumper JP1 installed) as previously mentioned. If it is less than 100 microseconds, a 74121 monostable multivibrator (one shot) should be added as indicated. If you are unsure of the duration, add the circuit anyway.

Once the interface is attached, a simple program can be used to test phoneme combinations. For example, sending "S*1L/@*KY" will say "automatic" and "Y2M*KIMb677" will say "continue". A simply program which does this requires only two lines:

```
100 INPUT A$
110 LPRINT A$;"?"; :GOTO 100
```

The APPLE II SWEET TALKER Board

The schematic of the APPLE II SWEET TALKER board is shown in Figure 5. The APPLE II SWEET TALKER plugs into any peripheral slot except 0 and is exercised directly from the monitor or through PEEK and POKE commands in BASIC. The address of the board is dependent upon the slot it is inserted into. Table 6 lists the board addresses for each peripheral card slot.

Operation is similar in most respects to the Parallel SWEET TALKER except that the data latch is provided on board in this version. Phoneme codes are sent in parallel to the SC-01 (IC 1) and latched into IC 2 and IC 3. The two manual inflection inputs are also stored in IC 3 synchronously with the phoneme data. Automatic inflection is generally adequate and the manual inflection inputs can be preset to 00 or 11 during program execution.

Speaking any phoneme is handled as simply as excuting the command POKE -16128,8 (for slot 1 "say" the phoneme AH2). This causes the data, 08 hex, to be stored in IC 2 and IC 3. It also triggers one shot IC 6a. After 10 microseconds, the falling edge of IC 6a triggers one shot IC 6b which provides a 10 microsecond strobe pluse to the SC-01 (IC 1). The actual phoneme sound begins when the 6 bit phoneme code is latched into the SC-01 control register (latching occurs on the rising edge of IC 6b). It will continue to make the same sound until another phoneme or stop code is loaded.

The action of this delayed strobe allows the APPLE II SWEET TALKER to conform to the timing constraints of the SC-01 yet be directly attached to the APPLE bus and run with no wait states. For additional information on the strobe and data timing on the SC-01 refer to the section on describing the Parallel SWEETTTALKER hardware.

The clock frequency is determined by an RC combination attached to IC 1 pins 15 and 16. The frequency is adjusted through potentiometer R8 and nominally set for 720 KHz. Slight adjustments to this control will vary the pitch of the output speech. While precisely preset at the factory, the easiest way to set this pot is by ear. Simply output a sequence of phonemes to the SC-01 and a set R8 for the most pleasent sounding voice.

Approximately 500 nanoseconds after the rising edge of the strobe pulse, the A/R line (pin 8) of the SC-01 goes to a logic 0 indicating that the synthesizer chip is busy "speaking". Q1 and IC 4 convert the CMOS output of pin 8 to LSTTL levels. The A/R output is connected to the D7 data bus line through a tri-state buffer IC 7. It can be monitored by executing a PEEK command at the same address as the phoneme data is loaded. When the SC-01 is busy, the D7 input will be a logic 0 and when it is ready to receive another phoneme code it will be a logic 1.

The remaining components on the APPLE II SWEET TALKER speech synthesizer board comprise the amplifier and filter sections. C1, C2, R5, and R6 form a simple low pass filter. The audio signal is then amplified by an LM386 1 watt amplifier (IC 8) to directly drive an 8 Ohm speaker. Potentiometer R7 controls the volume and the speaker connects to the 2 pin header provided.

The board operates on +5 volts and +12V supplied from the APPLE bus.

APPLE SWEET TALKER Demonstration Software

The APPLE II SWEET TALKER DEMO software allows the user to listen to phrases, build phrases and listen to Votrax phonemes.

NOTE: when the APPLE II is powered up, SWEET TALKER may sound off. To quiet the voice, use one of the instructions below. "s" is the slot in which you installed the SWEET TALKER board.

From the monitor Cs00:FF
From BASIC POKE - 16384+256*s,255

Before attempting to load this demonstration program, be sure that the cursor is a right bracket indicating Applesoft is the resident language. Type in the word "LOAD", but don't hit return. Disconnect the plug from the recorder's earphone jack. Start the recorder and listen for a steady tone. Promptly return the plug to the earphone jack and hit return on the keyboard. If problems occur, adjust the volume on the recorder and/or try loading the second copy of the program on the tape. If you are still unsuccessful, see the APPLE II Reference Manual for more complete instructions on loading tapes.

When the demonstration program is run, the MICROMINT logo appears and the program verifies the slot number in which SWEET TALKER is inserted (see program line 1). After a nine second pause SWEET TALKER identifies itself both on the screen and verbally with, "You hear SWEET TALKER by MICROMINT". You are then admonished, "Do not teach SWEET TALKER naughty words" and a menu is presented. Each of these menu choices is expained as follows:

1) QUOTE PHRASES

Fourteen phrases are included in the data statements of the demonstration program. When you are prompted "which?" respond "4-5" and SWEET TALKER will respond with "TWINKLE, TWINKLE LITTLE STAR". Answering "9-13" recites a limerick about a poor fellow named Hall. You may exit this section of the demonstration program with an "M" which will return you to the menu or a "B" which will take you directly to the phrase building portion of the demonstration program (with the last phrase spoken in the edit buffer).

2) BUILD PHRASES

At the bottom of the screen are phonemes for a phrase. Press return and SWEET TALKER will voice them. It is here, on the last six lines of the screen that you edit new or existing phrases. As the example shows, each phoneme is left justified in a field four characters wide. It may seem awkward at first remembering to pad with blanks to fill the field but this is more than compensated for when it becomes necessary to substitute a long phoneme for a short one, changing A to AH3 for example.

Besides the instructions, there are two screens which aid in assembling phrases. Specifically there is a screen of vowel phonemes and a screen of consonant phonemes. These occupy the top of the screen while you edit at the bottom. The vowels are displayed by typing "V" and return, in the first phoneme field (don't pad it with blanks, just "V" and return). On the vowel screen note the mark over the O in MOP indicating that the AH phoneme has the same sound as the O in MOP. The mark under the O in FOR shows that the O2 phoneme has the sound of the O in FOR. Typing "C" and return will display the consonants. Note the PAO phoneme is no sound for 47 milliseconds and the PA1 is no sound for 185 milliseconds.

Summarizing the BUILD PHRASE instructions:

- I Print these instructions
- V Print vowel phonemes
- C Print consonant phonemes
- R Restore before last change
- S Save phrase
- P change pitch
- M Return to menu
- B Enter build from quote phrases

"M" returns you to the main menu. "I" prints the instructions (you might want to do that after displaying the vowels or consonants). "P" allows you to change the pitch. 0, 1, 2 and 3 are valid pitches. Other number values will cause an illegal quantity error. A "GOTO 210" will get you back into the program without losing the phrase you are editing. Try changing the pitch with the following sequence: "P" return, "3" return, and return again. The phrase will be spoken in the highest pitch. "P" return, "0" return, will restore the pitch to its lowest value and just a return will recite the phrase again.

Unless you are quite familiar with the APPLE II's escape A and escape B sequences, you will want to reread the editing information in the Applesoft manual. These, in addition to the right arrow, left arrow, and repeat key will be used repeatedly while editing phrases to get them to sound just the way you want. Users with PLE will find that escape sequences incorporating the above can be very helpful in speeding the editing process.

As you build words, keep in mind that you are not explaining to SWEET TALKER how to spell the words but rather how to pronounce them. For example,

P O1 L E1 SH
and
P AH1 L E1 SH

don't sound or mean the same. However, both words are spelled POLISH. Another example is red and read, pronounced R EH1 EH3 D.

Try entering: B AH R B E K U

It's going to need some work to sound like "barbecue", and it should be modified as follows:

B	AH	R	B	R	AH2	K	U1		
B	AH1	R	B	R	AH2	K	Y1	IU	U1
B	AH1	R	B	R	EH3	K	Y1	IU · U1	U1

If you don't care for the slight Midwest accent, perhaps you should change it to:

B AH1 R B EH1 K Y1 IU U1 U1

NOTE: There will come a time when an error in editing a phrase will cause a near calamity. Hitting return in the middle of a phrase or forgetting to pad a phoneme out to four characters can cause everything to vanish. An "R" return (restore) command will reinstate the edit buffer to its state just prior to the last change.

When you finally have perfected a phrase you may wish to add it to the fourteen already stored in the program. "S" return will initiate the save sequence. First you will be asked "What English"? Respond with what statement (usually what the phrase says) you would like to appear on the screen when the phrase is spoken. After you press return, two data statements will appear on the screen. Using the right arrow and repeat key, pass the cursor over the first statement and press return. Repeat the same procedure with the second statement. These are now part of the program. Don't forget to save the program to tape or disk before you turn off the APPLE II. "RUN" will get you back into the program and you will notice that the count of phrases will have gone up by one.

3) RECITE PHONEMES

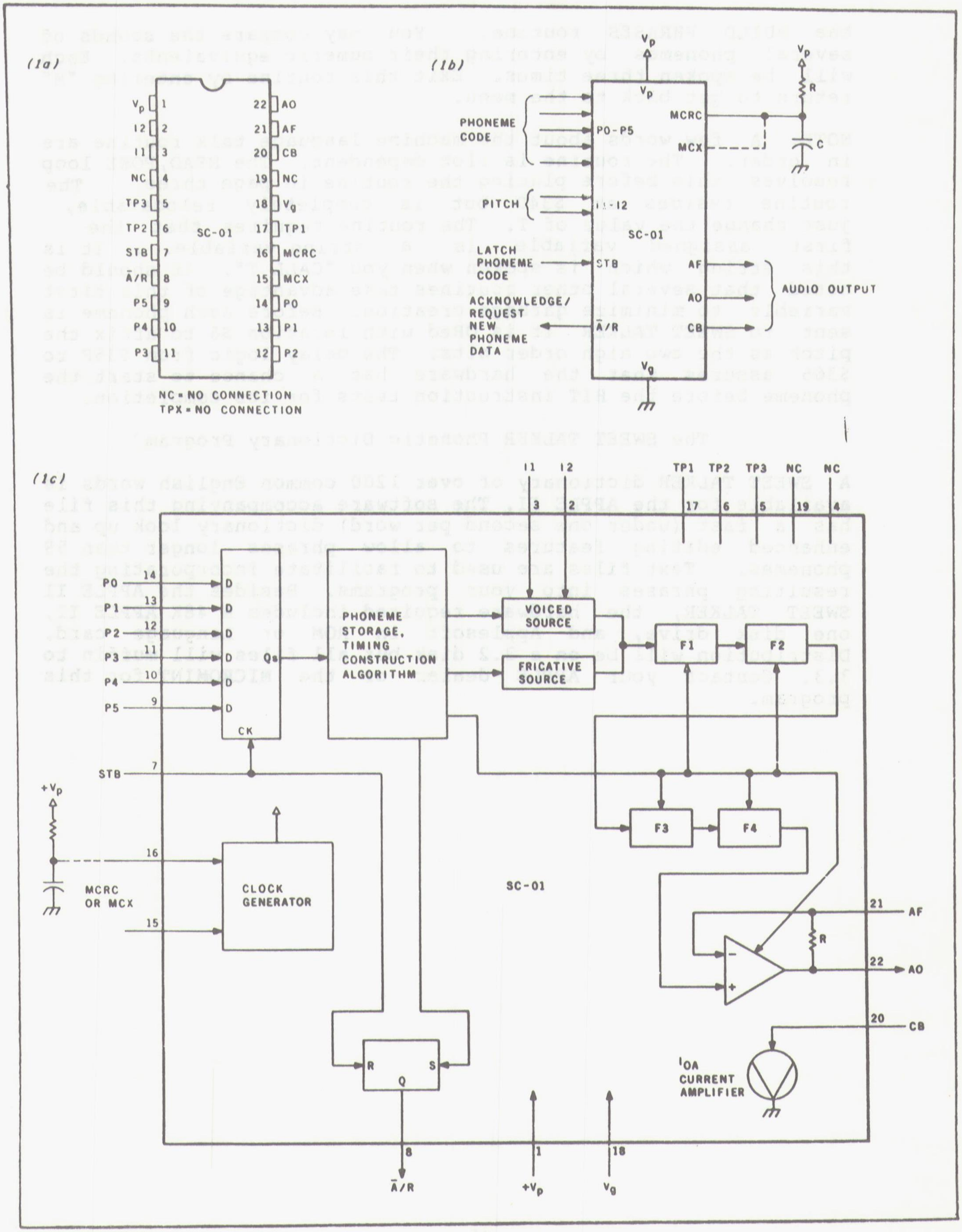
Entering "ALL" will recite each phoneme in alphabetical order. Entering "V" return and "C" return will put reference lists of vowels and consonants on the screen. Note that now there are numbers in front of each phoneme indicating the numeric code (from 0-63) that the SC-01 synthesizer chip uses to identify the phonemes. They are the same numbers that appear in the second data statement when you save a phrase from the BUILD PHRASES routine. You may compare the sounds of several phonemes by entering their numeric equivalents. Each will be spoken three times. Exit this routine by entering "M" return to get back to the menu.

NOTE: A few words about the machine language talk routine are in order. The routine is slot dependent. The READ,POKE loop resolves this before placing the routine in page three. The routine resides at $340 but is completely relocatable, just change the value of T. The routine requires that the first assigned variable is a string variable. . It is this string which is spoken when you "CALL T". It should be noted that several other routines take advantage of this first variable to minimize garbage creation. Before each phoneme is sent to SWEET TALKER it is ORed with location $6 to affix the pitch as the two high order bits. The delay logic from $35F to $365 assures that the hardware has a chance to start the phoneme before the BIT instruction tests for its completion.

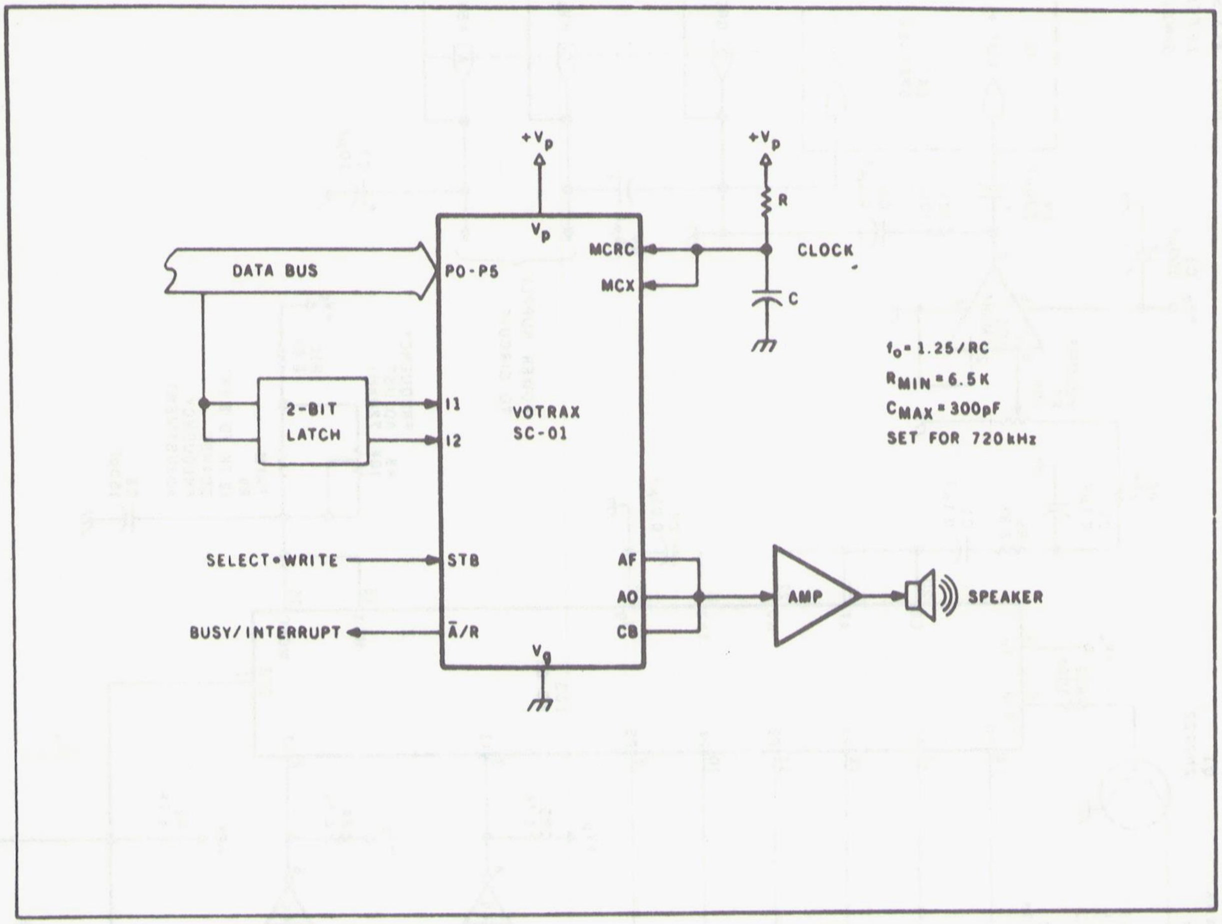
The SWEET TALKER Phonetic Dictionary Program

A SWEET TALKER dictionary of over 1200 common English words is available for the APPLE II. The software accompanying this file has a fast (under one second per word) dictionary look up and enhanced editing features to allow phrases longer than 59 phonemes. Text files are used to facilitate incorporating the resulting phrases into your programs. Besides the APPLE II SWEET TALKER, the hardware required includes a 48K APPLE II, one disk drive, and Applesoft in ROM or Language card. Distribution will be on a 3.2 disk but all files will muffin to 3.3. Contact your APPLE dealer or the MICROMINT for this program.

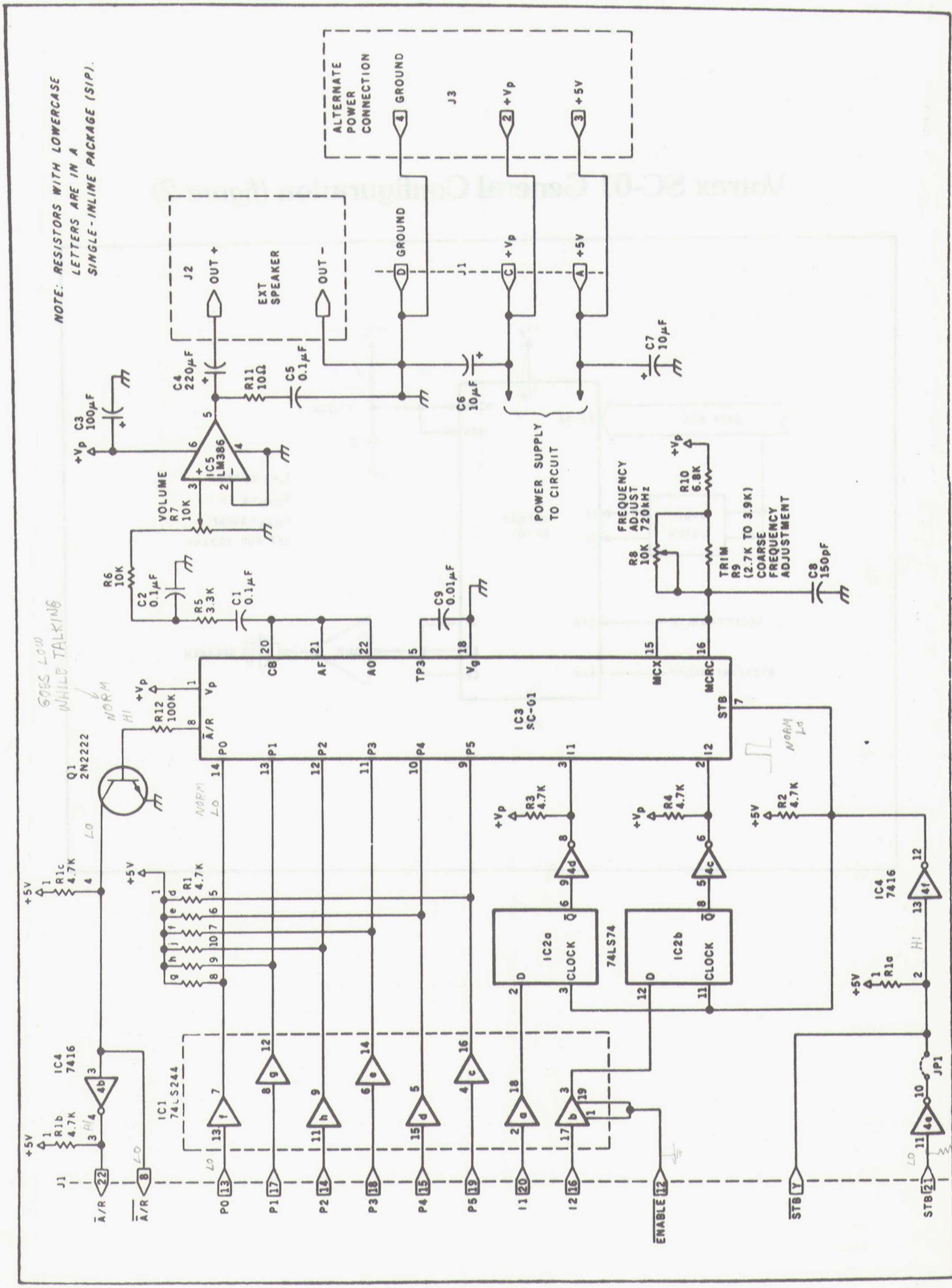
Votrax SC-01 Intergrated Circuit *(figure 1)*



Votrax SC-01 General Configuration *(figure 2)*



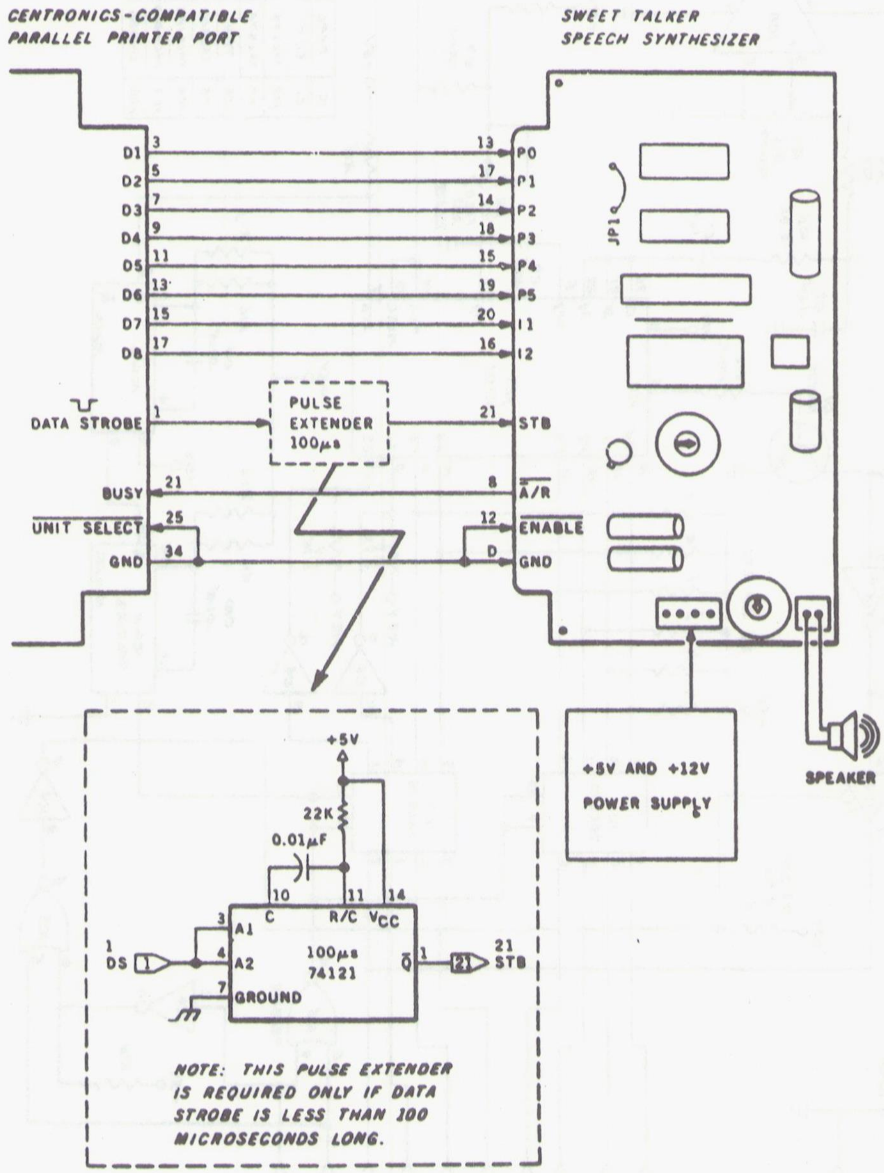
Schematic of the Parallel Sweet Talker Board *(figure 3)*



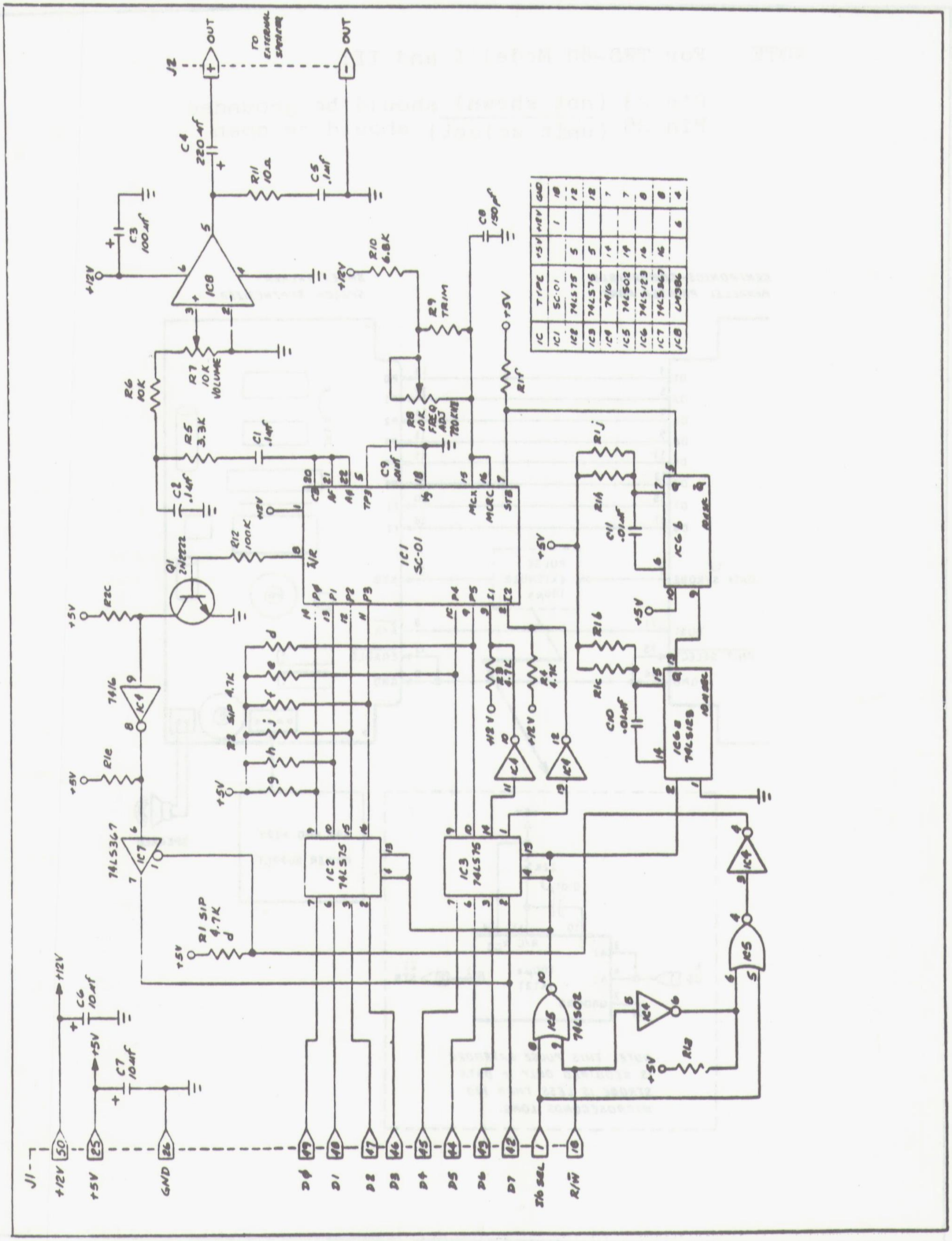
Sweet Talker Innerconnect Cabling *(figure 4)*

NOTE: For TRS-80 Model I and II:

Pin 23 (not shown) should be grounded
Pin 25 (unit select) should be open



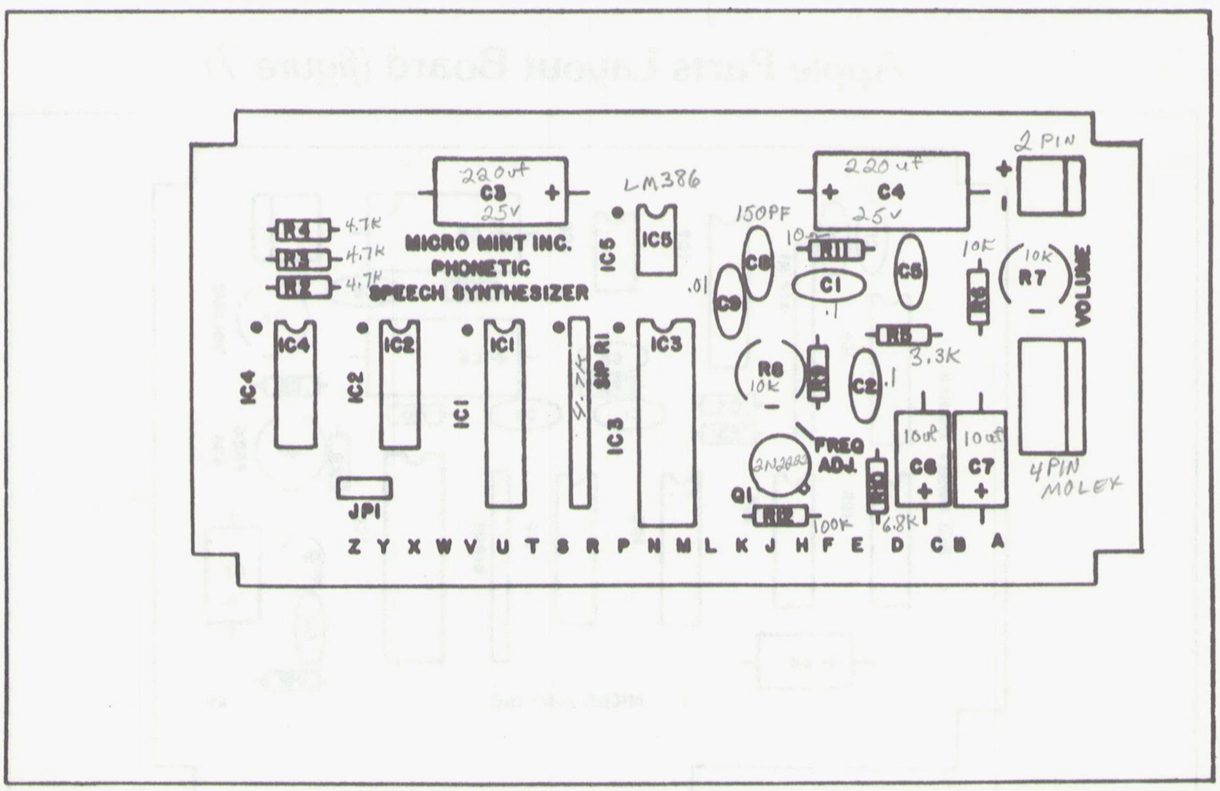
Apple II Sweet Talker Schematic *(figure 5)*



PARALLEL SWEET TALKER INTERFACE PARTS LIST

PART #	VALUE OR DESIGNATION
PC Board	Phonetic Synthesizer PCB
IC1	74LS244
IC2	74LS74
IC3	Votrax SC-01
IC4	7416
IC5	LM386 Power Amp
C1,C2,C5	0.1 Mfd. 12VDC Ceramic
C3	100 to 220 Mfd.25VDC Elec
C4	220 Mfd. 25VDC Elec.
C6,C7	10 Mfd. 25VDC Elec.
C8	150 Pfd. 12VDC Ceramic
C9	0.01 Mfd. 12VDC Ceramic
R1	4.7K SIP
R2,R3,R4	4.7K
R5	3.3K
R6	10K
R7	10K Potentiometer
R8	10K Potentiometer
R9	Trim (if necessary)
R10	6.8K
R11	10 Ohms
R12	100K
Q1	2N2222 transistor
S1	22 pin IC socket
Speaker Connector	2 Pin Molex Header
Power Connector	4 pin Molex header

Parts Layout Parallel Board *(figure 6)*



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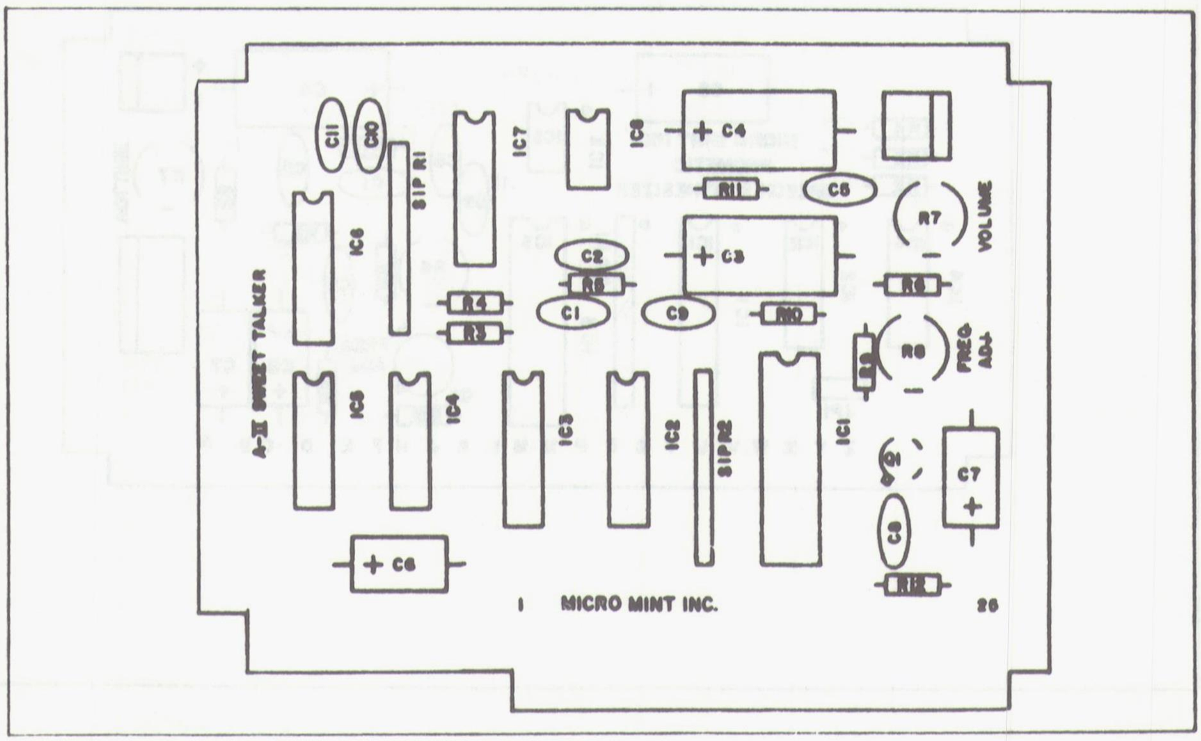
APPLE II SWEET TALKER INTERFACE PARTS LIST

PART #	VALUE OR DESIGNATION
PC Board	A-II Synthesizer PCB
IC1	Votrax SC-01
IC2,IC3	74LS75
IC4	7416
IC5	74LS02
IC6	74LS123
IC7	74LS367
IC8	LM386 Power Amp
C1,C2,C5	0.1 Mfd. 12VDC Ceramic
C3	100 to 220 Mfd.25VDC Elec
C4	220 Mfd. 25VDC Elec.
C6,C7	10 Mfd. 25VDC Elec.
C8	150 Pfd. 12VDC Ceramic
C9,C10,C11	0.01 Mfd. 12VDC Ceramic
R1,R2	4.7K SIP
R3,R4	4.7K
R5	3.3K
R6	10K
R7	10K Potentiometer
R8	10K Potentiometer
R9	Trim (if necessary)
R10	6.8K
R11	10 Ohms
R12	100K
Q1	2N2222 transistor
S1	22 pin IC socket
Speaker Connector	2 Pin Molex Header

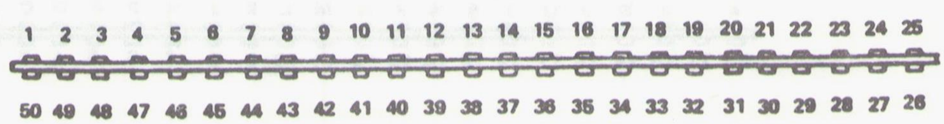
Apple Parts Layout Board *(figure 7)*



Apple Sweet Talker J1 Connector Pinout

PIN	SIGNAL	DESCRIPTION
1	I/O	I/O Select Strobe
2	A0	No Connection
3	A1	No Connection
4	A2	No Connection
5	A3	No Connection
6	A4	No Connection
7	A5	No Connection
8	A6	No Connection
9	A7	No Connection
10	N/C	No Connection
11	N/C	No Connection
12	N/C	No Connection
13	N/C	No Connection
14	N/C	No Connection
15	N/C	No Connection
16	N/C	No Connection
17	N/C	No Connection
18	R/W	Read/Write Peripheral Strobe
19	N/C	no Connection
20	N/C	No Connection
21	N/C	No Connection
22	N/C	No Connection
23	N/C	No Connection
24	N/C	No Connection
25	+5V	+5V Power Supply
26	GND	Signal Ground
27	N/C	No Connection
28	N/C	No Connection
29	N/C	No Connection
30	N/C	No Connection
31	N/C	No Connection
32	N/C	No Connection
33	N/C	No Connection
34	N/C	No Connection
35	N/C	No Connection
36	N/C	No Connection
37	N/C	No Connection
38	N/C	No Connection
39	N/C	No Connection
40	N/C	No Connection
41	N/C	No Connection
42	D7	Bidirectional Data Bus
43	D6	Bidirectional Data Bus
44	D5	Bidirectional Data Bus
45	D4	Bidirectional Data Bus
46	D3	Bidirectional Data Bus
47	D2	Bidirectional Data Bus
48	D1	Bidirectional Data Bus
49	D0	Bidirectional Data Bus
50	+12V	12 Volt Power Supply

VIEWED FACING THE CONNECTOR



Parallel Sweet Talker J1 Connector Pinout

PIN	SIGNAL	DESCRIPTION
1	N/C	nc
2	N/C	No Connection
3	N/C	No Connection
4	N/C	No Connection
5	N/C	No Connection
6	N/C	No Connection
7	N/C	No Connection
8	A/R	Busy
9	N/C	No Connection
10	N/C	No Connection
11	N/C	No Connection
12	Enable	Buffer Enable
13	P0	Data Bit 0
14	P2	Data Bit 1
15	P4	Data Bit 4
16	I2	Manual Inflection Bit 2
17	P1	Data Bit 1
18	P3	Data Bit 3
19	P5	Data Bit 5
20	I1	Manual Inflection Bit 1
21	STB	Phoneme Data Strobe
22	A/R	Busy
A	N/C	No Connection
B	N/C	No Connection
C	N/C	No Connection
D	N/C	No Connection
E	N/C	No Connection
F	N/C	No Connection
H	N/C	No Connection
J	N/C	No Connection
K	N/C	No Connection
L	N/C	No Connection
M	N/C	No Connection
N	N/C	No Connection
P	N/C	No Connection
R	N/C	No Connection
S	N/C	No Connection
T	N/C	No Connection
U	N/C	No Connection
V	N/C	No Connection
W	N/C	No Connection
X	N/C	No Connection
Y	STB	Phoneme Data Strobe
Z	N/C	No Connection

VIEWED FACING THE CONNECTOR

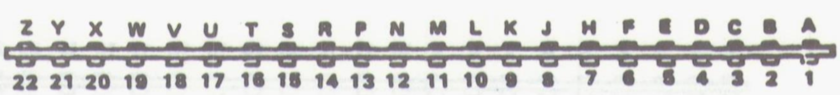


Table 1 Phoneme codes

HEX PHONEME CODE	PHONEME SYMBOL	ASCII	DURATION (msec)	EXAMPLE WORD
00	EH3	@	59	jacket
01	EH2	A	71	enlist
02	EH1	B	121	heavy
03	PA0	C	47	no sound
04	DT	D	47	butter
05	A2	E	71	made
06	A1	F	103	made
07	ZH	G	90	azure
08	AH2	H	71	honest
09	I3	I	55	inhibit
0A	I2	J	80	inhibit
0B	I1	K	121	inhibit
0C	M	L	103	mat
0D	N	M	80	sun
0E	B	N	71	bag
0F	V	O	71	van
10	CH	P	71	chip
11	SH	Q	121	shop
12	Z	R	71	zoo
13	AW1	S	146	lawful
14	NG	T	121	thing
15	AH1	U	146	father
16	OO1	V	103	looking
17	OO	W	185	book
18	L	X	103	land
19	K	Y	80	trick
1A	J	Z	47	judge
1B	H	[	71	hello
1C	G	\	71	get
1D	F	]	103	fast
1E	D	^	55	paid
1F	S	_	90	pass

HEX PHONEME CODE	PHONEME SYMBOL	ASCII	DURATION (msec)	EXAMPLE WORD
20	A	(space)	185	day
21	AY	!	65	day
22	Y1	"	80	yard
23	UH3	#	47	mission
24	AH	$	250	mop
25	P	%	103	past
26	O	&	185	cold
27	I	'	185	pin
28	U	(	185	move
29	Y	)	103	any
2A	T	*	71	tap
2B	R	+	90	red
2C	E	,	185	meet
2D	W	-	80	win
2E	AE	.	185	dad
2F	AE1	/	103	after
30	AW2	0	90	salty
31	UH2	1	71	about
32	UH1	2	103	uncle
33	UH	3	185	cup
34	O2	4	80	for
35	O1	5	121	aboard
36	IU	6	59	you
37	U1	7	90	you
38	THV	8	80	the
39	TH	9	71	thin
3A	ER	:	146	bird
3B	EH	;	185	get
3C	E1	<	121	be
3D	AW	=	250	call
3E	PA1	>	185	no sound
3F	STOP	?	47	no sound

Note: T must precede CH to produce "CH" sound.
D must precede J to produce "J" sound.

Table 2

TYPICAL PHONETIC WORD LIST

A	A1, AY, Y
able	A1, Y, B, UH3, L
about	UH1, B, UH2, AH2, U1, T
actual	AE1, EH3, K, T, CH, U1, UH3, L
add	AE1, EH3, D
adjust	UH1, D, J, UH1, UH3, S, T
B	B, E1, Y
back	B, AE1, AE1, K
basic	B, A1, Y, S, I2, K
been	B, EH1, EH3, N
before	B, Y, F, O2, O2, R
better	B, EH1, EH3, T, ER
C	S, E1, Y
came	K, A1, AY, Y, M
can	K, AE1, EH3, N
car	K, AH2, UH3, R
catalog	K, AE2, EH3, DT, UH3, L, AW2, AW2, G
change	T, CH, A1, AY, Y, N, D, J
D	D, E1, Y
data	D, A2, Y, DT, UH1
date	D, A2, AY, Y, T
decide	D, Y, S, AH2,EH3, Y, D
decision	D, Y, S, I2, ZH, UH3, N
deliver	D, Y, L, I2, V, ER
E	E1, Y
early	ER, R, L, Y
either	E1, Y, THV, ER
empty	EH2, EH3, M, P, T, Y
end	EH2, EH3, N, D
exact	EH2, EH3, G, PA0, Z, AE2, EH3, K, T
F	EH1, EH2, F
fact	F, AE2, EH3, K, T
fault	F, AW, L, T
final	F, AH2, Y, N, UH3, L
first	F, ER, R, S, T
follow	F, AH1, AW2, L, O1, U1
G	D, J, E1, Y
game	G, A2, AY, Y, M
good	G, OO1, OO1, D
great	G, R, A2, Y, T
ground	G, R, AH1, UH3, W, N, D
grow	G, R, O1, U1

H	A1, AY, Y, T, CH
hand	H, AE1, EH3, N, D
have	H, AE1, EH3, V
hear	H, AY, I3, R
heavy	H, EH1, V, Y
high	H, AH1, EH3, Y
I	AH1, EH3, I3, Y
important	I1, I3, M, P, O2, O2, R, T, EH3, N, T
include	I1, I3, N, K, L, IU, U1, U1, D
inform	I1, I3, N, F, O2, O2, R, M
insert	I1, N, S, R, R, T
instead	I1, I3, N, S, T, EH1, EH3, D
J	D, J, EH3, A1, AY, Y
job	D, J, AH1, UH3, B
join	D, J, O1, UH3, I3, AY, N
joy	D, J, O1, UH3, I3, AY
judge	D, J, UH1, UH2, D, J
jump	D, J, UH1, UH2, M, P
K	K, EH3, A1, AY, Y
keep	K, E1, Y, P
key	K, E1, Y
keyboard	K, AY, Y, B, O1, O2, R, D
kill	K, I1, I3, L
knowledge	N, AH1, UH3, L, I3, D, J
L	EH1, EH3, UH3, L
language	L, AE1, EH3, NG, G, W, I1, D, J
large	L, AH1, R, D, J
left	L, EH1, EH3, F, T
length	L, EH1, EH3, NG, TH
listen	L, I1, I3, S, I2, N
M	EH1, EH2, M
make	M, A1, AY, Y, K
many	M, EH2, EH2, N, Y
match	M, AE1, EH3, T, CH
memory	M, EH1, EH3, M, ER, Y
message	M, EH1, EH3, S, I2, D, J
N	EH1, EH2, N
name	N, A1, AY, Y, M
near	N, AY, I1, R
need	N, E1, Y, D
next	N, EH1, EH3, K, PA0, S, T
none	N, UH1, UH3, N
O	O2, O1, U1
object	UH1, B, D, J, EH1, EH3, K, T
obsolete	AH1, UH3, B, S, UH3, L, AY, Y, T
often	AW2, AW2, F, I3, N

omit	O1, U1, M, I1, I3, T
other	UH1, UH3, THV, ER
P	P, E1, Y
package	P, AE1, EH3, K, I1, D, J
paper	P, A1, Y, P, ER
part	P, AH1, R, T
person	P, ER, S, UH1, N
phone	F, O1, U1, N
Q	K, Y1, IU, U1, U1
qualify	K, W, AW1, L, I1, F, AH1, EH3, Y
quantity	K, W, AH1, N, T, I3, T, Y
question	K, W, EH1, EH3, S, T, CH, UH3, N
quick	K, W, I1, I3, K
quiet	K, W, AH1, EH3, AY, I2, T
R	AH1, UH2, ER
raise	R, A1, AY, Y, Z
reach	R, E1, Y, T, CH
ready	R, EH1, EH3, D, Y
remain	R, E1, M, A1, AY, Y, N
resistor	R, E1, Z, I1, S, T, ER
S	EH1, EH2, S
safe	S, A1, AY, Y, F
sale	S, A1, A2, AY, UH3, L
schedule	S, K, EH1, EH3, D, J, IU, U1, L
scrap	S, K, R, AE1, EH3, P
section	S, EH1, EH3, K, SH, UH3, N
T	T, E1, AY, Y
talk	T, AW, K
technical	T, EH1, EH3, K, N, I3, K, UH3, L
terminal	T, ER, M, EH3, N, UH2, L
think	TH, I1, I3, NG, K
time	T, AH1, EH3, Y, M
U	Y1, IU, U1, U1
under	UH2, UH2, N, D, ER
uniform	Y1, IU, U1, N, I3, F, O1, R, M
until	UH2, UH2, N, T, I1, I3, L
up	UH1, UH2, P
urgent	R, R, D, J, I3, N, T
us	UH1, UH2, S
use	Y1, IU, U1, U1, Z
V	V, E1, AY, Y
vacant	V, A1, Y, K, EH3, N, T
valid	V, AE1, UH3, L, I1, D
value	V, AE1, EH3, L, Y1, IU, U1
vendor	V, EH1, EH3, N, D, ER
vent	V, EH1, EH3, N, T
verify	V, EH1, R, I3, F, AH1, EH3, Y

very	V, EH1, R, Y
via	V, E1, AY, UH2, UH3
victor	V, I1, I3, K, T, ER
voice	V, O1, UH3, I3, AY, S
void	V, O1, UH3, I3, AY, D
volt	V, O2, O2, L, T
volume	V, AH1, UH3, L, Y1, IU, U1, M
W	D, UH1, B, UH3, L, Y1, IU, U1
wage	W, A1, AY, Y, D, J
wait	W, A1, AY, Y, T
want	W, AH1, UH3, N, T
was	W, UH1, UH3, Z
wash	W, AW, SH
water	W, AH1, UH3, T, ER
watt	W, AH1, UH3, T
wave	W, A1, AY, Y, V
we	W, E1, Y
weapon	W, EH2, EH2, P, UH1, N
wednesday	W, EH1, N, Z, D, A1, I3, Y
week	W, E1, Y, K
weigh	W, A2, A2, Y
went	W, EH1, EH3, N, T
west	W, EH1, EH3, S, T
wet	W, EH1, EH3, T
what	W, UH3, UH1, T
wheel	W, E1, Y, L
when	W, EH1, EH3, N
where	W, EH3, A2, EH3, R
which	W, I1, I3, T, CH
while	W, AH1, EH3, I1, UH3, L
whiskey	W, I1, I3, S, K, AY, Y
white	W, UH3, AH2, Y, T
who	H, IU, U1, U1
will	W, I1, I3, L
window	W, I1, N, D, O1, U1
winter	W, I1, I3, N, T, ER
wire	W, AH1, EH3, AY, R
with	W, I1, I3, TH
withdraw	W, I1, I3, TH, D, R, AW
without	W, I1, I3, TH, UH2, AH2, U1, T
word	W, ER, R, D
work	W, ER, R, K
wrong	R, AW, NG
X	EH1, EH2, K, PA0, S
x-ray	EH1, EH2, K, PA0, S R, A1, I3, Y
Y	W, AH1, EH3, I3, Y
yankee	Y1, AE1, EH3, NG, K, E1, Y
yard	Y1, AH1, R, D
year	Y1, AY, I3, R
yellow	Y1, EH1, EH3, L, O1, U1
yes	Y1, EH3, EH1, S

yesterday	Y1, EH3, EH1,S, T, ER, D, A1, I3, Y
yet	Y1, EH1, EH3, T
your	Y, O2, O2, R
Z	Z, E1, Y
zap	Z, AE1, EH3, P
zero	Z, AY, I1, R, O1, U1
zone	Z, O1, U1, N
zulu	Z, IU, U1, L, IU, U1

Table 3

APPLE COMPUTER SLOT ADDRESSES

SLOT	DECIMAL ADDRESS	HEX ADDRESS
1	-16128	C100
2	-15872	C200
3	-15616	C300
4	-15360	C400
5	-15104	C500
6	-14848	C600
7	-14592	C700

Votrax®
A Division of Federal Screw Works
500 Stephenson Highway
Troy, Michigan 48084

SC-01 SPEECH SYNTHESIZER

DATA SHEET

Votrax® CMOS Phoneme Speech Synthesizer

GENERAL DESCRIPTION

The SC-01 Speech Synthesizer is a completely self-contained solid state device. This single chip phonetically synthesizes continuous speech, of unlimited vocabulary, from low data rate inputs. Figure 1.

Speech is synthesized by combining phonemes (the building blocks of speech) in the appropriate sequence. The SC-01 Speech Synthesizer contains 64 different phonemes which are accessed by a 6-bit code. It is the proper sequential combination of these phoneme codes that creates continuous speech.

The SC-01 Speech Synthesizer is cost-effective, consumes minimal power and enables in-house product development without vendor dependency. Signals from the SC-01 are applied to an audio output device to amplify and distribute the synthesized speech. See Figure 2.

Figure 1. Votrax® SC-01 Speech Synthesizer

FEATURES

- Single CMOS chip
- 70 bits per second
- 22 pin package
- 9 ma. current drain
- Wide voltage supply range
- Latched 5V. compatible inputs
- Digital pitch level inputs
- Automatic inflection
- On-chip master clock circuit
- Optional external master clock
- Variety of voice effects
- Sound effects
- Customer product security

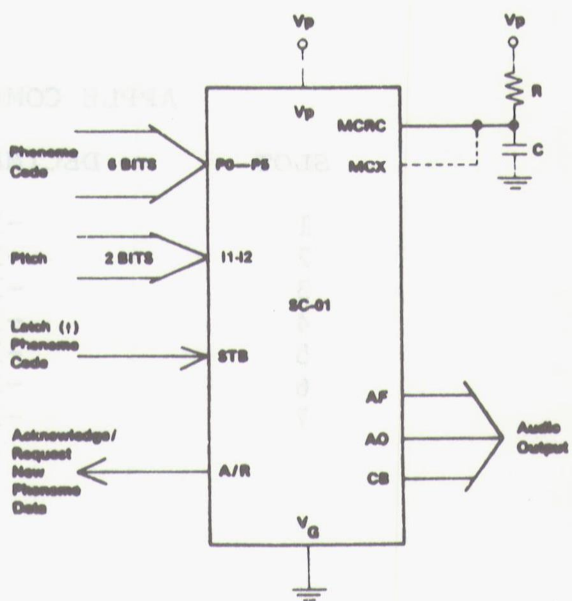


Figure 2. SC-01 Flow Diagram

Votrax® reserves the right to alter its product line at any time, or change specifications or design without notice and without obligation.

PHYSICAL DESCRIPTION

The SC-01 Speech Synthesizer is a 22 pin Large Scale Integrated Circuit which contains all the circuitry necessary to generate phonetically synthesized speech. The SC-01 is fabricated using CMOS technology, which offers high input impedance and low power drain.

ELECTRICAL DESCRIPTION

The SC-01 Speech Synthesizer is a program-compatible with existing Votrax® phoneme synthesizers. It requires 70 bits of data per second for continuous speech production. The 6-bit phoneme codes are 5 volt logic compatible and are latched for data bus applications. A phoneme-construction algorithm and filters, within the chip, create the synthesized audio output.

PHONEME DESCRIPTION

Table 1 lists the 64 phonemes produced by the SC-01. Each phoneme code is accompanied by its symbol, average duration time, and an example. The underlined segments of the example word demonstrate the phoneme use, i.e., sound to be pronounced.

Table 2 subdivides the 64 phoneme symbols into seven categories. Each category represents a different production feature. The first six categories are characterized by voiced, fricative (expired voice), and nasal sounds. The seventh category is characterized by phonemes with no sound output.

PHONEME PROGRAMMING

Manual Operations: Votrax® maintains a library of phonetically programmed words. Reference to this library and programming manuals will aid in word synthesis.

Automatic Operations: Votrax® can supply a micro-computer system for automatic conversion of English text into phoneme sequences. This system is particularly useful for in-house vocabulary development and product security. Contact Votrax® for further information.

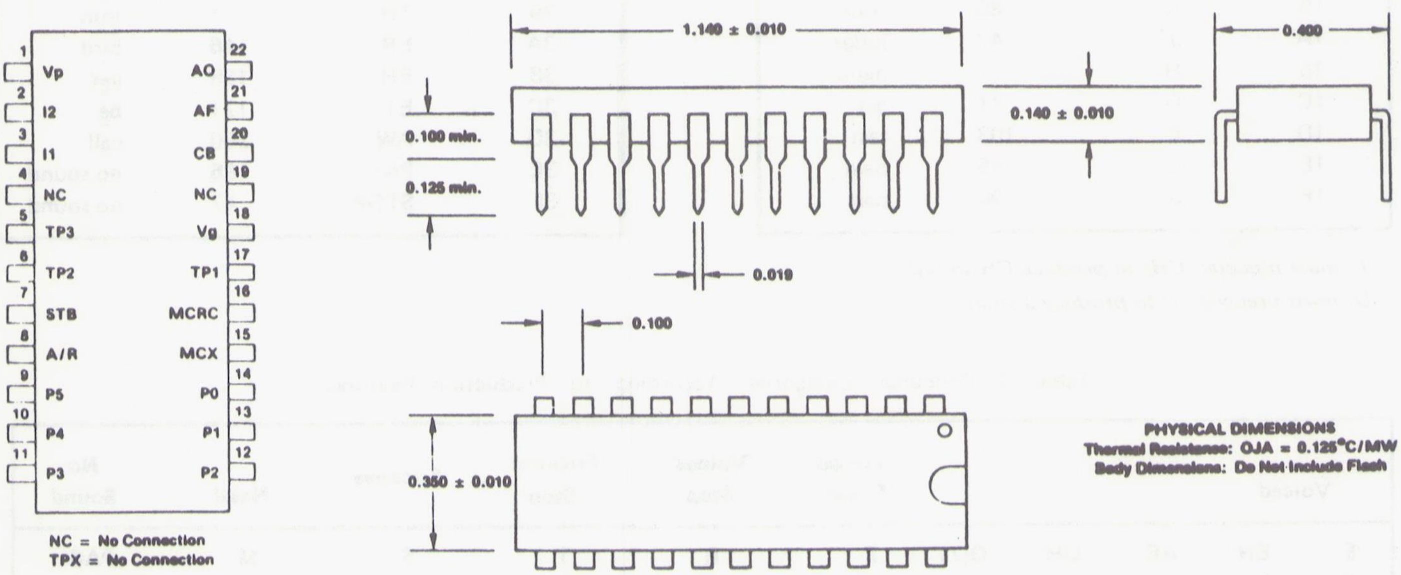


Figure 3. SC-01 Footprint and Outline Dimensions

Votrax® reserves the right to alter its product line at any time, or change specifications or design without notice and without obligation.

Table 1. Phoneme Chart

Phoneme Code	Phoneme Symbol	Duration (ms)	Example Word
ØØ	EH3	59	jacket
Ø1	EH2	71	enlist
Ø2	EH1	121	heavy
Ø3	PAØ	47	no sound
Ø4	DT	47	butter
Ø5	A2	71	made
Ø6	A1	103	made
Ø7	ZH	90	azure
Ø8	AH2	71	honest
Ø9	I3	55	inhibit
ØA	I2	80	inhibit
ØB	I1	121	inhibit
ØC	M	103	mat
ØD	N	80	sun
ØE	B	71	bag
ØF	V	71	van
1Ø	CH*	71	chip
11	SH	121	shop
12	Z	71	zoo
13	AW1	146	lawful
14	NG	121	thing
15	AH1	146	father
16	OO1	103	looking
17	OO	185	book
18	L	103	land
19	K	80	trick
1A	J*	47	judge
1B	H	71	hello
1C	G	71	get
1D	F	103	fast
1E	D	55	paid
1F	S	90	pass

Phoneme Code	Phoneme Symbol	Duration (ms)	Example Word
2Ø	A	185	day
21	AY	65	day
22	Y1	80	yard
23	UH3	47	mission
24	AH	250	mop
25	P	103	past
26	O	185	cold
27	I	185	pin
28	U	185	move
29	Y	103	any
2A	T	71	tap
2B	R	90	red
2C	E	185	meet
2D	W	80	win
2E	AE	185	dad
2F	AE1	103	after
3Ø	AW2	90	salty
31	UH2	71	about
32	UH1	103	uncle
33	UH	185	cup
34	O2	80	for
35	O1	121	aboard
36	IU	59	you
37	U1	90	you
38	THV	80	the
39	TH	71	thin
3A	ER	146	bird
3B	EH	185	get
3C	E1	121	be
3D	AW	250	call
3E	PA1	185	no sound
3F	STOP	47	no sound

/T/ must precede /CH/ to produce CH sound.
/D/ must precede /J/ to produce J sound.

Table 2. Phoneme Categories According to Production Features

Voiced					'Voiced' Fricat.	'Voiced' Stop	Fricative Stop	Fricative	Nasal	No Sound
E	EH	AE	UH	OO1	Z	B	T	S	M	PAØ
E1	EH1	AE1	UH1	R	ZH	D	DT	SH	N	PA1
Y	EH2	AH	UH2	ER	J	G	K	CH	NG	STOP
Y1	EH3	AH1	UH3	L	V		P	TH		
I	A	AH2	O	IU	THV			F		
I1	A1	AW	O1	U				H		
I2	A2	AW1	O2	U1						
I3	AY	AW2	OO	W						

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SIGNAL DESCRIPTION (See Figures 4 and 5)

Phoneme 6-Bit Selection Code (P0-P5): Data input is to six pins. Latching is controlled by the strobe (STB) signal.

Strobe (STB): Latching occurs on rising edge of strobe signal.

Inflection Level Setting (I1, I2): Instantaneously sets pitch level of voiced phonemes.

Acknowledge/Request ($\overline{A}$/R): Acknowledges receipt of phoneme data (signal goes from high to low one master clock cycle following active edge of STB signal). Also indicates timing out of old phoneme concurrent with request for new phoneme data (signal goes from low to high).

NOTE

If external phoneme timing is desired, phoneme requests can be ignored. However, best speech is realized with internal timing.

Master Clock Resistor-Capacitor (MCRC): This input determines the internal master clock frequency. Select R-C values for 720 kHz to achieve standard phoneme timing. Connect this input to MCX when using internal clock; ground when using external clock.

NOTE

Varying clock frequency varies voice and sound effects. As clock frequency decreases, audio frequency decreases and phoneme timing lengthens. Figures 6 and 7 illustrate manual and DAC (Digital to Analog Converter) voice variation schematics, respectively.

Master Clock External (MCX): Allows control by an external clock signal.

NOTE

Ground MCRC during MCX operation.

Audio Output (AO): Supplies analog signal to audio output device.

Audio Feedback (AF): Used with Class A or Class B transistor audio amplifiers for added stability.

Class B (CB): Current source for Class B transistor audio amplifier.

Table 3. Timing Specifications

CHARACTERISTIC	SYMBOL	MIN	TYP	MAX	UNIT
Input Setup Time (P_I to STB)	T_S	450			NS
Input Hold Time (P_I to STB)	T_H	0			NS
Rise Time of STB Edge (.8V to 4V)	T_{RS}			100	NS
A/R Width ($\overline{A}$/R Connected to STB) +	T_{ARW}	1	1.3	2	µs
STB Width	T_{SW}	200			NS
STB Low *	T_{SL}				NS
Propagation Delay (STB toA/R after T_{ARW})	T_{DAR}			500	NS
A/R Rise Time (Capacitive load = 30pf)	T_{RAR}			100	NS
A/R Fall Time (Capacitive load = 30pf)	T_{FAR}			100	NS
Time from $\overline{A}$/R Request to STB Service)	T_{ARS}	0		500	µs
Time of Phoneme Duration +	T_{PH}	47	107	250	MS

+ Dependent on Master Clock frequency: 720kHz

* Strobe must remain low (72x Master Clock Period) before rising edge

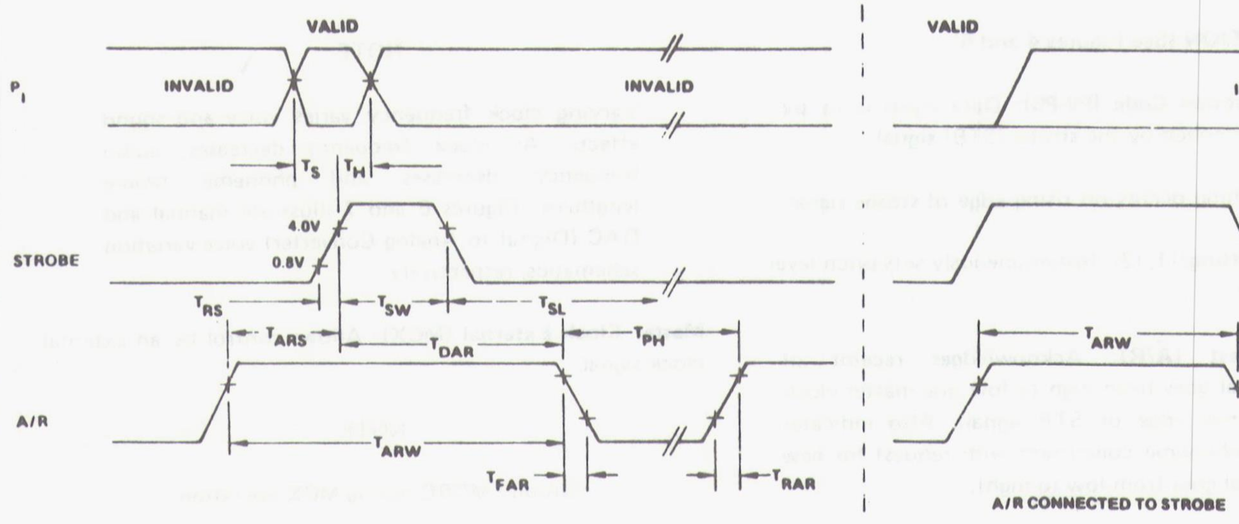

Figure 4. Timing Diagram

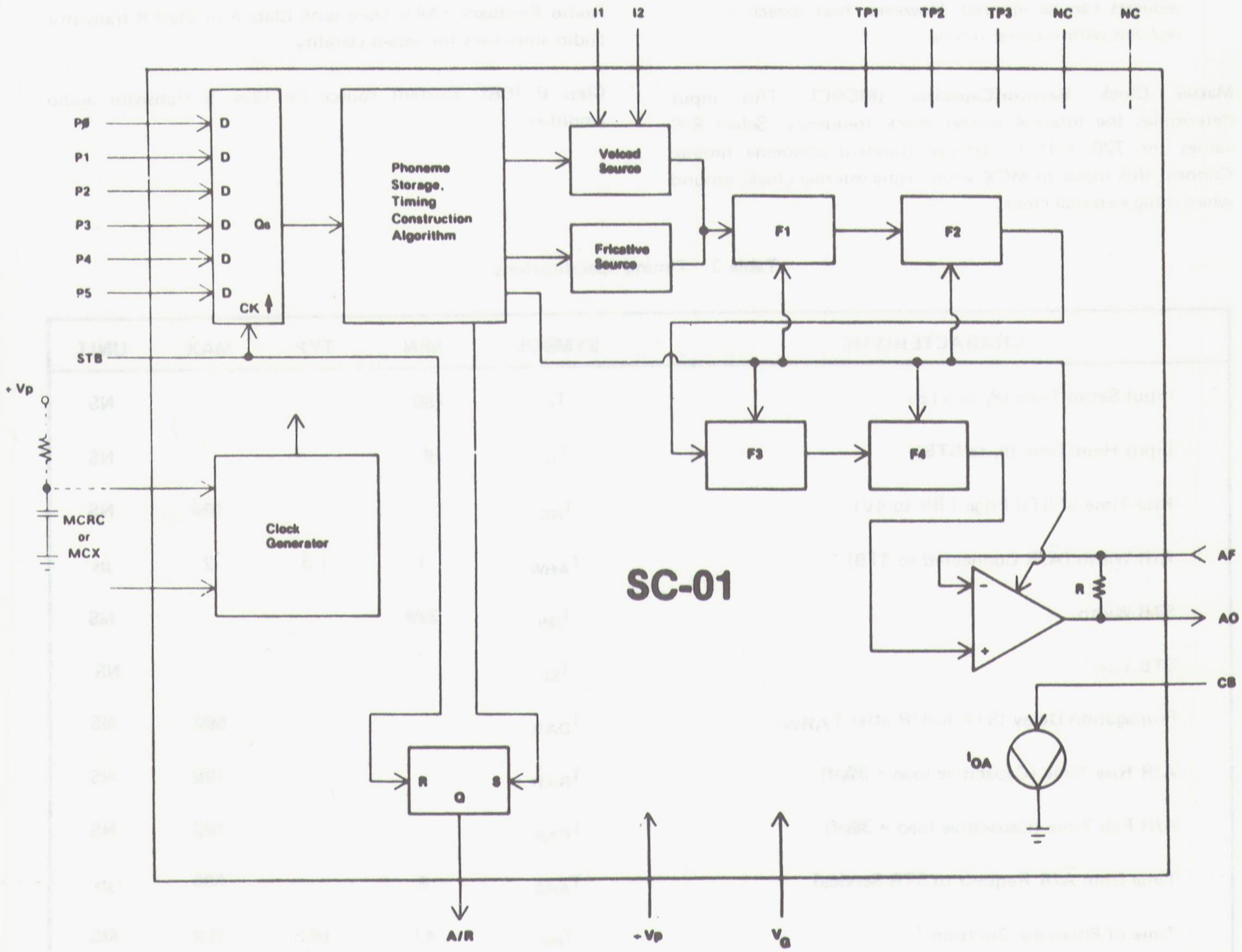

Figure 5. SC-01 Block Diagram

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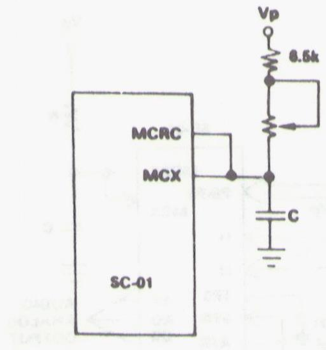

Figure 6. Variable Voice by Potentiometer Control

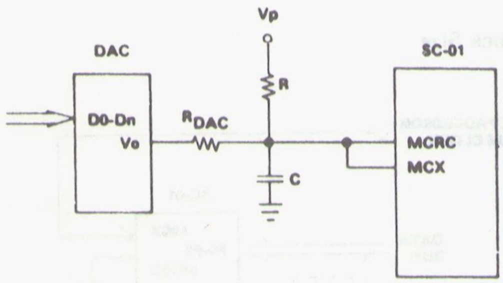

Figure 7. Variable Voice by DAC Current Injection

TYPICAL APPLICATIONS

General: The SC-01 Speech Synthesizer is easily designed into systems ranging in complexity from ROM/counters to microprocessor controllers.

Single Message System: See Figure 8. When the counter is released (START is TRUE), the message is clocked out of the ROM by the A/R signal. The system must be stopped when DONE is TRUE. Note: When using A/R tied to STB, connect a .01 uf capacitor to TP3 to insure power up reset of SC-01.

NOTE

Data at address Ø must be a pause phoneme code.

Multiple Message, Fixed Block Size: See Figure 9. Message address block is loaded into the counter. The message is then clocked out of the ROM by the A/R signal.

NOTE

Message Block = 2^n maximum.

Multiple Message, Variable Block Size: See Figure 10. The microprocessor loads phonemes into a data bus. The A/R signal generates an interrupt request for each new phoneme.

CONNECTING THE AUDIO OUTPUT DEVICE

Audio Output: The AO signal has a maximum peak to peak voltage swing of .26 times Vp, depending upon the phoneme selected, and the AO signal is D.C. biased.

Class A Amplifier: See Figure 11. For a single transistor amplifier, the selection of R, C, or R_s values depends upon the value of Vp and the desired audio level.

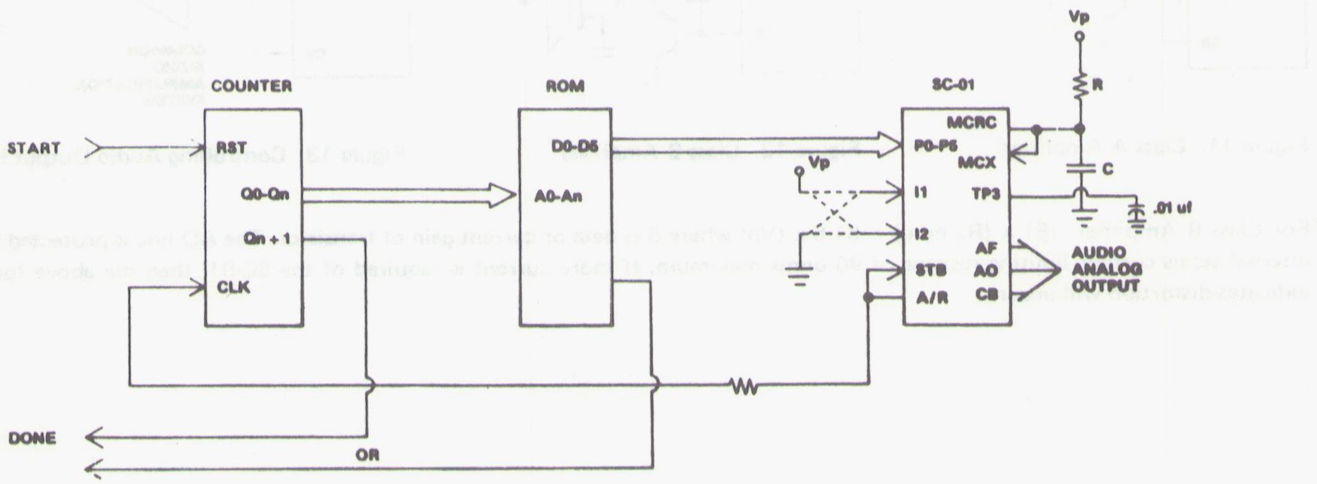

Figure 8. Single Message System

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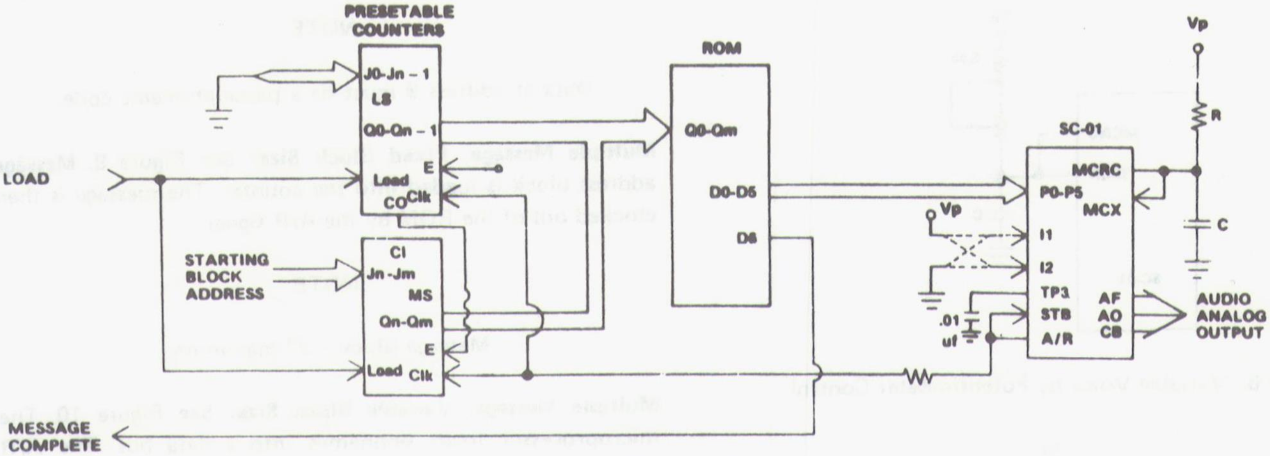

Figure 9. Multiple Message, Fixed Block Size

Class B Amplifier: See Figure 12. A current source (CB) is required for this push-pull amplifier.

NOTE

Minimum power is consumed when speech is inactive. When Vp = +12.0 volts and R_s = 40 ohms, the bias current drain is approximately 3.5 milliamps.

Controlling Audio Output Power: See Figure 13. A resistor or potentiometer from the speaker to ground can be used to control the audio output power.

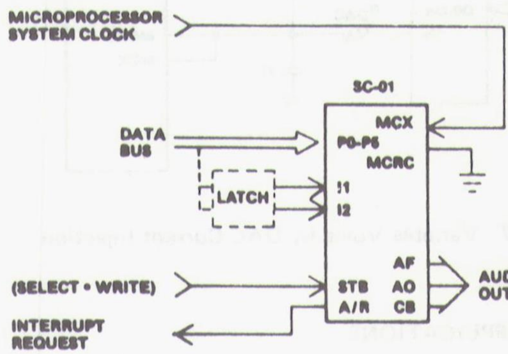

Figure 10. Multiple Message, Variable Block Size

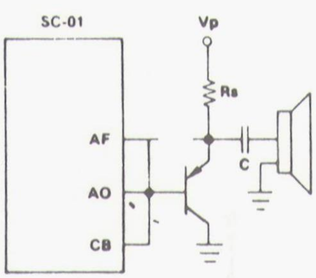

Figure 11. Class A Amplifier

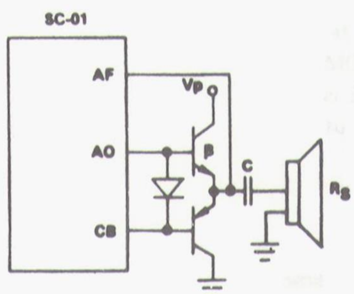

Figure 12. Class B Amplifier*

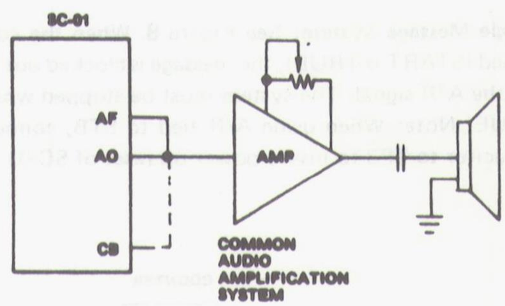

Figure 13. Controlling Audio Output Power

*For Class B Amplifier: (β) x (R_s min.) = 81.6 x (Vp) where β is beta or current gain of transistor. The AO line is protected by an internal series current limiting resistor of 90 ohms maximum. If more current is required of the SC-01, then the above formula indicates distortion will occur.

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Table 4. Analog Output Specifications

CHARACTERISTIC	MIN	MAX	UNIT
Output Voltage (AH Phoneme)	.18 x Vp	.26 x Vp	Vp-p
Output Bias Current ** (.6V < CB < Vp)	3.5	7.3	mA

ELECTRICAL CHARACTERISTICS: T_o = ∅ to 7∅°C, Vp = 7 to 14 V_{DC}

CHARACTERISTIC		MIN	TYP	MAX	UNIT
Digital Input Impedance		1 meg.			Ohm
Input Capacitance (P_I, STB)				3	pf
Input Capacitance (I1, I2, MCX)				8	pf
Digital Input Logic "∅" (except I1, I2, MCX)		V_G - ∅.5		V_G + ∅.8	V_{DC}
Digital Input Logic "∅" (MCX)				V_G + 1.∅	V_{DC}
Digital Input Logic "∅" (I1, I2)				.2 x Vp	V_{DC}
Digital Input Logic "1" (except I1, I2, MCX)		V_G + 4.∅		Vp + ∅.5	V_{DC}
Digital Input Logic "1" (I1, I2)		.8 x Vp			V_{DC}
Digital Input Logic "1" (MCX)		4.6			V_{DC}
Digital Output Logic "∅" (I sink = ∅.8mA)				V_G+∅.5	V_{DC}
Digital Output Logic "1" (I source = ∅.5mA)		Vp–∅.5			V_{DC}
Power Supply Current	Vp = 9V		9.1		mA
	Vp = 9V**		11	18	mA
	Vp = 14V**		18	27	mA
*Master Clock Frequency			720K		Hz
MCX Input Duty Cycle		60:40		40:60	%
Master Clock Resistor Value (MCRC)***		6.5k			Ohm
Master Clock Capacitor Value (MCRC)***				3∅∅	pf

**Variable*

***With CB, AF, AO connected for Class B audio amplifier (see APPLICATION NOTES)*

****Frequency of Master Clock* ≃ 1.25 / RC

Note: TP1, TP2 must be left open for normal operation.

Table 5. Absolute Maximum Ratings

ABSOLUTE MAXIMUM RATINGS *

RATING	SYMBOL	VALUE	UNIT
Power Supply Voltage	Vp	20	V_{DC}
Power Dissipation at 25°C	P_{DM}	650	mW
Derating Above 25°C		5	mW/°C
Operating Ambient Temperature	T_o	Ø to 7Ø	°C
Storage Temperature	T_{STG}	−55 to 125	°C
Input Voltage	V_{INM}	−Ø.5 to Vp+Ø.5	V_{DC}
DC Current Max. Above Vp+Ø.5V	I_{INM}	1.Ø	ma
Lead Temperature (soldering 1Ø sec.)	T_L	3ØØ	°C

* *Operation above these limits could damage the device.*

NORMAL OPERATING CONDITIONS: $7v \leq Vp \leq 14v$, $0°C \leq T_o \leq 70°C$

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WARRANTEE

Factory manufactured and tested Parallel SWEET TALKER and A-II SWEET TALKER boards carry a 60 day warrantee including parts and labor. No credit will be given for boards which show damage through neglect or user modification. Any unit returned for repair after the warrantee period must be shipped prepaid and insured. There is a minimum inspection fee for boards not under warrantee. Under no circumstances is any hardware to be returned to the MICROMINT without prior authorization. The MICROMINT will assume no liabilities for unauthorized returns.

The MICROMINT makes no warrantee on user assembled boards, power supplies, or blank boards.

The MICROMINT reserves the right to change any specification at any time.