THE MICROMOUTH SPEECH SYNTHESIZER INTERFACE

OWNERS MANUAL AND ASSEMBLY INSTRUCTIONS

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Introduction

Advances in the production of high density LSI chips and new techniques to synthesize speech have reduced the cost of voice output systems an order of magnitude. Attaching a speech synthesizer to your computer is now as reasonable as adding any other peripheral.

The dividing line in cost is primarily the number of words that the synthesizer can speak. Limited vocabulary synthesizers such as the TMS 0280 in the Texas Instruments Speak-and-Spell, or any others that have their vocabulary stored totally in ROM, are generally less expensive. Speech interfaces using phoneme synthesizers such as the Votrax usually require the help of a computer program to generate extended voice output.

The Micromouth is one of the more cost effective limited vocabulary voice synthesizers. It uses the new DIGI-TALKER DT1050 chip set from National Semiconductor which has a stored vocabulary of 144 expressions.

Using this interface it is possible to add voice output to monitoring functions, computer games, and calculations. It can say "THE TIME IS 6:40 PM" and "NUMBER 4 IS SET AT 6.35 VOLTS" just as easily as "CONTROL ERROR..." or "DANGER...A STAR IS ON THE LEFT AT 1000 METERS".

The Digi-Talker Micromouth board is plug compatible with the APPLE II and TRS-80 Model I computers. It is bus compatible with other computers such as Digital Group or Heath H8, and can be connected to any computer with an 8 bit parallel port (such as a printer port). It requires no software beyond a simple BASIC statement to say any expression in the vocabulary list. For example, OUT 127,120 (or POKE -16001,120 in the APPLE II) will say "PLEASE".

The designs and attributes of the Micromouth Speech Processor Board will be discussed in detail later. First, a little background on speech synthesis techniques in general and then the Digi-Talker in particular.

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 spectrual parameters are derived from basic word sounds. A phoneme generator in turn is 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. In most cases, the electronic voice generated is quite intelligible but may have a "mechanical or non-human" quality about it. Continuous speech using phoneme synthesis can generally be accomplished with less than 400 bits/second data rate. This technique is used by the Votrax Division of Federal Screw Works in their SC-01 Speech Synthesizer Chip and other products.

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. Quality 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 very old technique produces speech by generating a waveform with the amplitude characteristics of voice in contrast to parameter encoding methods which represent speech in terms of frequency. The simplest form is uncompressed digital data recording called pulse-code modulation.

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.

One major advantage of digitally encoded speech is its human quality. 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. The clarity of the reproduction depends on the speech compression method used.

Unfortunately, one problem in using PCM alone is that it requires very high data rates. 100 KBits/sec are not unusual with this method. To reduce the data rate it is necessary to compress the speech data. One compression method is called delta modulation. As in PCM, the analog speech waveform is sampled, but this time only the changes in amplitude between samples are stored. Since speech contains many redundant sounds and silences, these changes are much less than than the absolute amplitude of the waveform. Delta modulation therefore reduces the amount of memory required to store a library of words.

Ultimately, the total memory required for continuous speech becomes a function of exotic compression algorithms. Data rates as low as 2400 bits/sec have been achieved. The National Semiconductor Digi-Talker DT-1050 speech synthesis chip set uses data compressed digitized speech.

Digi-Talker

The Micromouth synthesized speech board is based upon the National Semiconductor DT-1050 speech-synthesizer chip set. The chip set consists of a speech processor (SPC) and and two 64 Kbit ROMs.

The speech processor uses PCM encoding with a comprehensive data compression algorithm developed by Forest Mozer at the University of California. The primary compression method employed is delta modulation. As previously described, this concept recognizes that speech is generally smooth and continuous. Rather than storing the absolute amplitude of the voice signal (remember, analog values are stored as digital numbers, the larger the voltage the more bits are necessary to represent it), the differences between successive samples are stored instead. During speech reconstruction, successive amplitudes in the output waveform are obtained by adding the difference (delta value) to the previous value.

The speech processor also uses phase-angle adjustment and half-period zeroing compression techniques. Phase-angle adjustment is based on the concept that the intelligibility of speech is not determined by the phase angle of its Fourier components. Therfore, these values can be adjusted to produce a waveform with mirror symmetry. Being symmetrical, the redundant data need not be stored twice.

In half-period zeroing, the low amplitude portion of a signal is reproduced as silence. For the most part, only the center half of any pitch period needs to be stored since the center half contains most of the amplitude. The remainder of the waveform contains relatively little of significance and can be reduced to silence.

The 144 expression Digi-Talker vocabulary was initially recorded through a microphone, then differentiated and digitized. A computer program was applied to the data to perform phase-angle adjustment, delta-modulation, and half-period zeroing. The redundant pitch periods and phonemes were reduced to individual stored periods and number of times they are repeated (usually 3 to 8). The resulting data containing frequency, amplitude, and control information is stored in the 128 Kbit (2 X 64K) speech ROMs.

Each block of speech data contains a control word specifying the ROM location of an expression, the type of wave form to be generated and the number of times to repeat it. Speech data from the ROM is loaded into the SPC's data register and passed on to the delta-modulator decoder. This results in a 4 bit number that is applied to the D/A. Successive and regressive digitizations produce a final waveform that is generated in real time.

The Micromouth Hardware

In general, saying any of the 144 stored expressions is done just by loading a word code into the SPC. The code (selected from the enclosed list) is latched when the write enable and chip select lines are strobed. The SPC immediately commences speaking the addressed expression. If the input code is 0, corresponding to "THIS IS DIGI-TALKER", it takes approximately 1.3 seconds to say. A word like "AT" takes much less time. If another word address is strobed into the SPC while it is speaking, it will terminate the current output and begin the new expression. To keep from jamming one word on top of another, a handshaking signal (INTR) goes to a logic low when the SPC is talking.

The Micromouth board is designed to be signal compatible with a number of computers or exercised through a parallel I/O port. Connector J1 is plug compatible with the APPLE II and connector J2 is compatible with the TRS-80 Model I

The Micromouth board is designed to accomodate bidirectional as well as unidirectional buses. The data bus is normally attached to pins 8 thru 15 of IC1. The busy line from the SPC, INTR, is jumpered (either JP4 or JP5) to accomodate the particular bus being used. For TRS-80 and APPLE II which both have bidirectional data buses, JP5 is inserted to connect the INTR output to the D0 bus line. During an input command intended to read the status of this line, only the least significant bit (LSB) will be affected. For a unidirectional bus such as a Digital Group computer, JP4 would be inserted and IC6 pin 5 connected to the LSB of the input bus. Detailed connetion instructions will be given later.

ICs 4,5, and 6 perform address decoding and chip selection. The port address of the board is set by inserting JP1 or JP2. With JP1 installed, the address is port 7F hex (127 decimal). With JP2 intalled, it is port FF hex (255 decimal). On the APPLE II the address depends upon the slot in which the board is inserted. An address map for the Micromouth Speech Processor board installed in an APPLE II is provided.

The Speech Processor chip requires 7 to 11 volts for normal operation while the ROMs and other ICs only require 5 volts. To accomodate the different ranges two separate voltage regulators are used. IC9 can safely accomodate an input range of 12 to 24 volts. When installed in an APPLE II it receives 12 volts from the bus. On the TRS-80 a separate 22 VCT power transformer supplies approximately 15 VRMS. IC9 and Z1 regulate the input to the SPC to about 9 volts. IC10 in turn reduces this to the 5 volts required by the rest of the components.

The typical current requirements of the Micromouth Speech Processor Board circuitry is about 250 mA. Most of this is consumed by the two 64 Kbit ROMs which are only used a few microseconds at a time. A memory enable signal, ROMEM, is used with a transistor (Q1) to gate the power on and off to the ROMs. The average current required ends up being about 80 mA.

The final interface section is the filter and amplifier, ICs

7 and 8. As in any digitized speech output, a low pass filter is required. For low pitched male voices the cutoff frequency should be about 100 Hz and for high pitched female or children's voices it should be 300Hz. The filter on the Micromouth board has a cutoff frequency around 150 Hz. The frequency response of the output speaker and the dynamics of its enclosure can also affect sound quality.

Using the Speech Processor Board with BASIC

The main attribute of a canned speech synthesizer is low software overhead. With the Micromouth Speech Processor board voicing any or all of the 144 expressions can be accomplished using a simple BASIC OUT or POKE command.

To say "TWENTY" for example, you would execute an OUT 127,20 in BASIC. In the APPLE II rather than OUT statements they use POKE. The appropriate command would be POKE -16001,20 if the board is installed in slot 1. The information communicated, a decimal 20, is the same even though the command may be slightly different (program examples use only OUT statements and port 127 consistently).

Saying words in series can be handled in one of two ways. One way is to use timing loops or other program execution steps to allow enough time for a word to be spoken before loading the SPC with the next word code. The preferred method is to check the busy line (INTR) before loading the next word. In this way speech can sound continuous regardless of the length of each word. The INTR status bit is read as the LSB of INP(127) (or INP(255) if JP2 is installed). In the examples provided, when the SPC was talking INP(127) was equal to 1 and, when it was clear INP(127) was equal to 0.

This may vary from computer to computer. With the Micromouth attached and powered but not speaking, read the the value of INP(127), (PRINT PEEK(-16001) in an APPLE II). This is the "not busy" value. When the Micromouth is speaking, the LSB of that port will change from a 0 (not speaking) to a 1 (speaking). Depending upon the affect of system connections to the other 7 bus lines, the absolute value you read can be anything between 0 and 255. In the Digital Group computer for example, the bus is held low and the values are 0 and 1. The TRS-80 can be either this or 254/255 depending upon the brand of expansion interface. It is best to experimentally read this port to properly define the particular port value for your machine when it is talking.

It is necessary to use this handshaking INTR line to finish one word before loading another. For example, the number 21, which consists of "TWENTY" and "ONE" sucessively, would be said as follows:

```
100 OUT 127,20 : GOSUB 1000 : OUT 127,1
110 END

1000 IF INP(127)=1 THEN GOTO 1000 ELSE RETURN
```

A similar program can be used to dump the entire Digi-Talker vocabulary:

```
100 FOR N=0 to 143 : OUT 127,N : GOSUB 1000 : NEXT N
110 END

1000 IF INP(127)=1 THEN GOTO 1000 ELSE RETURN
```

Longer statements are typically handled by preloading all the word codes using DIM statements and then just calling the list. Such a technique is used to say, "AT THE MARK THE TIME IS 2:45 PM ....(BEEP)".

```
100 DIM N(15)
110 DATA 61,138,105,71,138,139,96,2,4,5,47,44,71,71,65
120 FOR X=1 to 15 :READ N(X) : NEXT X

150 FOR X=1 TO 15 : OUT 127,N(X) : GOSUB 1000 : NEXT X
160 END

1000 IF INP(127)=1 THEN GOTO 1000 ELSE RETURN
```

Listing 1 is a simple program for saying multiplication tables. While most of you probably know them by this point, there might be some children around that are still learning. This program asks the operator to choose a multiplication table between 1 and 10. If 8 were chosen for example, the program would say:

```
ZERO TIMES EIGHT EQUALS ZERO
ONE  TIMES EIGHT EQUALS EIGHT
TWO  TIMES EIGHT EQUALS SIXTEEN
.
.
TEN  TIMES EIGHT EQUALS EIGHTY
```

Listing 2 is a program which further exercises the interface and demonsrtates a few more applications. Speech example A says, "BEEP..BEEP...BEEP...BEEP...THE TIME IS...TWELVE HOURS... SEVENTEEN MINUTES..........BEEP". It is very much like the time verbal time message on CHU Canada heard on a short wave radio.

Speech example B illustrates how process control applications might be handled. It says, "CONTROL ERROR ... MARK SEVEN TWENTY PM ....FLOW RATE IS THIRTY GALLONS A MINUTE..... LOWER SPEED TO TWELVE HUNDRED RPM AND SET FLOW RATE TO ONE HUNDRED GALLONS A MINUTE...".

Assembling the Micromouth Board

Step 1 --- Insert and solder the three IC sockets. Note that there is an indentation or dot designating pin 1. The sockets should line up with the silk screen on the board.

Step 2 --- Insert and solder all resistors and capacitors. Note the polarity of the electrolytic capacitors (C1, C2 and C7) and orient the positive side of the capacitor with the "+" marked on the board. Insert and solder R4, Q1, and the crystal (the crystal should lie flat - a dab of glue helps secure it).

Step 3 --- Insert and solder D1, D2, and Z1. Note the polarity of these devices. The bar side of the component should line up with the silk screen on the board. Insert and solder IC9 and IC 10. No heat sinks are required. No other IC's should be inserted at this time.

Step 4 --- If you are constructing a TRS-80 version, solder the transformer leads to the designated solder pads. The black lead goes to point A; the white (sometimes green instead) lead goes to point B; and the red lead goes to CT. Plug in the transformer. The voltage at IC9 pin 2 should be between +8.5V and +9.5V. The voltage at IC10 pin 2 should be between +4.75V and +5.25V. If either is incorrect, disconnect the power and check the transformer connections and diode polarities. (APPLE owners can make these checks by plugging the Micromouth board into a peripheral shot and powering up the computer).

Step 5 --- After determining that the power is correct, insert and solder all ICs except ICs 1, 2, and 3. Repeat the same proceedure outlined in step 4.

Step 6 --- Install Jumpers

For the TRS-80 install JP1 (or JP2 for port 255), JP5, and JP9.

For the APPLE II install JP1 (or JP2 for port C1FF), JP5, and JP10.

NOTE: No other jumpers should be installed! Unless otherwise specified, jumper positions not designated for connection should be left open. These other jumpers are provided to allow a variety of connection options to the Micromouth. A table is included which explains their functions. Also, only one connector, either J1 or J2, can be in use at a time. Nothing should be attached to the unused connector.

Step 7 --- Carefully insert ICs 1, 2, and 3 into the sockets. Be careful with IC1 and treat it as a CMOS device (avoid static). Note that one ROM chip is labeled SSR1 while the other is labeled SSR2. SSR1 should be inserted into IC2 and SSR2 should be inserted into IC3. Note that the chips have an indentation on one edge. This indentation should line up with the silk screen.

Step 8 --- With both the Micromouth and computer unpowered, attach the Micromouth board to the computer. For an APPLE II, insert the board into peripheral slot 1. For a TRS-80 Model I attach the 40 conductor jumper cable between J2 and the keyboard (or J3 on the Expansion Interface) connector. Attach an 8 Ohm speaker between points X and Y on the Micromouth board.

Step 9 --- Apply power to the computer (on a TRS-80 the Micromouth power module should be plugged in first). Sometimes on powerup, arbitrary sounds with come from the speaker. This is OK. Execute and OUT 127,0 (POKE -16001,0 for an APPLE II) in BASIC. The Micromouth should say "This is Digi-Talker". That completes the testing proceedure.

Using a Parallel Port Instead of the Data Bus

The Micromouth Speech Processor board can also be jumpered to accomodate parallel port connection. This is accomplished by inserting jumpers JP6, JP8 and JP9 (all other open). +12V to +15V can be applied to pin 39 of J2 and ground to pin 8. With address input pins 36, 38, 35, 31, 34, 40, 27, and 25 on J2 left open, a constant chip select will be generated. The 8 bit parallel output from the computer is attached to pins 20, 24, 28, 18, 26, 32, 22, and 30 on J2. The processor busy status, available at pin 21, is handled by directly reading the INTR line via an input port.

To load the word code into the SPC, the same signal that latches the 8 bit computer data bus onto the output port can be used as the write enable strobe. An alternative method is to use another parallel output bit to simulate the strobe. Which ever is used, the write enable strobe is applied to J2 pin 12 (normally high, strobing low).

Connecting Micromouth to the Digital Group Z-80 and S100 Bus

Micromouth can be connected to a Digital Group or S100 system either through a parallel port as described above or by jumpering the J2 connector signals directly to the bus. Both the Digital Group and S100 computers have unidirectional data buses but this can be accomodated. For I/O port 127 decimal operation on either system, install jumpers JP1, JP4, JP6, and JP9.

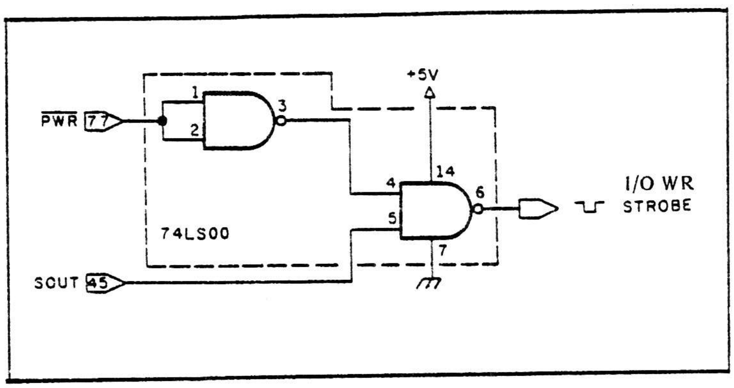
A cross reference list of J2 versus DG I/O and S100 Bus pin numbers are as follows:

J2	Signal	DG I/O	S100
39	+12 V	22	2 (+16V)
8	GND	2	100
12	I/O WR	X	see below
19	I/O RD	11	see below
36	A7	W	83
38	A6	V	82
35	A5	U	29
31	A4	T	30
34	A3	S	31
40	A2	R	81
27	A1	P	80

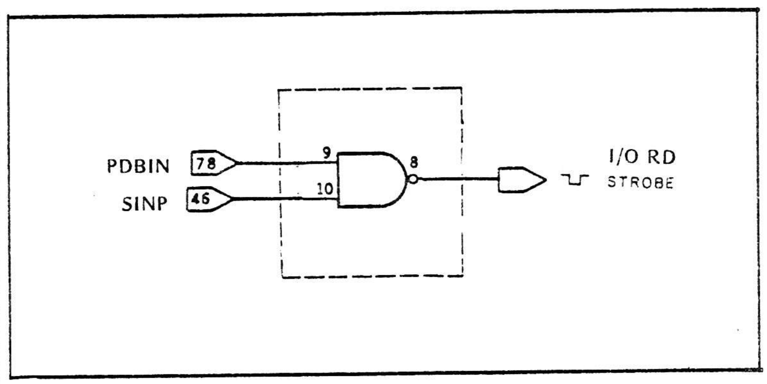
(Continued from Page 8)

25	A0	N	79
23	D0 IN	10	95
20	D7 OUT	C	90
24	D6 OUT	D	40
28	D5 OUT	E	39
18	D4 OUT	F	38
26	D3 OUT	H	89
32	D2 OUT	J	88
22	D1 OUT	K	35
30	D0 OUT	L	36

S100 I/O WR



S100 I/O RD



* Digi-Talker is a trade mark of National Semiconductor Corp.

Connecting Micromouth to the H-8

Connecting the Micromouth Speech Processor board to an H-8 computer can be done either through a parallel port or directly to the bus. If connected directly to the H-8 bus the H-8 signals will have to be inverted. The schematic demonstrates the hardware conversion necessary. The output of the converter is attached to the J2 connector of Micromouth Speech Processor board. The board can be powered from the +18V H-8 supply (pin #47) through J2 pin 39 if jumper JP6 is installed. When using this higher voltage, it may be necessary to add a heatsink to IC9.

If connecting the Micromouth to the H-8-2 board, the Micromouth Speech Processor board should be jumpered to accommodate parallel port connection. This is accomplished by inserting jumpers JP6, JP8 and JP9 (all other open). With address input pins 36, 38, 35, 31, 34, 40, 27, and 25 on J2 left open, a constant chip select will be generated. The 8 bit parallel output from the computer is attached to pins 20, 24, 28, 18, 26, 32, 22, and 30 on J2. (The processor busy status, available at pin 21, is handled by directly reading the INTR line via an input port.)

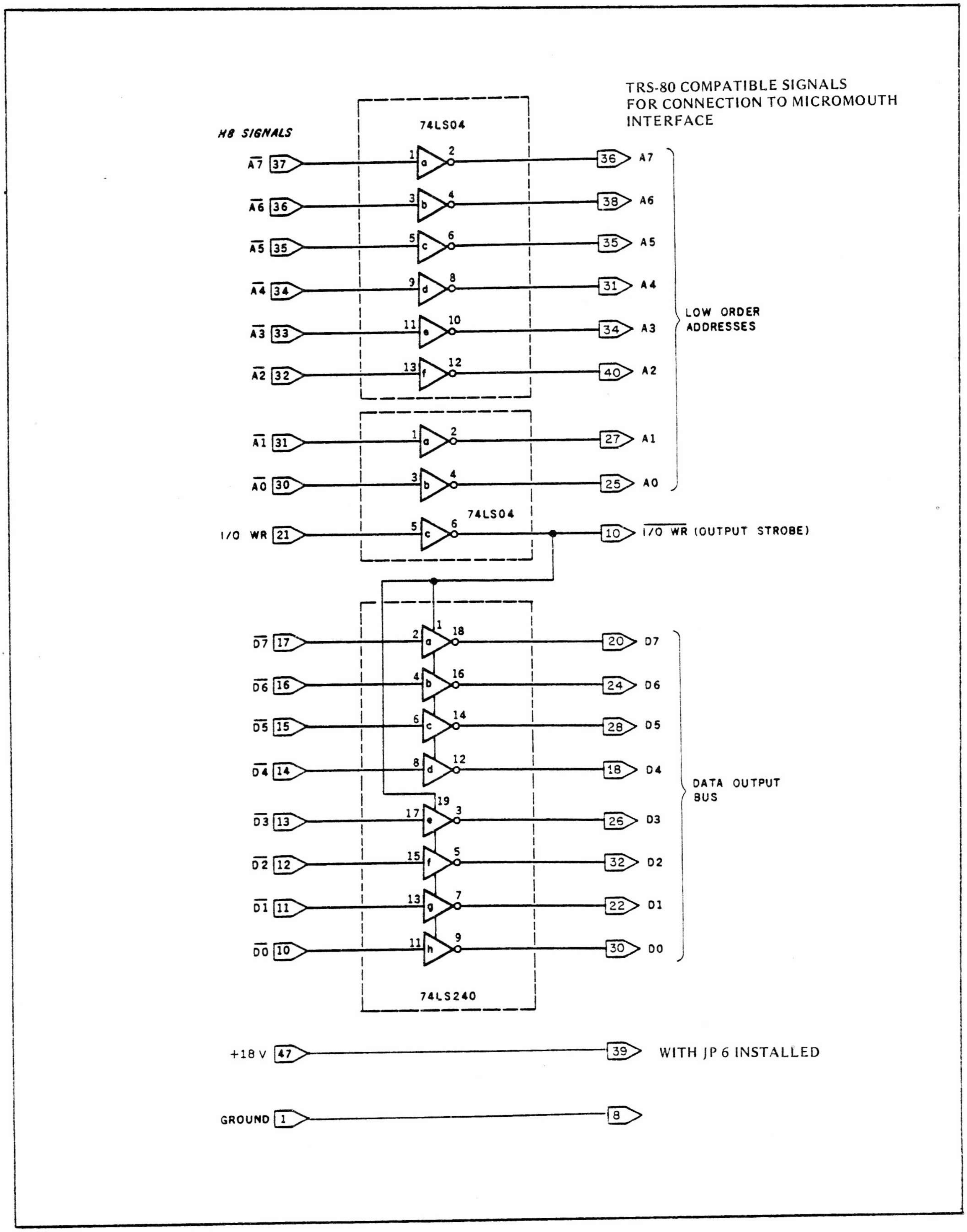
Select a port from 0 to 99 and install the jumpers for your particular channel. A1-A2, B1-B2, C1-C2, E1-E2. It is not necessary to invert the data signals on the H-8-2 board since this is taken care of through the E1-E2 jumper.

Signal	H-8-2 pin	J2 pin
D0	1	30
D1	2	22
D2	3	32
D3	4	26
D4	5	18
D5	6	28
D6	7	24
D7	8	20
GND	9 & 10	8

The H-8-2 board will have to be initialized before it can operate. The following is the typical proceedure in BASIC:

```
100 OUT xxx,129
110 OUT xxx,129              where:
120 OUT xxx,64                     xxx= control port
130 OUT xxx,78                     nnn= data output port
140 OUT xxx,5
150 OUT nnn,data
```

H8/Micromouth Interface



Notes For TRS-80 Users

The Micromouth Speech Processor board can be used on a number of computers. However there are differences between computers even of the same brand. The TRS-80 model I seems to be particularly susceptible to variations in performance. This is primarily due to manufacturing improvements that were incorporated during the three years it was in production. The TRS-80 is particular sensitive to having peripherals attached to its expansion bus (J3) connector and often programs will hang as a result. Generally, the problem is due to noise induced on the TEST (pin 23) and INT (pin 21) lines. If this is a problem in your system, one possible solution is to add two 4.7K pull-up resistors from pins 21 and 23 of J2 to +5V on the Micromouth board. This should minimize any interference.

Filtering ---- Additional Notes

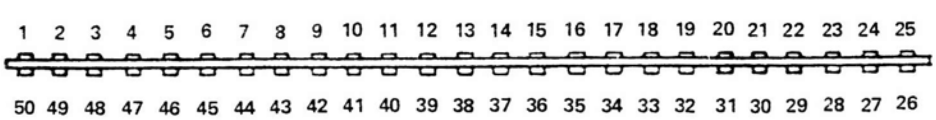
The Digi-Talker output filter provided on the Micromouth board consists of a simple low pass filter. Additional filtering could conceivably improve the sound. Overall sound quality seems equally dependent upon the filter and the speaker enclosure/dynamics. In some cases the RC filter components used in the standard Micromouth may inadaquately match your speaker and should be changed. Higher frequencies are enhanced by lowering the value of R3 (perhaps to 2.7K). Lower frequencies are enhanced by raising the values of C5 and C6. Finally, optimum performance is gained by extracting the raw audio signal at the junction of R2 and C4 and adding an external 4 pole band pass filter and amplifier.

Micromouth J1 (APPLE) Connector Pinout

PIN	SIGNAL	DESCRIPTION
1	I/O	I/O Select Strobe
2	A0	Address Bus
3	A1	Address Bus
4	A2	Address Bus
5	A3	Address Bus
6	A4	Address Bus
7	A5	Address Bus
8	A6	Address Bus
9	A7	Address Bus
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	---	Spare
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	N/C	No Connection
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	---	Spare
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 input

NOTE: Means Negative (logical"0") True Input or Output

VIEWED FACING THE CONNECTOR

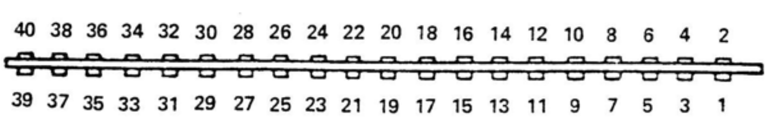


Micromouth J2 (TRS-80) Connector Pinout

PIN	SIGNAL	DESCRIPTION
1	N/C	No Connection
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	GND	Signal Ground
9	N/C	No Connection
10	N/C	No Connection
11	N/C	No Connection
12	OUT	Peripheral Write Output Strobe
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	D4	Bidirectional Data Bus
19	IN	Peripheral Read Input Strobe
20	D7	Bidirectional Data Bus
21	INT	Interrupt Input (not used)
22	D1	Bidirectional Data Bus
23	TEST	Bus Tri-state Input (not used)
24	D6	Bidirectional Data Bus
25	A0	Address Bus (LSB)
26	D3	Bidirectional Data Bus
27	A1	Address Bus
28	D5	Bidirectional Data Bus
29	N/C	No Connection
30	D0	Bidirectional Data Bus
31	A4	Address Bus
32	D2	Bidirectional Data Bus
33	N/C	No Connection
34	A3	Address Bus
35	A5	Address Bus
36	A7	Address Bus (MSB)
37	N/C	No Connection
38	A6	Address Bus
39	N/C	Optional +12V input (JP6 inserted)
40	A2	Address Bus

NOTE: Means Negative (logical"0") True Input or Output

VIEWED FACING THE CONNECTOR



Digitalker Speech Processor Interface Parts List

PART #		VALUE OR DESIGNATION
PC Board		Speech Processor PCB
IC1-IC3		DT1050 SPC Chip Set
IC4		74LS30
IC5		74LS02
IC6		74LS367
IC7		LM741 Operational Amp
IC8		LM386 Power Amp
IC9-IC10		MC7805 Voltage Regulator
Q1		TIP32 Transistor
D1-D2	*	1N4001 Diode
Z1		1N4730A Zener Diode
AC Transformer (22 VCT)	*	MICROMINT PITB-109
C1		470 Mfd. 25VDC Elec.
C2		10 Mfd. 25VDC Elec.
C3,C4,C5,C6,C8,C11		0.1 Mfd. 12VDC Ceramic
C7		100-300 Mfd. 16VDC Elec.
C9		68 Pfd. 12VDC Ceramic
C10		33 Pfd. 12VDC Ceramic
R1		330 Ohm (ORG ORG BRN)
R2,R9		3.3K (ORG ORG RED)
R3		10K (BRN BLK ORG)
R4		10K Potentiometer
R5		10 Ohm (BRN BLK BLK)
R6		1.8K (BRN GRY RED)
R7		1 Meg (BRN BLK GRN)
R8		1K (BRN BLK RED)
XTAL		4 MHz. Crystal
40 Pin Socket		1 piece (IC1)
24 Pin Socket		2 Pieces (IC2,IC3)
Speaker Connector		2 Pin Header & Mate
Misc Hdwr.		3 Screws (1/2") and Nuts
J2 Cable	*	40 cond. Ribbon cable

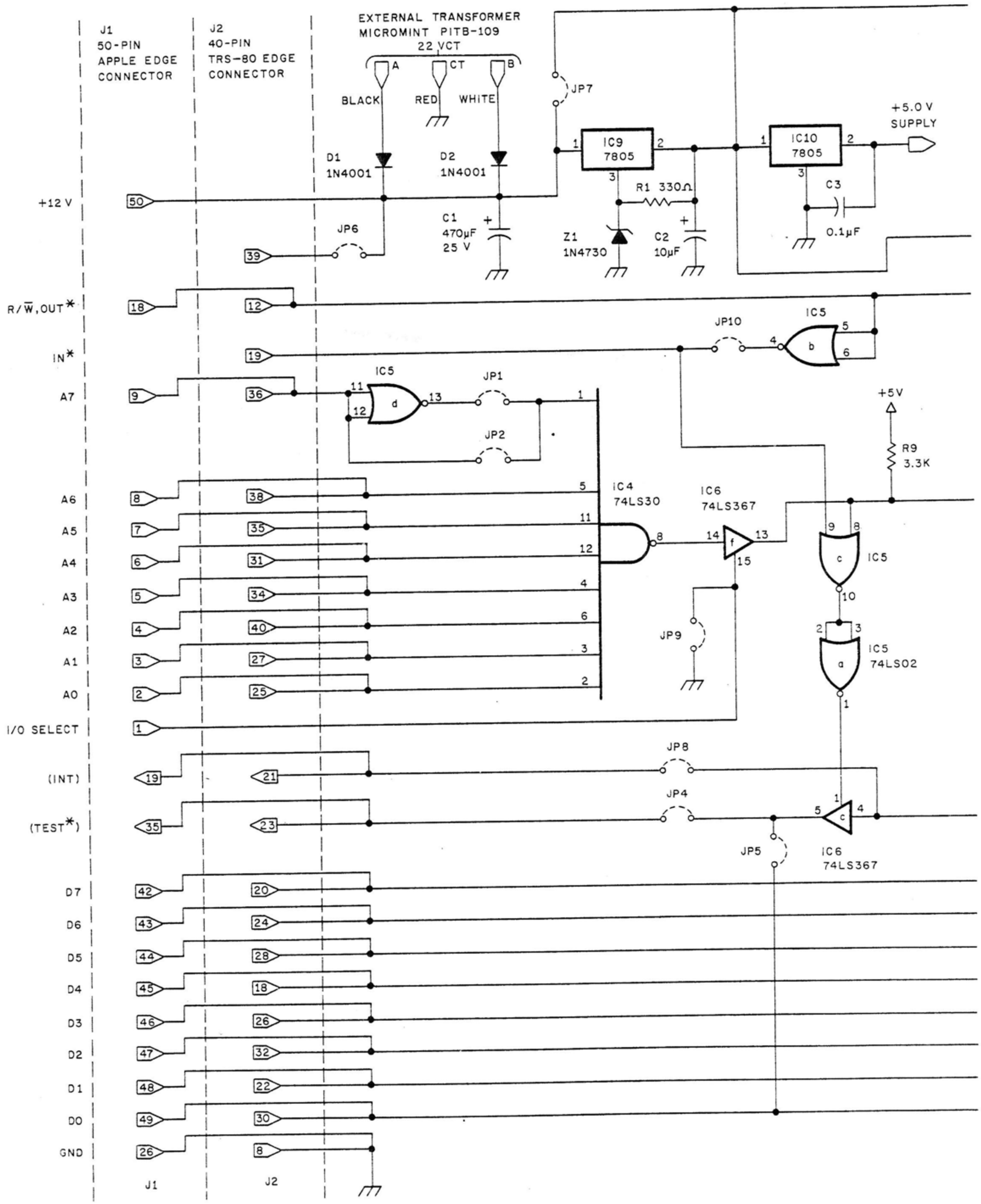
* Supplied only with TRS-80 version

Listing 1

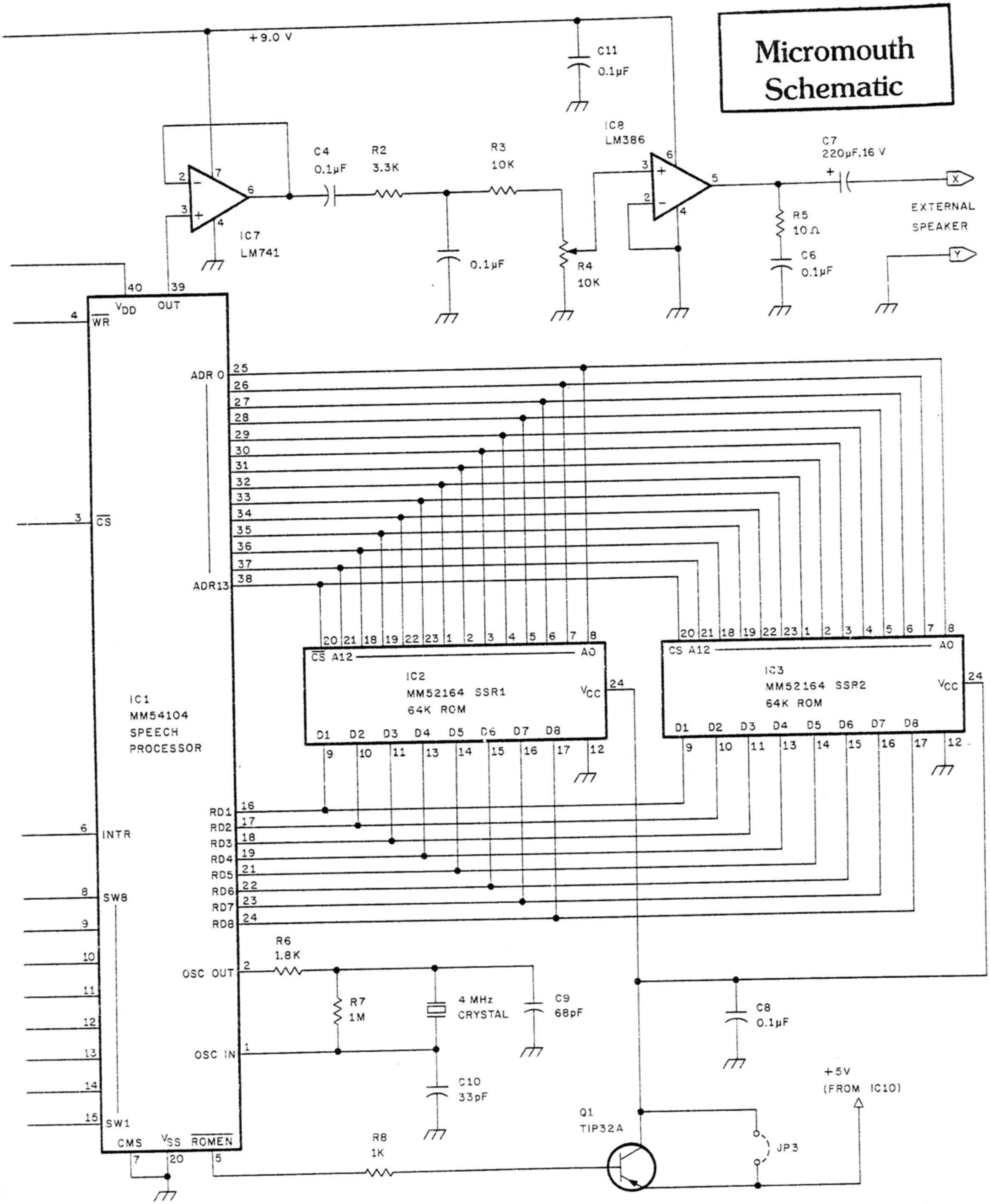
```
list

100 PRINT "MULTIPLICATION TABLE EXERCISER"
110 OUT 127,0:REM Say This is Digi-Talker
120 PRINT:PRINT"Which table do you want to review (1 to 10)";
130 INPUT N
140 FOR X=0 TO 10
150 PRINT X;"X";N;"=";X*N:J=X*N
160 IF X=0 THEN OUT 127,31:GOSUB 290:GOTO 180
170 OUT 127,X:GOSUB 290
180 GOSUB 310:OUT 127,N:GOSUB 290
190 OUT 127,80:GOSUB 290:OUT 127,129:GOSUB 290
200 J1=INT(J/10)
210 IF J=100 THEN OUT 127,1:GOSUB 290:OUT 127,28:GOSUB 290:GOTO 260
220 IF J=0 THEN OUT 127,31:GOSUB 290:GOTO 260
230 IF J<20 THEN OUT 127,J:GOSUB 290:GOTO 260
240 OUT 127,18+J1:GOSUB 290
250 IF J-J1*10>0 THEN OUT 127,J-J1*10:GOSUB 290:GOTO 260
260 NEXT X
270 PRINT:GOTO 120
280 REM
290 IF INP(127)=1 THEN 290 ELSE RETURN:REM check end of word
300 REM
310 OUT 127,139:GOSUB 290:OUT 127,129:GOSUB 290:RETURN
320 REM say TIMES

READY
```

Listing 2

```
list

50 DIM N(20),M(60)
55 DATA 71,138,139,96,71,12,69,93,129,71
60 DATA 17,69,110,129,71,71,71,71,71,71,71
65 FOR T=1 TO 19: READ N(T):NEXT T
70 DATA 65,71,76,71,71,75,81,71,71,105,71,7,20,47,44,71,71
75 DATA 83,125,96,1,28,21,6,85,129,32,110,71,71,104,133
80 DATA 2,12,28,049,047,044,60,131,83,125,2,1,28,10,85
85 DATA 129,32,110, 71,71,71,71,71
90 FOR T=1 TO 56:READ M(T):NEXT T
100 REM DIGI-TALKER TEST PROGRAM
110 PRINT "DIGI-TALKER TEST PROGRAM"
120 PRINT: PRINT"1. Say entire vocabulary"
130 PRINT"2. Count from 0 to 20"
140 PRINT"3. Tones"
150 PRINT"4. Speech example A"
160 PRINT"5. Speech example B"
165 PRINT"6. Say 'THIS IS DIGI-TALKER'"
170 PRINT:PRINT"Enter choice (1-5) ";:INPUT A
180 IF A=1 THEN GOSUB 250
190 IF A=2 THEN GOSUB 300
200 IF A=3 THEN GOSUB 350
210 IF A=4 THEN GOSUB 400
220 IF A=5 THEN GOSUB 450
225 IF A=6 THEN OUT 127,0:GOSUB 1000
230 GOTO 110
250 REM speak entire word list
260 FOR T=0 TO 143:OUT 127,T:GOSUB 1000
270 NEXT T: RETURN
300 REM speak numbers 0-20
310 OUT 127,31: GOSUB 1000
320 FOR T=1 TO 20: OUT 127,T: GOSUB 1000
330 NEXT T: RETURN
350 REM 80 Hz and 400 Hz tone
360 FOR T=0 TO 5:OUT 127,65:GOSUB 1000
370 OUT 127,66:GOSUB 1000:NEXT T
380 RETURN
400 REM Speak Time
410 FOR B=0 TO 5:OUT 127,65:GOSUB 1000
415 FOR C=0 TO 2:OUT 127,71:GOSUB 1000:NEXT C
420 NEXT B
425 FOR T=1 TO 18 :OUT 127,N(T):GOSUB 1000:NEXT T
430 FOR T=0 TO 5:OUT 127,65:FOR S=0 TO 100:NEXT S:NEXT T
440 RETURN
450 REM example of use as error detector and verbal annunciator
460 FOR T=1 TO 55: OUT 127,M(T):GOSUB 1000:NEXT T
470 RETURN
1000 IF INP(127)=1 THEN 1000 ELSE RETURN
1010 IF INP(127)=1 THEN 1010 ELSE RETURN

READY
```


J1
50-PIN
APPLE EDGE
CONNECTOR
J2
40-PIN
TRS-80 EDGE
CONNECTOR
EXTERNAL TRANSFORMER
MICROMINT PITB-109
22 VCT
A
CT
B
BLACK
RED
WHITE
JP7
D1
1N4001
D2
1N4001
IC9
7805
IC10
7805
+5.0 V
SUPPLY
R1 330Ω
C3
0.1µF
+12 V
JP6
C1
470µF
25 V
Z1
1N4730
C2
10µF
R/W̄,OUT*
IN*
JP10
IC5
A7
JP1
JP2
+5V
R9
3.3K
A6
A5
A4
A3
A2
A1
A0
IC4
74LS30
IC6
74LS367
JP9
IC5
74LS02
I/O SELECT
(INT)
JP8
(TEST*)
JP4
JP5
IC6
74LS367
D7
D6
D5
D4
D3
D2
D1
D0
GND
J1
J2

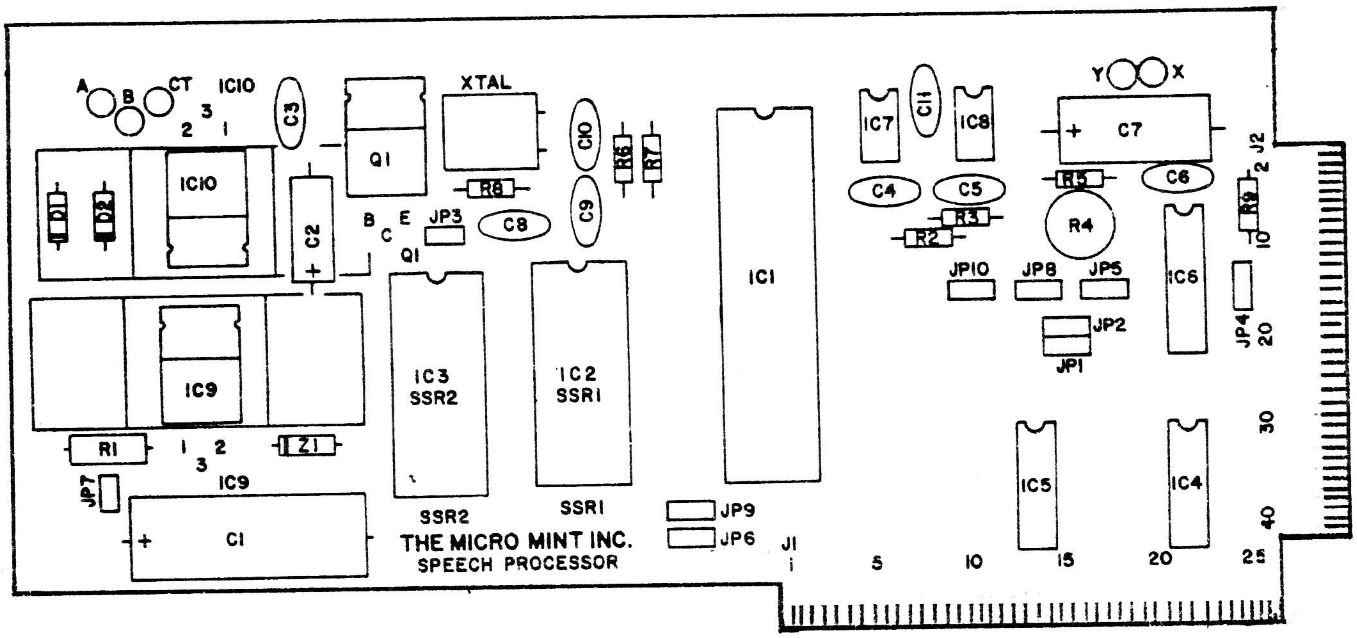
Micromouth Schematic



Digitalker Vocabulary

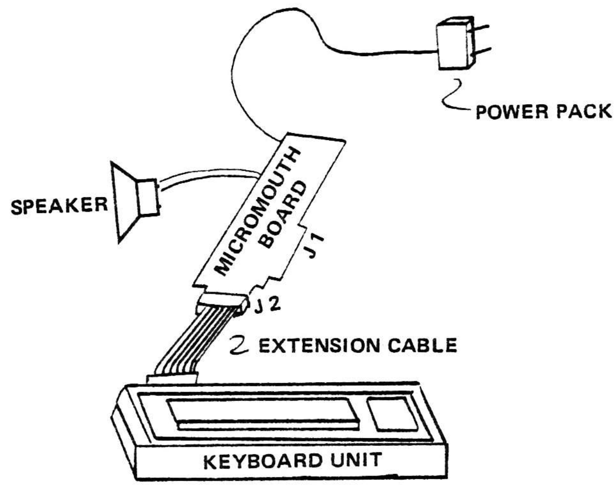
Word	Digital Address	8-Bit Binary Address SW 8 → SW 1	Word	Digital Address	8-Bit Binary Address SW 8 → SW 1	Word	Digital Address	8-Bit Binary Address SW 8 → SW 1
THIS IS DIGITALKER	000	00000000	W	054	00110110	MILLI	108	01101100
ONE	001	00000001	X	055	00110111	MINUS	109	01101101
TWO	002	00000010	Y	056	00111000	MINUTE	110	01101110
THREE	003	00000011	Z	057	00111001	NEAR	111	01101111
FOUR	004	00000100	AGAIN	058	00111010	NUMBER	112	01110000
FIVE	005	00000101	AMPERE	059	00111011	OF	113	01110001
SIX	006	00000110	AND	060	00111100	OFF	114	01110010
SEVEN	007	00000111	AT	061	00111101	ON	115	01110011
EIGHT	008	00001000	CANCEL	062	00111110	OUT	116	01110100
NINE	009	00001001	CASE	063	00111111	OVER	117	01110101
TEN	010	00001010	CENT	064	01000000	PARENTHESIS	118	01110110
ELEVEN	011	00001011	400HERTZ TONE	065	01000001	PERCENT	119	01110111
TWELVE	012	00001100	80HERTZ TONE	066	01000010	PLEASE	120	01111000
THIRTEEN	013	00001101	20MS SILENCE	067	01000011	PLUS	121	01111001
FOURTEEN	014	00001110	40MS SILENCE	068	01000100	POINT	122	01111010
FIFTEEN	015	00001111	80MS SILENCE	069	01000101	POUND	123	01111011
SIXTEEN	016	00010000	160MS SILENCE	070	01000110	PULSES	124	01111100
SEVENTEEN	017	00010001	320MS SILENCE	071	01000111	RATE	125	01111101
EIGHTEEN	018	00010010	CENTI	072	01001000	RE	126	01111110
NINETEEN	019	00010011	CHECK	073	01001001	READY	127	01111111
TWENTY	020	00010100	COMMA	074	01001010	RIGHT	128	10000000
THIRTY	021	00010101	CONTROL	075	01001011	SS (Note 1)	129	10000001
FORTY	022	00010110	DANGER	076	01001100	SECOND	130	10000010
FIFTY	023	00010111	DEGREE	077	01001101	SET	131	10000011
SIXTY	024	00011000	DOLLAR	078	01001110	SPACE	132	10000100
SEVENTY	025	00011001	DOWN	079	01001111	SPEED	133	10000101
EIGHTY	026	00011010	EQUAL	080	01010000	STAR	134	10000110
NINETY	027	00011011	ERROR	081	01010001	START	135	10000111
HUNDRED	028	00011100	FEET	082	01010010	STOP	136	10001000
THOUSAND	029	00011101	FLOW	083	01010011	THAN	137	10001001
MILLION	030	00011110	FUEL	084	01010100	THE	138	10001010
ZERO	031	00011111	GALLON	085	01010101	TIME	139	10001011
A	032	00100000	GO	086	01010110	TRY	140	10001100
B	033	00100001	GRAM	087	01010111	UP	141	10001101
C	034	00100010	GREAT	088	01011000	VOLT	142	10001110
D	035	00100011	GREATER	089	01011001	WEIGHT (Note 2)	143	10001111
E	036	00100100	HAVE	090	01011010			
F	037	00100101	HIGH	091	01011011			
G	038	00100110	HIGHER	092	01011100			
H	039	00100111	HOUR	093	01011101			
I	040	00101000	IN	094	01011110			
J	041	00101001	INCHES	095	01011111			
K	042	00101010	IS	096	01100000			
L	043	00101011	IT	097	01100001			
M	044	00101100	KILO	098	01100010			
N	045	00101101	LEFT	099	01100011			
O	046	00101110	LESS	100	01100100			
P	047	00101111	LESSER	101	01100101			
Q	048	00110000	LIMIT	102	01100110			
R	049	00110001	LOW	103	01100111			
S	050	00110010	LOWER	104	01101000			
T	051	00110011	MARK	105	01101001			
U	052	00110100	METER	106	01101010			
V	053	00110101	MILE	107	01101011			

Micromouth Parts Layout

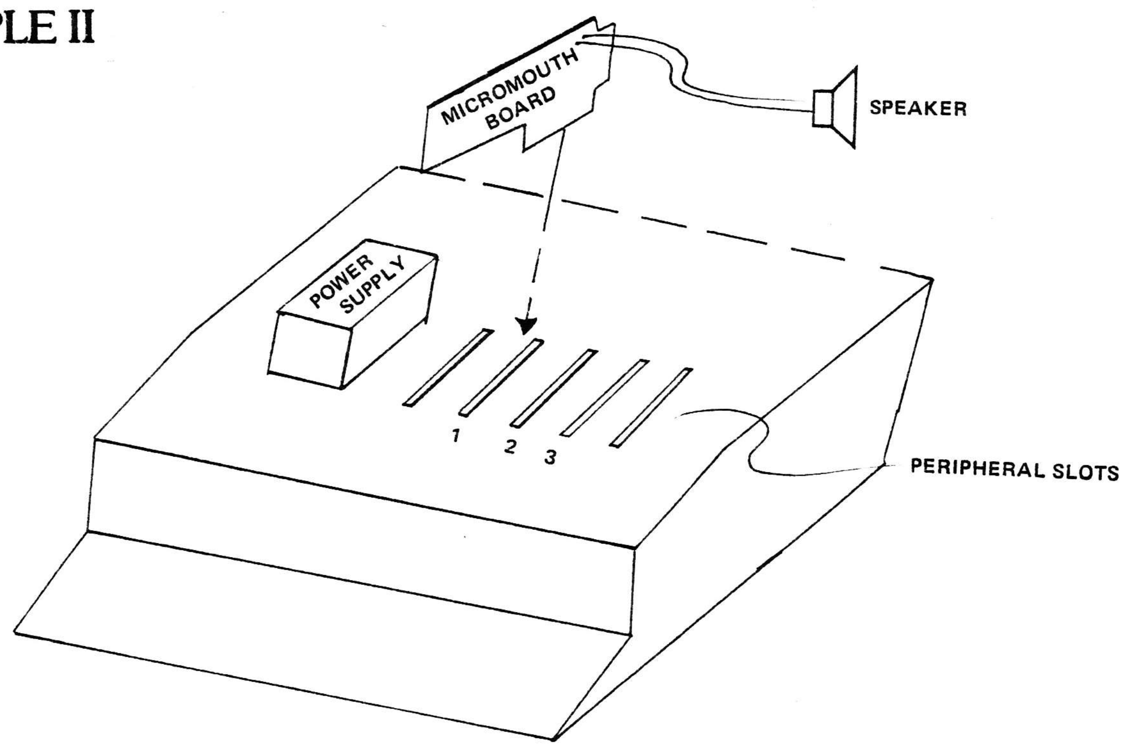


Installation Diagram

TRS-80



APPLE II



Micromouth is Radio Shack and Apple II Hardware and software compatible. Factory manufactured and tested units carry a 60 day warrantee including parts and labor. The MICROMINT makes no warantee on user assembled Micromouth systems, power supply kits, or blank boards. The MICROMINT will, however, offer an inspection and repair service for purchasers of full Micromouth kits. Prices for this service are available on request. 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, Inc. reserves the right to change any specification at any time.