

*Votrax*

1394 Rankin  
Troy, MI. 48083

## 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.

#### 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

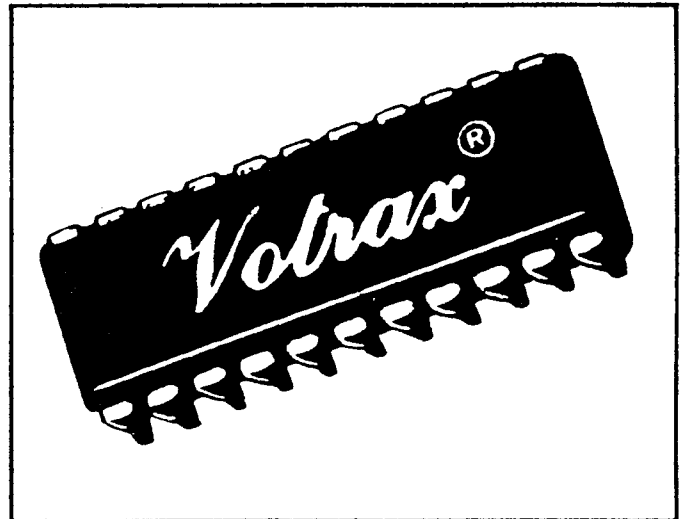


Figure 1. Votrax® SC-01 Speech Synthesizer

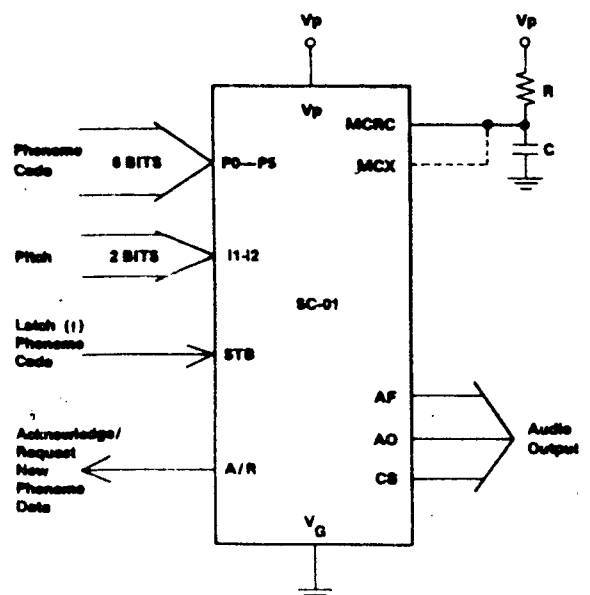


Figure 2. SC-01 Flow Diagram

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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<sup>®</sup> 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.

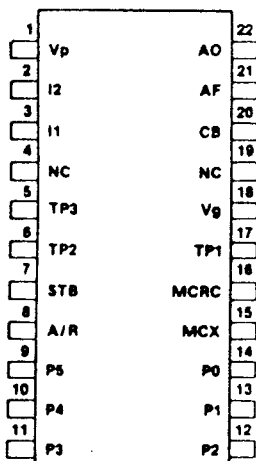
example word demonstrate the phoneme use, i.e., sound to be pronounced.

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.

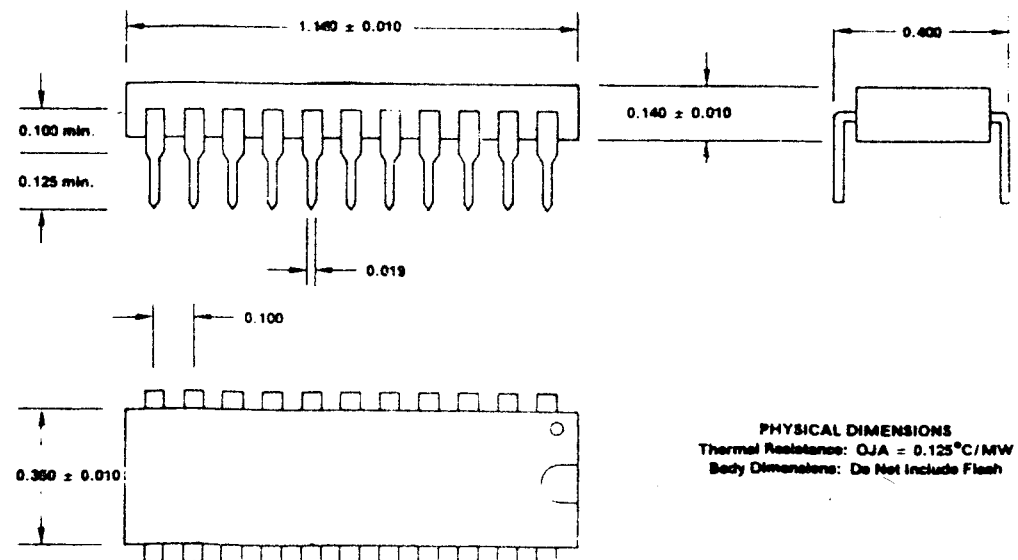
### PHONEME PROGRAMMING

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

**Automatic Operations:** Votrax<sup>®</sup> 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<sup>®</sup> for further information.



NC = No Connection  
TPX = No Connection



**PHYSICAL DIMENSIONS**  
Thermal Resistance: QJA = 0.125°C/MW  
Body Dimensions: Do Not Include Flash

Table 1. Phoneme Chart

1-8 HEX  
 9-16 PHON  
 17-24 CAT  
 25-32 DUR  
 33- EXAMPLE

Phoneme Code	Phoneme Symbol	CAT	Duration (ms)	Example Word
00	EH3	V	59	jacket
01	EH2	V	71	enlist
02	EH1	V	121	heavy
03	PA0	NS	47	no sound
04	DT	FS	47	butter
05	A2	V	71	made
06	A1	V	103	made
07	ZH	VF	90	azure
08	AH2	V	71	honest
09	I3	V	55	inhibit
0A	I2	V	80	inhibit
0B	I1	V	121	inhibit
0C	M	N	103	mat
0D	N	N	80	sun
0E	B	VS	71	bag
0F	V	VF	71	van
10	CH*	F	71	chip
11	SH	F	121	shop
12	Z	VF	71	zoo
13	AW1	V	146	lawful
14	NG	N	121	thing
15	AH1	V	146	father
16	OO1	V	103	looking
17	OO	V	185	book
18	L	V	103	land
19	K	FS	80	trick
1A	J*	VF	47	judge
1B	H	F	71	hello
1C	G	VS	71	get
1D	F	F	103	fast
1E	D	VS	55	paid
1F	S	F	90	pass

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

\*T must precede /CH/ to produce CH sound.

\*D must precede /J/ to produce J sound.

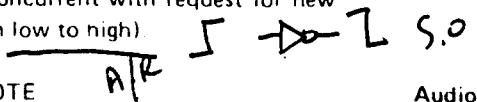
Table 2. Phoneme Categories According to Production Features

Voiced	V	VF 'Voiced' Fricat.	VS 'Voiced' Stop	FS Fricative Stop	F Fricative	N Nasal	NS No Sound			
E	EH	AE	UH	OO1	Z	B	T	S	M	PA0
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						

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

NOTE



Ground MCRC during MCX operation.

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

**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

**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.

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

Table 3. Timing Specifications

CHARACTERISTIC	SYMBOL	MIN	TYP	MAX	UNIT
Input Setup Time ( $P_1$ to STB)	$T_S$	450			NS
Input Hold Time ( $P_1$ to STB)	$T_H$	0			NS
Rise Time of STB Edge (.8V to 4V)	$T_{RS}$			100	NS
A/R Width ( $\bar{A}/R$ Connected to STB) *	$T_{ARW}$	1	1.3	2	$\mu s$
STB Width	$T_{SW}$	200			NS
STB Low *	$T_{SL}$				NS
Propagation Delay (STB to A/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 $\bar{A}/R$ Request to STB Service)	$T_{ARS}$	0		500	$\mu s$
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

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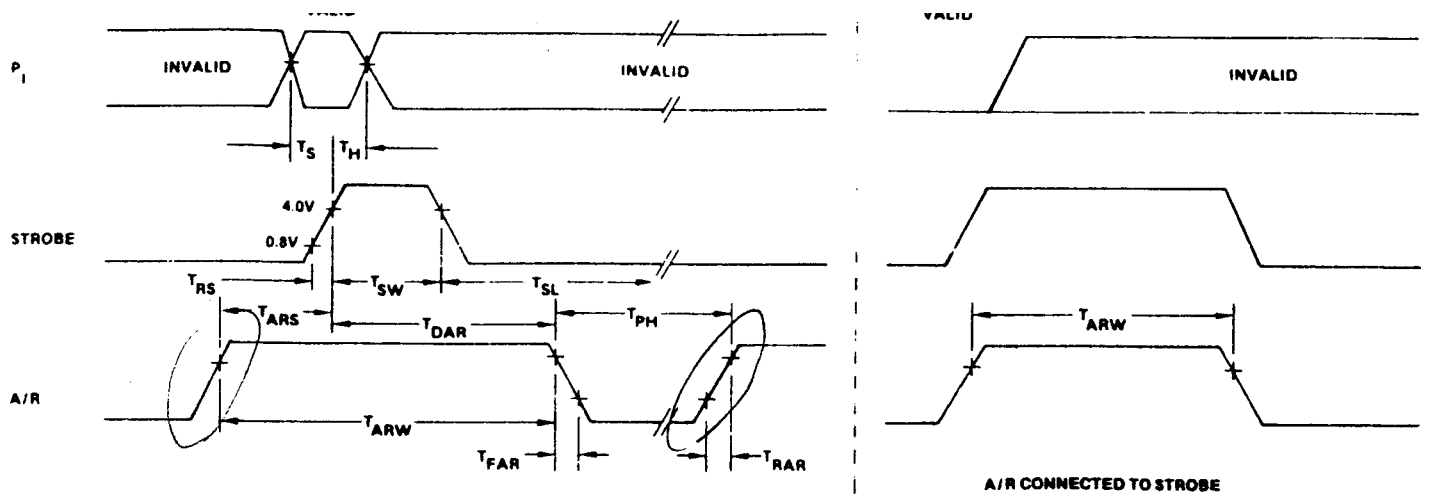


Figure 4. Timing Diagram

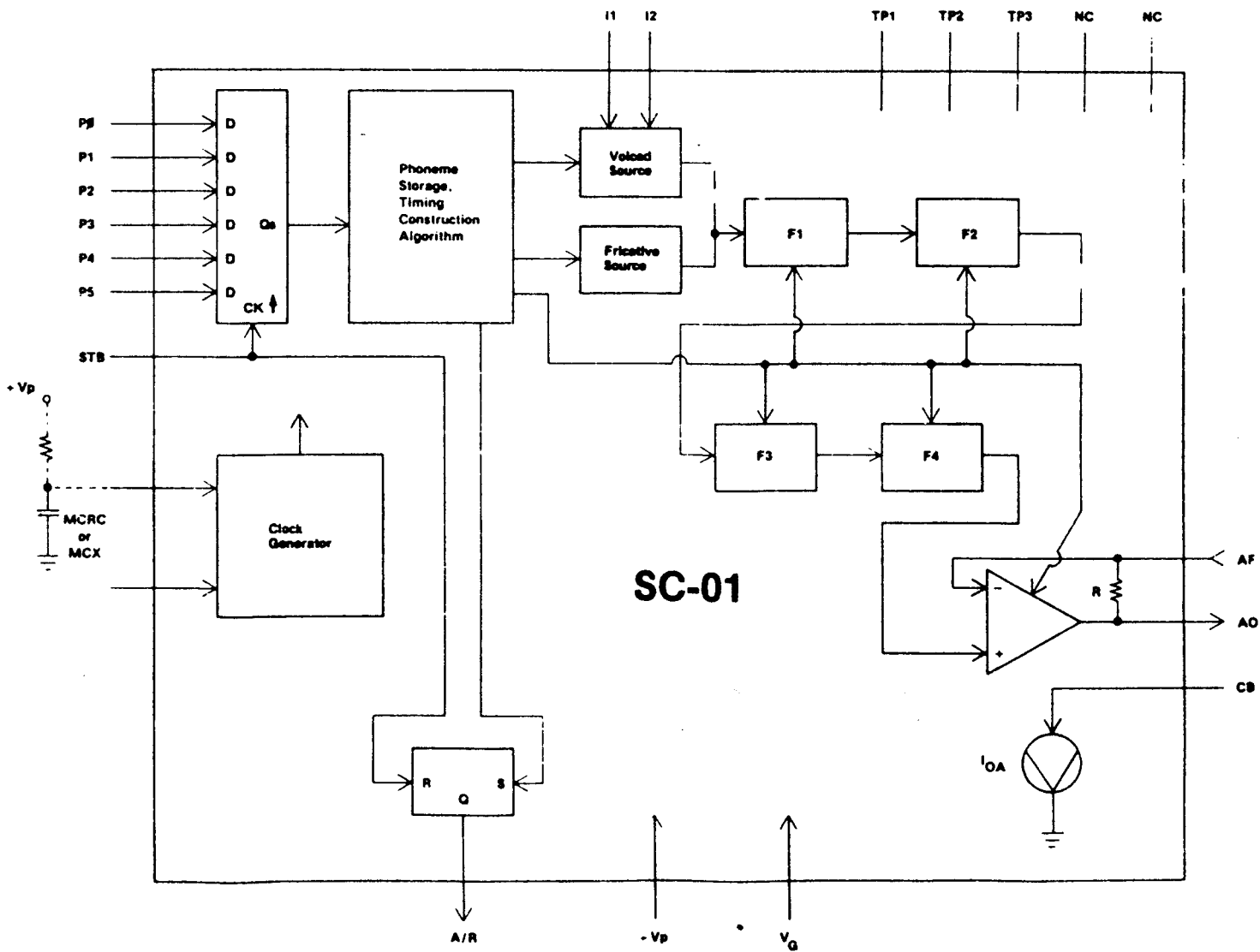


Figure 5. SC-01 Block Diagram

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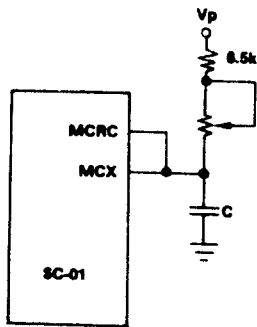


Figure 6. Variable Voice by Potentiometer Control

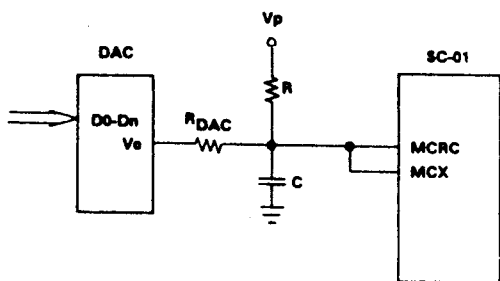


Figure 7. Variable Voice by DAC Current Injection

### 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  $\mu$ f capacitor to TP3 to insure power up reset of SC-01.

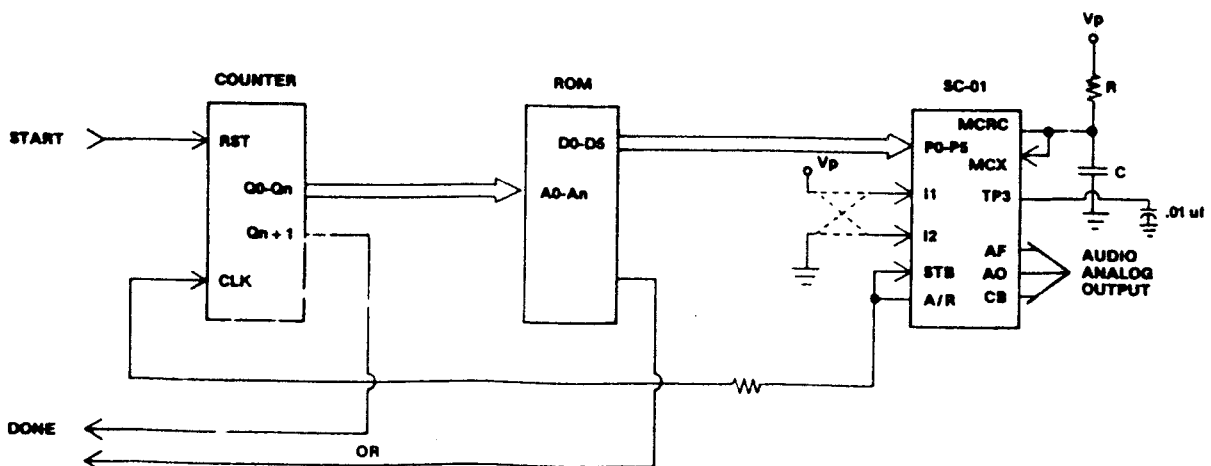


Figure 8. Single Message System

### NOTE

Data at address 0 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  $V_p$ , 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  $V_p$  and the desired audio level.

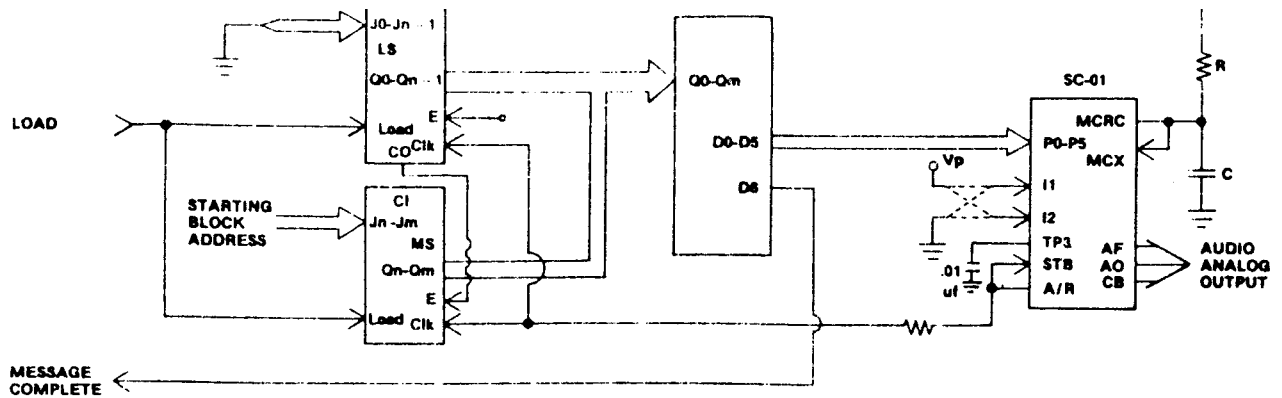


Figure 9. Multiple Message, Fixed Block Size

**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  $V_p = +12.0$  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.

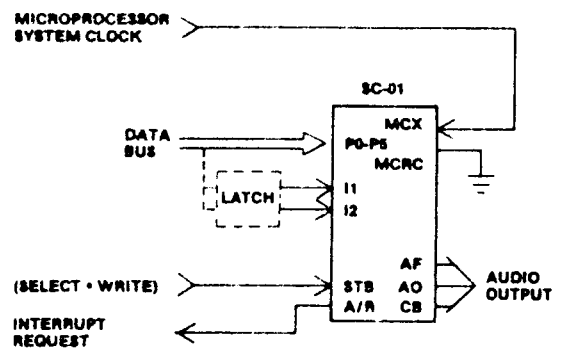


Figure 10. Multiple Message, Variable Block Size

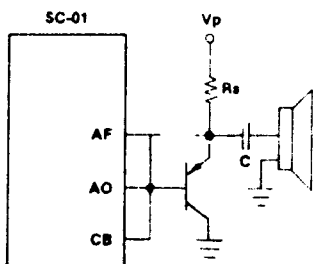


Figure 11. Class A Amplifier

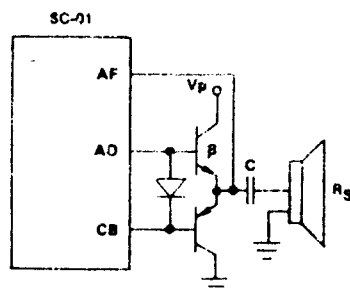


Figure 12. Class B Amplifier\*

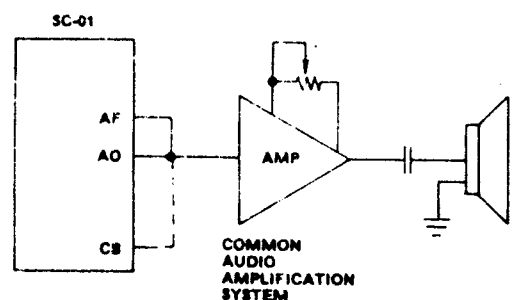


Figure 13. Controlling Audio Output Power

\*For Class B Amplifier:  $(\beta) \times (R_s \text{ min.}) = 81.6 \times (V_p)$  where  $\beta$  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

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<sub>o</sub> = 0 to 70°C, Vp = 7 to 14 V<sub>DC</sub>

CHARACTERISTIC	MIN	TYP	MAX	UNIT
Digital Input Impedance	1 meg.			Ohm
Input Capacitance (P <sub>1</sub> , STB)			3	pf
Input Capacitance (I1, I2, MCX)			8	pf
Digital Input Logic "0" (except I1, I2, MCX)	V <sub>G</sub> - 0.5		V <sub>G</sub> + 0.8	V <sub>DC</sub>
Digital Input Logic "0" (MCX)			V <sub>G</sub> + 1.0	V <sub>DC</sub>
Digital Input Logic "0" (I1, I2)			.2 x Vp	V <sub>DC</sub>
Digital Input Logic "1" (except I1, I2, MCX)	V <sub>G</sub> + 4.0		Vp + 0.5	V <sub>DC</sub>
Digital Input Logic "1" (I1, I2)	.8 x Vp			V <sub>DC</sub>
Digital Input Logic "1" (MCX)	4.6			V <sub>DC</sub>
Digital Output Logic "0" (I sink = 0.8mA)			V <sub>G</sub> + 0.5	V <sub>DC</sub>
Digital Output Logic "1" (I source = 0.5mA)	Vp - 0.5			V <sub>DC</sub>
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)***			300	pf

\*Variable

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

\*\*\*Frequency of Master Clock  $\approx 1.25 / RC$

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

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RATING	SYMBOL	VALUE	UNIT
Power Supply Voltage	V <sub>p</sub>	20	V <sub>DC</sub>
Power Dissipation at 25°C	P <sub>DM</sub>	650	mW
Derating Above 25°C		5	mW °C
Operating Ambient Temperature	T <sub>o</sub>	0 to 70	°C
Storage Temperature	T <sub>STG</sub>	-55 to 125	°C
Input Voltage	V <sub>INM</sub>	-0.5 to V <sub>p</sub> +0.5	V <sub>DC</sub>
DC Current Max. Above V <sub>p</sub> +0.5V	I <sub>INM</sub>	1.0	ma
Lead Temperature (soldering 10 sec.)	T <sub>L</sub>	300	°C

\* Operation above these limits could damage the device.

NORMAL OPERATING CONDITIONS:  $7v \leq V_p \leq 14v$ ,  $0^\circ C \leq T_o \leq 70^\circ C$

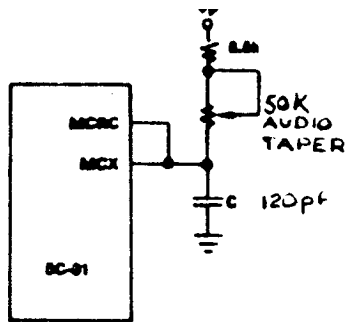


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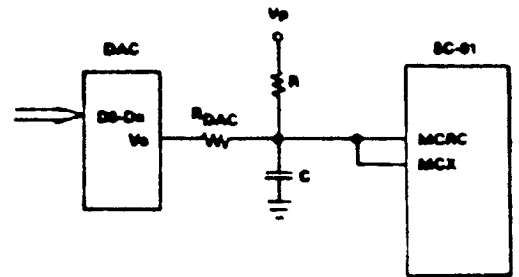


Figure 7. Variable Voice by DAC Current Injection

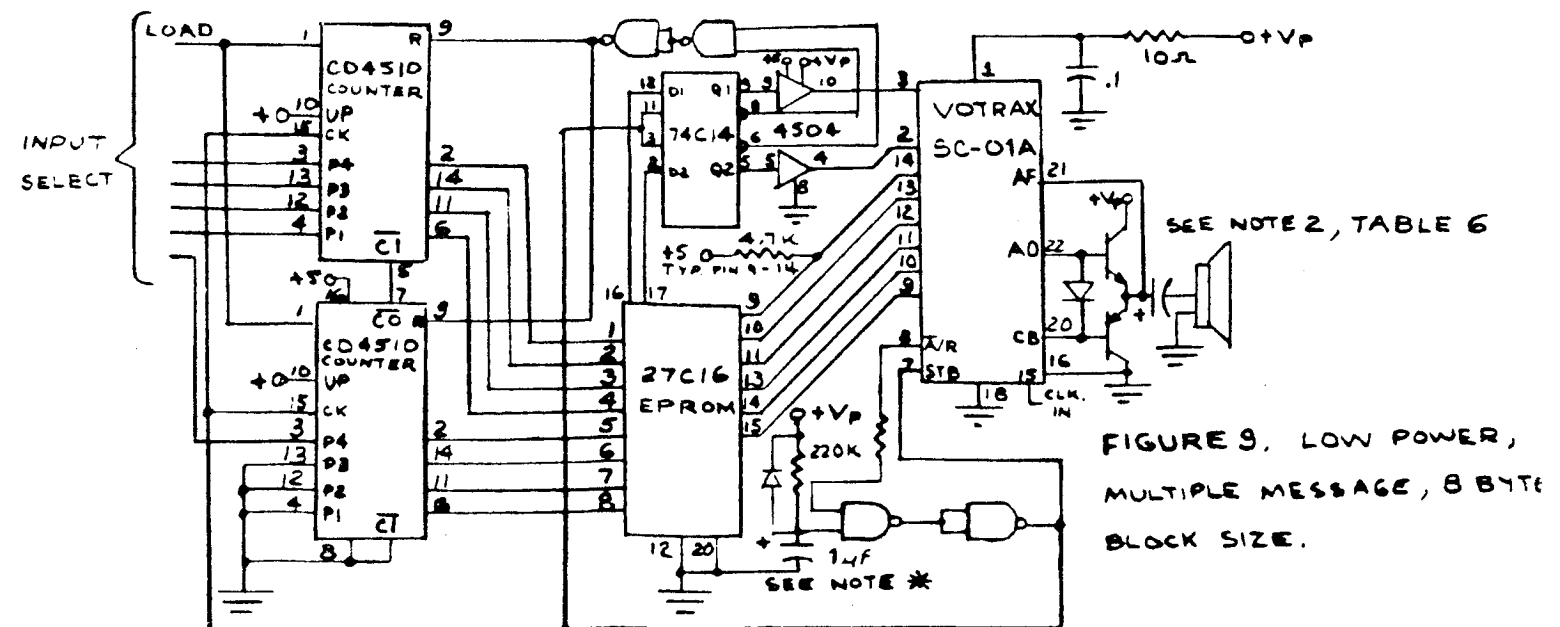
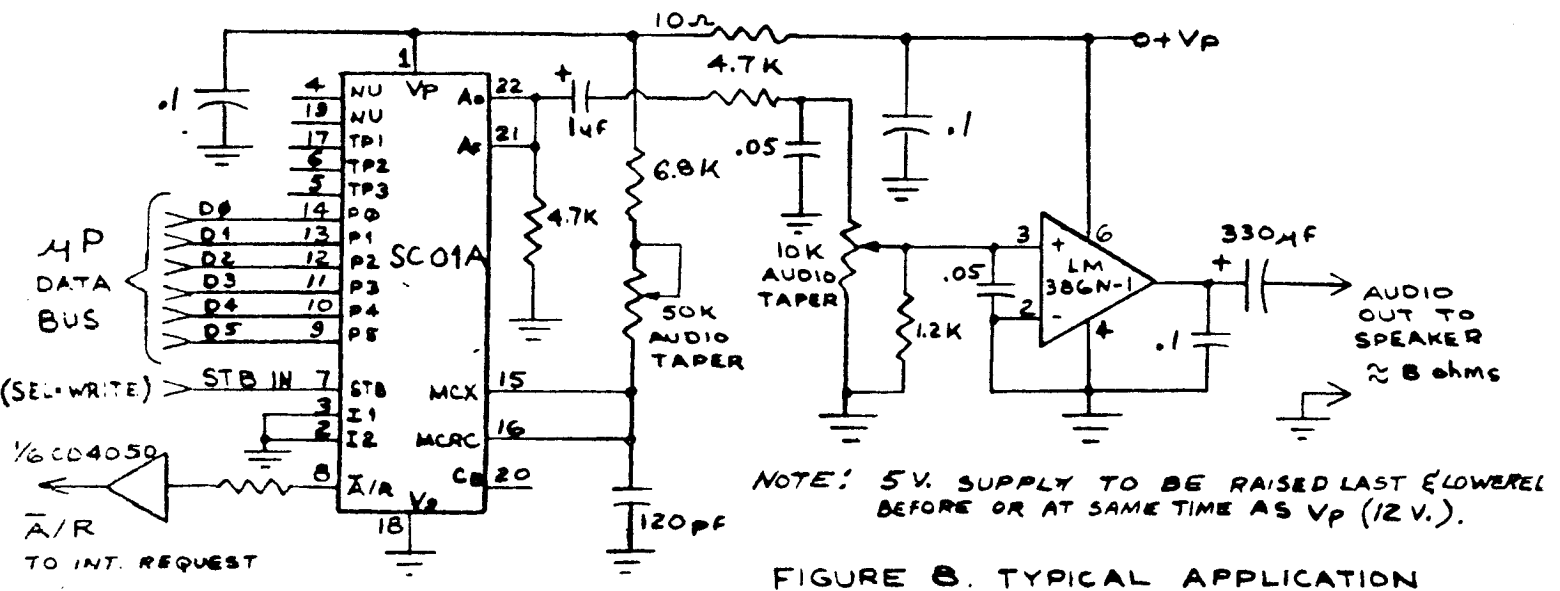


FIGURE 9. LOW POWER, MULTIPLE MESSAGE, 8 BYTE BLOCK SIZE.

# Votrax<sup>®</sup>

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

## SC-01 SPEECH SYNTHESIZER DATA SHEET

### Votrax<sup>®</sup> 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.

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#### FEATURES

- Single CMOS chip
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- 22 pin package
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- Wide voltage supply range
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Figure 1. Votrax<sup>®</sup> SC-01 Speech Synthesizer

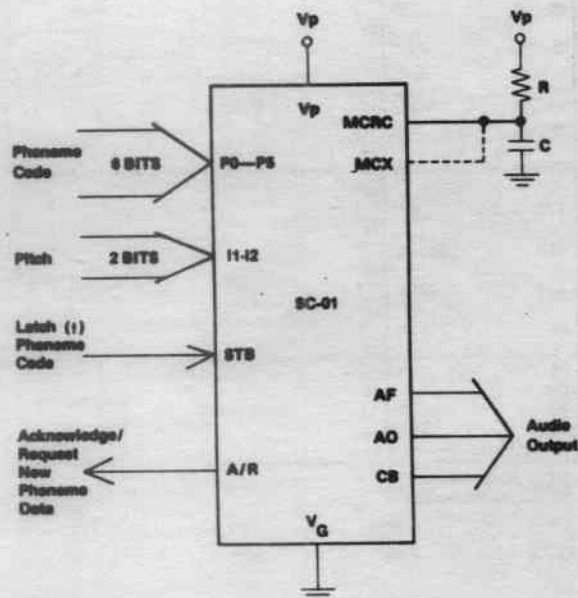


Figure 2. SC-01 Flow Diagram

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## 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<sup>®</sup> 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.

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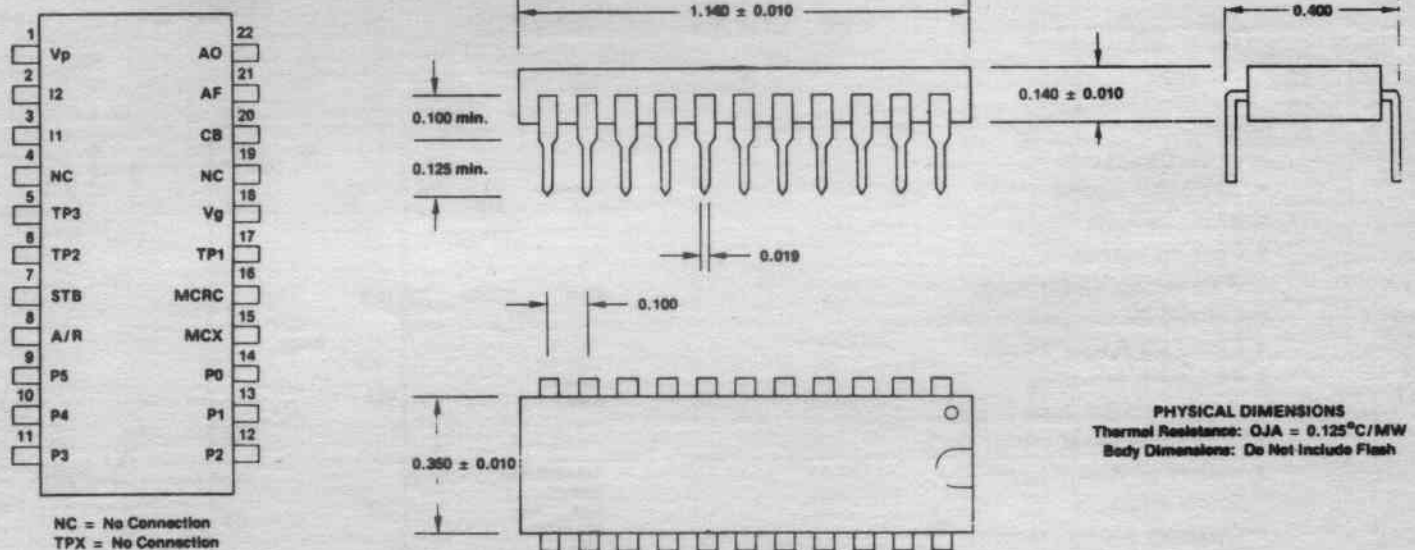


Figure 3. SC-01 Footprint and Outline Dimensions

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Table 1. Phoneme Chart

Phoneme Code	Phoneme Symbol	Duration (ms)	Example Word	Phoneme Code	Phoneme Symbol	Duration (ms)	Example Word
00	EH3	59	jacket	20	A	185	day
01	EH2	71	enlist	21	AY	65	day
02	EH1	121	heavy	22	Y1	80	yard
03	PA0	47	no sound	23	UH3	47	mission
04	DT	47	butter	24	AH	250	mop
05	A2	71	made	25	P	103	past
06	A1	103	made	26	O	185	cold
07	ZH	90	azure	27	I	185	pin
08	AH2	71	honest	28	U	185	move
09	I3	55	inhibit	29	Y	103	any
0A	I2	80	inhibit	2A	T	71	tap
0B	I1	121	inhibit	2B	R*	90	red
0C	M	103	mat	2C	E	185	meet
0D	N	80	sun	2D	W	80	win
0E	B	71	bag	2E	AE	185	dad
0F	V	71	van	2F	AE1	103	after
10	CH*	71	chip	30	AW2	90	salty
11	SH	121	shop	31	UH2	71	about
12	Z	71	zoo	32	UH1	103	uncle
13	AW1	146	lawful	33	UH	185	cup
14	NG	121	thing	34	O2	80	for
15	AH1	146	father	35	O1	121	aboard
16	OO1	103	looking	36	IU	59	you
17	OO	185	book	37	U1	90	you
18	L	103	land	38	THV	80	the
19	K	80	trick	39	TH	71	thin
1A	J*	47	judge	3A	ER	146	bird
1B	H	71	hello	3B	EH	185	get
1C	G	71	get	3C	E1	121	be
1D	F	103	fast	3D	AW	250	call
1E	D	55	paid	3E	PA1	185	no sound
1F	S	90	pass	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	PA0
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 ( $\bar{A}/R$ ):** 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 ( $P_1$ to STB)	$T_S$	450			NS
Input Hold Time ( $P_1$ to STB)	$T_H$	0			NS
Rise Time of STB Edge (1.8V to 4V)	$T_{RS}$			100	NS
A/R Width ( $\bar{A}/R$ Connected to STB) *	$T_{ARW}$	1	1.3	2	$\mu s$
STB Width	$T_{SW}$	200			NS
STB Low *	$T_{SL}$				NS
Propagation Delay (STB to A/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 $\bar{A}/R$ Request to STB Service)	$T_{ARS}$	0		500	$\mu s$
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

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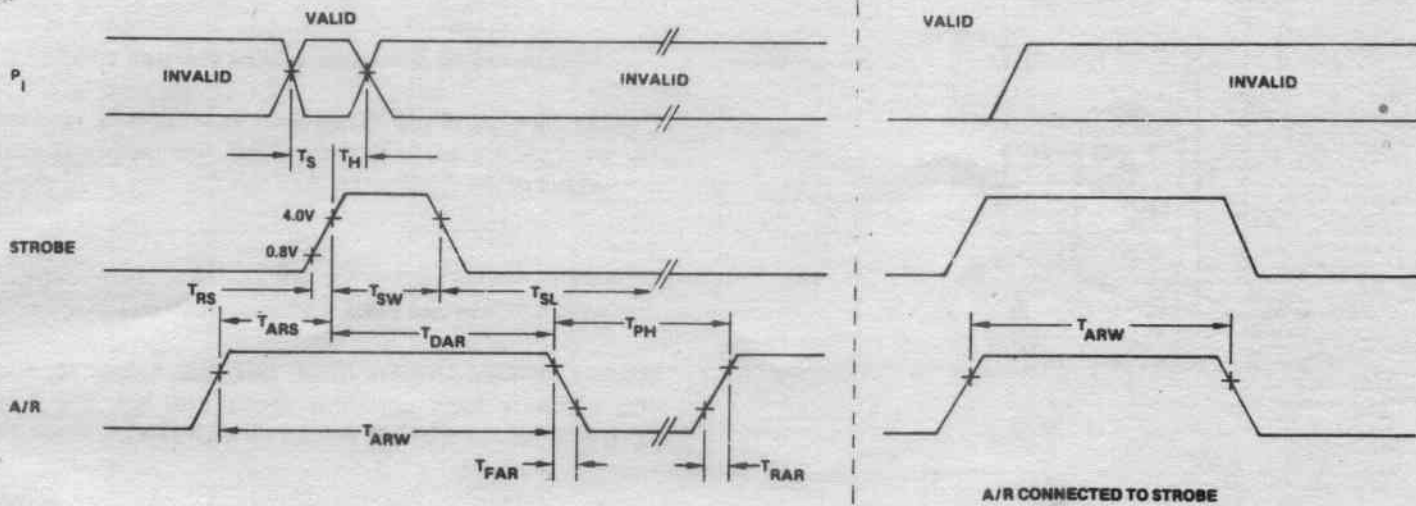


Figure 4. Timing Diagram

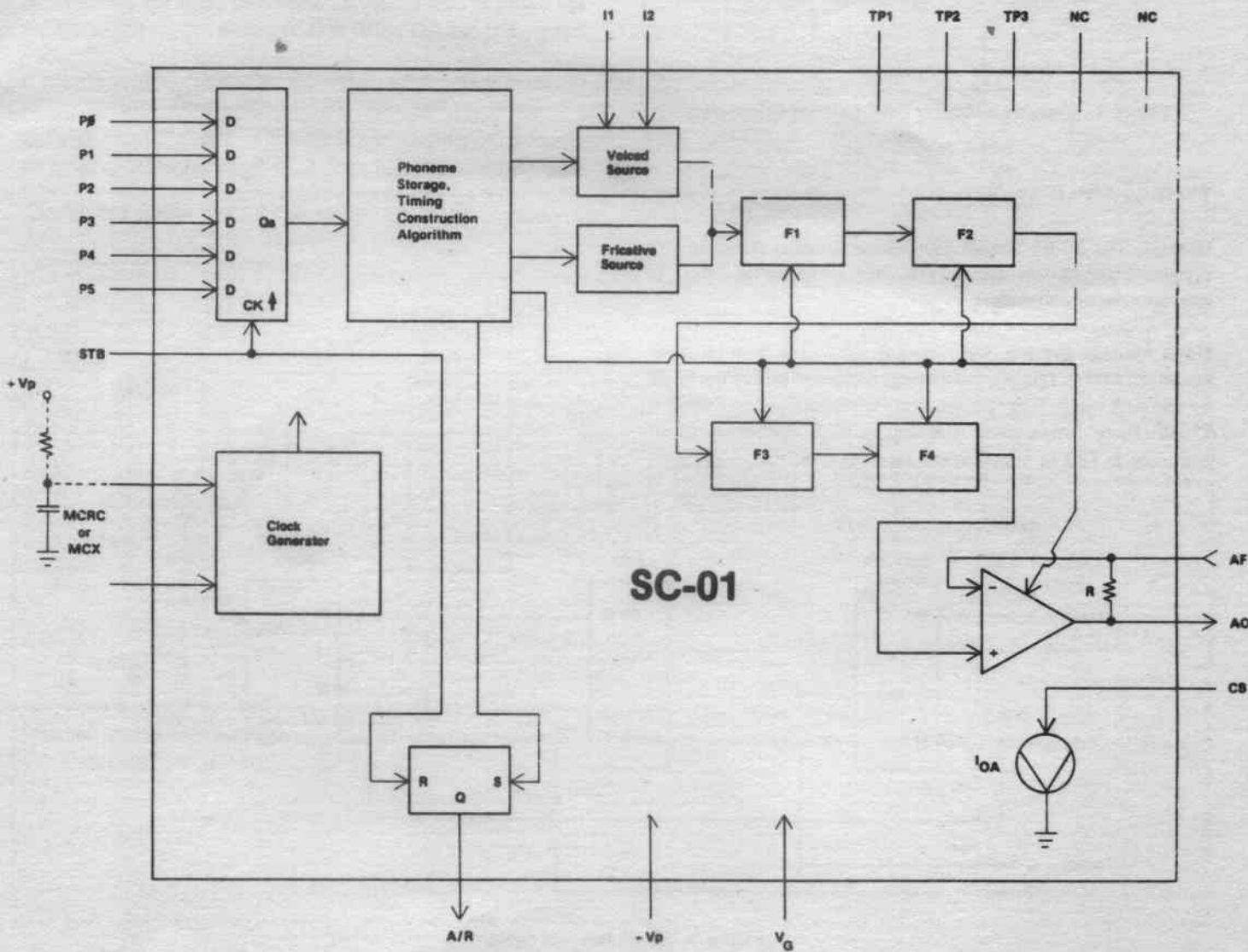


Figure 5. SC-01 Block Diagram

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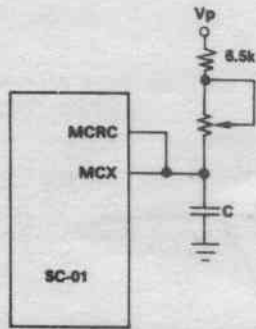


Figure 6. Variable Voice by Potentiometer Control

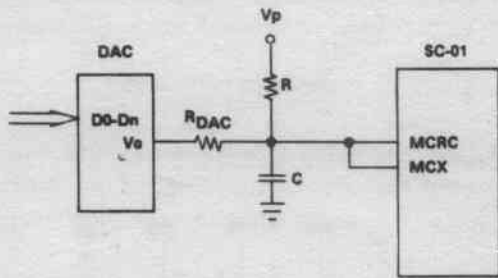


Figure 7. Variable Voice by DAC Current Injection

NOTE

Data at address 0 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  $V_p$ , 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  $V_p$  and the desired audio level.

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  $\mu$ f capacitor to TP3 to insure power up reset of SC-01.

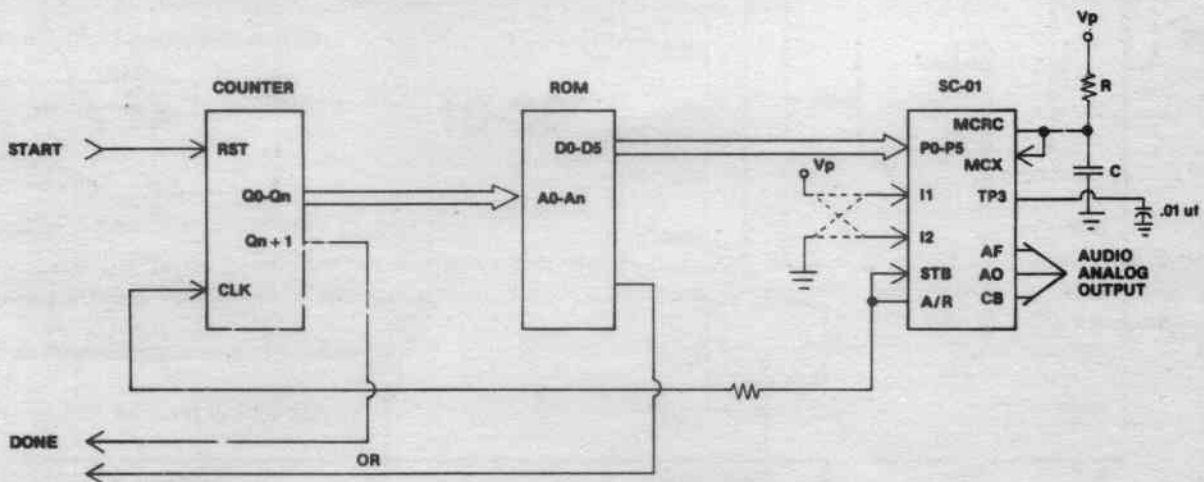


Figure 8. Single Message System

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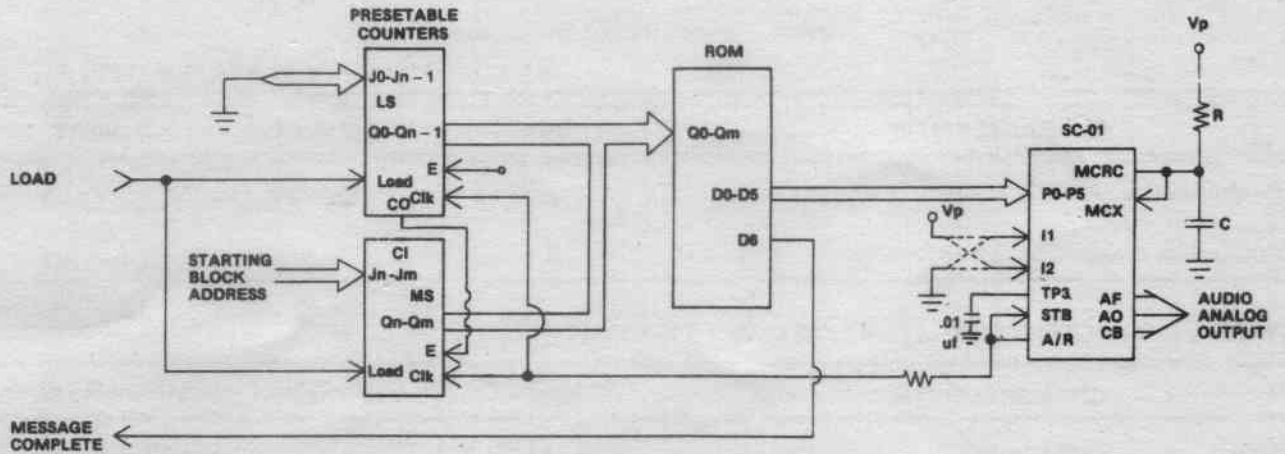


Figure 9. Multiple Message, Fixed Block Size

**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  $V_p = +12.0$  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.

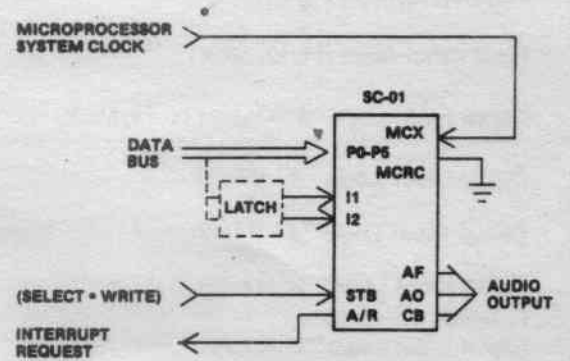


Figure 10. Multiple Message, Variable Block Size

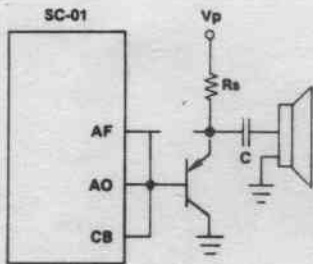


Figure 11. Class A Amplifier

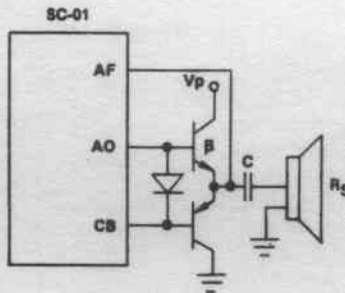


Figure 12. Class B Amplifier\*

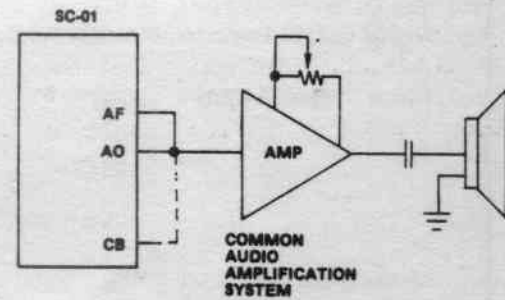


Figure 13. Controlling Audio Output Power

\*For Class B Amplifier:  $(\beta) \times (R_s \text{ min.}) = 81.6 \times (V_p)$  where  $\beta$  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.

Table 4. Analog Output Specifications

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

ELECTRICAL CHARACTERISTICS: T<sub>0</sub> = 0 to 70°C, V<sub>p</sub> = 7 to 14 V<sub>DC</sub>

CHARACTERISTIC	MIN	TYP	MAX	UNIT
Digital Input Impedance	1 meg.			Ohm
Input Capacitance (P <sub>1</sub> , STB)			3	pf
Input Capacitance (I1, I2, MCX)			8	pf
Digital Input Logic "0" (except I1, I2, MCX)	V <sub>G</sub> - 0.5		V <sub>G</sub> + 0.8	V <sub>DC</sub>
Digital Input Logic "0" (MCX)			V <sub>G</sub> + 1.0	V <sub>DC</sub>
Digital Input Logic "0" (I1, I2)			.2 x V <sub>p</sub>	V <sub>DC</sub>
Digital Input Logic "1" (except I1, I2, MCX)	V <sub>G</sub> + 4.0		V <sub>p</sub> + 0.5	V <sub>DC</sub>
Digital Input Logic "1" (I1, I2)	.8 x V <sub>p</sub>			V <sub>DC</sub>
Digital Input Logic "1" (MCX)	4.6			V <sub>DC</sub>
Digital Output Logic "0" (I sink = 0.8mA)			V <sub>G</sub> + 0.5	V <sub>DC</sub>
Digital Output Logic "1" (I source = 0.5mA)	V <sub>p</sub> - 0.5			V <sub>DC</sub>
Power Supply Current	V <sub>p</sub> = 9V	9.1		mA
	V <sub>p</sub> = 9V**	11	18	mA
	V <sub>p</sub> = 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)***			300	pf

\*Variable

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

\*\*\*Frequency of Master Clock  $\approx 1.25 / RC$ 

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

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

Table 5. Absolute Maximum Ratings

## ABSOLUTE MAXIMUM RATINGS \*

RATING	SYMBOL	VALUE	UNIT
Power Supply Voltage	$V_p$	20	$V_{DC}$
Power Dissipation at 25°C	$P_{DM}$	650	mW
Derating Above 25°C		5	mW °C
Operating Ambient Temperature	$T_o$	0 to 70	°C
Storage Temperature	$T_{STG}$	-55 to 125	°C
Input Voltage	$V_{INM}$	-0.5 to $V_p+0.5$	$V_{DC}$
DC Current Max. Above $V_p+0.5V$	$I_{INM}$	1.0	ma
Lead Temperature (soldering 10 sec.)	$T_L$	300	°C

\* Operation above these limits could damage the device.

NORMAL OPERATING CONDITIONS:  $7v \leq V_p \leq 14v$ ,  $0^\circ C \leq T_o \leq 70^\circ C$

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SC-01  
SPEECH  
SYNTHESIZER**



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## **INTRODUCTION**

VOTRAX<sup>®</sup> Speech Synthesis Technology produces each of the 45 basic speech sounds, called phonemes. This handy dictionary gives you quick access to the VOTRAX<sup>®</sup> phoneme sequences used to create approximately 1400 words. Because VOTRAX<sup>®</sup> speech synthesis uses these basic phonetic sounds, you may program virtually any word in the English language by learning to use and combine the various phoneme codes.

This dictionary is intended for use with the SC-01 Speech Synthesizer. It can also serve as a guide for programming any product containing a VOTRAX<sup>®</sup> synthesizer.

## GENERAL DESCRIPTION OF THE SC-01 CHIP

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.

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.

## PHONEME DESCRIPTION

Table 1 lists the 64 phonemes produced by the SC-01. Each sound is represented by its VOTRAX<sup>™</sup> phoneme code and is accompanied by its phoneme symbol and an example. The underlined segments of the example word demonstrate the phoneme use, i.e., sound to be pronounced.

Table 2 provides the phoneme sequences used to produce vowels in the group called diphthongs, (2 vowel sounds in sequence, identified as a single sound, e.g., the long "i" vowel).

TABLE 1: PHONEME CHART

Phoneme Code	Phoneme Symbol	Duration (ms)	Example Word
ØØ	EH3	59	jack <u>e</u> t
Ø1	EH2	71	en <u>l</u> ist
Ø2	EH1	121	he <u>a</u> vy
Ø3	PAØ	47	no sound
Ø4	DT	47	bu <u>t</u> ter
Ø5	A2	71	ma <u>d</u> e
Ø6	A1	103	ma <u>d</u> e
Ø7	ZH	90	azu <u>r</u> e
Ø8	AH2	71	h <u>o</u> nest
Ø9	13	55	in <u>h</u> ibit
ØA	12	80	in <u>h</u> ibit
ØB	11	121	in <u>h</u> ibit
ØC	M	103	ma <u>i</u>
ØD	N	80	su <u>n</u>
ØE	B	71	ba <u>g</u>
ØF	V	71	va <u>n</u>
1Ø	CH*	71	ch <u>i</u> p
11	SH	121	sh <u>o</u> p
12	Z	71	z <u>o</u> o
13	AW1	146	law <u>f</u> ul
14	NG	121	th <u>i</u> ng
15	AH1	146	fa <u>t</u> her
16	001	103	loo <u>k</u> ing
17	00	185	bo <u>o</u> k
18	L	103	lan <u>d</u>
19	K	80	tr <u>i</u> ck
1A	J*	47	ju <u>d</u> ge
1B	H	71	he <u>l</u> lo
1C	G	71	ge <u>t</u>
1D	F	103	fa <u>s</u> t
1E	D	55	pa <u>i</u> d
1F	S	90	pa <u>s</u> s

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

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

**TABLE 1: PHONEME CHART**

Phoneme Code	Phoneme Symbol	Duration (ms)	Example Word
20	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
30	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	253	call
3E	PA1	185	no sound
3F	STOP	47	no sound

**TABLE 2: DIPHTHONG CHART**

Phoneme Combination	Key Words
A1-AY-Y	fate, maid
AH1-EH3-Y	find, wide
UH3-AH2-Y	fight, white
AH1-I3-UH3-L	file, smile
O1-UH3-Y	foy, boy
O1-I3-UH3-L	foil, spoil
AH1-O2-U1	found, cow
UH3-AH2-U1	foust, house
O1-U1	float, note
Y1-IU-U1	few, you, music
AY-I1	fear, beer

**Phonetic Programs**

A A1, AY, Y  
a-2 UH2, UH3  
able A1, Y, B, UH3, L  
abort UH1, B, O2, O2, R, T  
about UH1, B, UH2, AH2, U1, T  
above UH1, B, UH1, UH3, V  
accept EH1, K, PAO, S, EH1, EH3, P, T  
access AE1, EH3, K, PAO, S, EH1, EH3, S  
account UH1, K, AH1, UH3, W, N, T  
acid AE1, EH3, S, I1 D  
act AE1, EH3, K, T  
active AE1, EH3, K, T, I1, V  
actual AE1, EH3, K, T, CH, U1, UH3, L  
add AE1, EH3, D  
address AE1, EH3, D, R, EH1, EH3, S  
ade (use "aid" program)  
adjust UH1, D, J, UH1, UH3, S, T  
adjucent UH1, D, J, A1, AY, S, EH3, N, T  
advance AE1, EH3, D, V, AE1, EH3, N, T, S  
advise AE1, EH3, D, V, AH1, EH3, Y, Z  
affect UH1, F, EH1, EH3, K, T  
after AE1, EH3, F, T, ER  
again UH1, G, A2, EH1, N  
age A1, AY, Y, D, J  
agent A1, Y, D, J, EH3, N, T  
ahead UH1, H, EH1, EH3, D  
aid A1, AY, Y, D  
air EH2, EH2, R  
alarm UH1, L, AH1, R, M  
alert UH1, L, ER, R, T  
all AW, L  
allocate AE1, UH3, L, UH2, K, A1, Y, T  
allow UH1, L, AH1, UH3, U1  
alpha AE1, AW2, L, F, UH1  
already AW, L, R, EH1, EH3, D, Y  
also AW, L, S, O1, U1  
altitude AE1, UH3, L, T, I2, T, IU, U1, U1, D  
aluminum UH1, L, IU, U1, M, I3, N, UH1, M  
am AE1, EH3, M

america UH1, M, EH1, R, I3, K, UH2, UH3  
amount UH1, M, AH1, UH3, W, N, T  
amp AE1, EH3, M, P  
amplify AE1, EH3, M, P, L, I3, F, AH1, EH3, AY  
an AE1, EH3, N  
and AE1, EH3, N, D  
angle AE1, EH3, NG, G, UH3, L  
another UH1, N, UH1, UH3, THV, ER  
answer AE1, EH3, N, S, ER  
any EH2, EH2, N, Y  
apostrophe UH1, P, AH1, UH3, S, T, R, UH3, F, Y  
approach UH1, P, R, O1, U1, T, CH  
approve UH1, P, R, IU, U1, U1, V  
approximate UH1, P, R, AH1, K, PAO, S, EH3, M, I3, T  
approximate-2 UH1, P, R, AH1, K, PAO, S, EH3, M, A2, Y, T  
april A1, Y, P, R, UH2, L  
architect AH1, R, K, UH2, T, EH3, EH2, K, T  
are (see "R" program)  
area EH1, EH3, R, Y, UH1  
arrive UH1, R, AH1, EH3, Y, V  
arrow EH1, EH3, R, O1, U1  
article AH1, R, T, EH3, K, UH3, L  
as AE1, EH3, Z  
ASCII AE1, EH3, S, K, Y  
ask AE1, EH3, S, K  
assemble UH1, S, EH1, EH3, M, B, UH3, L  
asset AE1, EH3, S, EH1, T  
assign UH1, S, AH1, EH3, Y, N  
assist UH1, S, I1, I3, S, T  
associate UH1, S, O1, SH, Y, A1, Y, T  
associate-2 UH1, S, O1, SH, Y, I2, T  
assume UH1, S, IU, U1, M  
at AE1, EH3, T  
ate (see "eight" program)  
attach UH1, T, AE1, EH3, T, CH  
attempt UH1, T, EH1, EH3, M, P, T  
attend UH1, T, EH1, EH3, N, D  
audio AW, D, Y, O1, U1



august AW2, AW2, G, EH2, S, T  
 authorize AW2, AW2, TH, ER, AH1, Y, Z  
 automatic AW2, AW2, DT, UH3, M, AE1,  
 EH3, DT, I3, K  
 available UH1, V, A1, Y, L, UH3, B,  
 UH3, L  
 average AE1, EH3, V, R, I1, D, J  
 avoid UH1, V, O1, UH3, I3, AY, D

**B** B, E1, Y  
 back B, AE1, AE1, K  
 bad B, AE1, AE1, D  
 badge B, AE1, AE1, D, J  
 bag B, AE1, AE1, G  
 balance B, AE1, AH2, L, I3, N, DT, S  
 ball B, AW2, AW1, L  
 band B, AE1, EH3, N, D  
 bank B, AE1, I3, NG, K  
 bar B, AH1, UH3, R  
 base B, A1, AY, Y, S  
 basic B, A1, Y, S, I2, K  
 bat B, AE1, EH3, T  
 batch B, AE1, EH3, T, CH  
 bath B, AE1, AE1, EH3, TH  
 battery B, AE1, EH3, T, ER, Y  
 be (use "B" program)  
 bed B, EH1, EH3, D  
 been B, EH1, EH3, N  
 beep B, E1, Y, P  
 before B, Y, F, O2, O2, R  
 begin B, Y, G, I1, I3, N  
 bell B, EH1, UH3, L  
 below B, Y, L, UH3, O2, U1  
 bend B, EH1, EH3, N, D  
 best B, EH1, EH3, S, T  
 beta B, A2, A2, AY, T, UH2  
 better B, EH1, EH3, T, ER  
 between B, Y, T, W, E1, Y, N  
 bid B, I1, I3, D  
 big B, I1, I3, G  
 bill B, I1, I3, L  
 billion B, I1, I3, L, Y, UH3, N  
 bin B, I1, I3, N  
 binary B, AH1, Y, N, EH3, EH3, ER, Y

birthday B, ER, R, TH, D, A1, I3, Y  
 bit B, I1, I3, T  
 bite B, UH3, AH2, Y, T  
 black B, L, AE1, EH3, K  
 blank B, L, AE1, EH3, NG, K  
 blew (use "blue" program)  
 blind B, L, AH1, EH3, Y, N, D  
 block B, L, AH1, UH3, K  
 blown B, L, O1, U1, N  
 blue B, L, IU, U1, U1  
 blur B, L, ER, R  
 board B, O1, O2, R, D  
 bolt B, O2, O2, L, T  
 bond B, AH1, UH3, N, D  
 book B, OO1, OO1, K  
 bored (use "board" program)  
 boss B, AW1, AW2, S  
 bother B, AH1, UH3, THV, ER  
 bottom B, AH1, UH3, T, UH1, M  
 bought B, AW1, AW2, T  
 box B, AH1, UH3, K, PAO, S  
 brace B, R, A1, Y, S  
 brain B, R, A1, Y, N  
 brake B, R, A1, Y, K  
 branch B, R, AE1, EH3, N, T, CH  
 bravo B, R, AH1, UH3, V, O1, U1  
 break (use "brake" program)  
 bridge B, R, I1, I3, D, J  
 brief B, R, AY, Y, F  
 bright B, R, UH3, AH2, Y, T  
 bring B, R, I1, I3, NG  
 broke B, R, O1, U1, K  
 brought B, R, AW, T  
 brown B, R, AH1, UH3, U1, N  
 bubble B, UH1, UH2, B, UH3, L  
 budget B, UH1, UH3, D, J, I2, T  
 bug B, UH1, UH2, G  
 build B, I2, I2, L, D  
 bus B, UH1, UH2, S  
 business B, I3, I3, Z, N, EH2, S  
 busy B, I3, I2, Z, Y  
 but B, UH1, UH2, T  
 button B, UH1, UH3, T, EH3, N  
 buy B, AH1, EH3, I3, Y

by B, AH1, EH3, I3, Y  
 bye B, AH1, EH3, I3, Y  
 byte (use "bite" program)  
  
**C** S, E1, Y  
 cable K, A1, Y, B, UH3, L  
 calendar K, AE1, UH3, L, I3, N, D, ER  
 calibrate K, AE1, UH3, L, UH3, B, R, A1, Y, T  
  
 call K, AW2, AW1, L  
 came K, A1, AY, Y, M  
 can K, AE1, EH3, N  
 cancel K, AE1, EH3, N, S, UH3, L  
 capable K, A1, Y, P, UH3, B, UH3, L  
 capacitor K, UH2, P, AE1, EH3, S, EH3, T, ER  
  
 capacity K, UH2, P, AE1, EH3, S, I3, DT, Y  
  
 car K, AH1, UH3, R  
 card K, AH1, R, D  
 care K, EH3, EH3, ER  
 carpenter K, AH1, R, P, I3, N, D, ER  
 carriage K, EH2, EH3, R, I1, D, J  
 carry K, EH2, EH3, R, Y  
 carton K, AH1, R, T, I3, N  
 case K, A1, AY, Y, S  
 cash K, AE1, EH3, SH  
 cassette K, UH1, S, EH1, EH3, T  
 cassette-2 K, A2, AY, S, EH1, EH2, T  
 category K, AE1, EH3, DT, UH3, G, O1, R, Y  
  
 catalog K, AE1, EH3, DT, UH3, L, AW2, AW2, G  
  
 caution K, AW2, AW1, SH, UH3, N  
 cent S, EH1, EH3, N, T  
 center S, EH1, EH3, N, T, ER  
 centi S, EH1, EH3, N, T, I1, I3  
 centigrade S, EH1, N, T, I3, G, R, A1, Y, D  
 certify S, R, R, T, I3, F, AH1, Y  
 change T, CH, A1, AY, Y, N, D, J  
 character K, EH1, R, EH1, K, T, ER  
 charge T, CH, AH1, R, D, J  
 charlie T, CH, AH1, R, L, Y  
 chart T, CH, AH1, R, T

check T, CH, EH1, EH3, K  
 cheer T, CH, AY, I2, R  
 chip T, CH, I1, I3, P  
 choice T, CH, O1, UH3, I3, AY, S  
 circle S, ER, R, K, UH3, L  
 circuit S, R, R, K, I2, T  
 city S, I1, T, Y  
 claim K, L, A1, AY, Y, M  
 class K, L, AE1, EH3, S  
 clean K, L, E1, AY, N  
 clear K, L, AY, I3, R  
 clerk K, L, ER, K  
 clip K, L, I1, I3, P  
 clock K, L, AH1, UH3, K  
 close K, L, UH3, O1, U1, Z  
 close-2 K, L, UH3, O2, U1, S  
 cloud K, L, AH1, UH3, W, D  
 coarse K, O1, O2, R, S  
 code K, OO1, O2, U1, D  
 coin K, O1, UH3, I3, AY, N  
 collar K, AH1, UH3, L, ER  
 collect K, UH1, L, EH1, K, T  
 colon K, OO1, O2, U1, L, I2, N  
 color K, UH2, UH2, L, ER  
 column K, AH1, UH3, L, UH3, M  
 combine K, UH2, M, B, AH1, EH3, Y, N  
 comma K, AH1, UH3, M, UH1  
 command K, UH2, M, AE, EH3, N, D  
 commerce K, AH1, UH3, M, ER, S  
 commercial K, UH1, UH3, M, ER, SH, UH3, L  
  
 communicate K, UH2, M, Y1, IU, U1, N, I3, K, A1, Y, T  
  
 company K, UH1, UH3, M, P, EH3, N, Y  
 compare K, UH1, UH3, M, P, EH3, EH3, ER  
  
 compile K, UH1, UH3, M, P, AH1, EH3, I3, UH3, L  
  
 complete K, UH1, UH3, M, P, L, AY, Y, T  
 comply K, UH1, UH3, M, P, L, AH1, EH3, Y  
  
 component K, UH2, M, P, O2, O1, N, EH2, N, T  
  
 computer K, UH1, M, P, Y1, IU, U1, T, ER

conceal K, UH1, N, S, E1, AY, L  
 condense K, UH1, N, D, EH1, EH3, N, S  
 condition K, UH1, N, D, I1, I3, SH, UH3, N  
 confirm K, UH1, N, F, ER, R, M  
 confuse K, UH1, N, F, Y1, IU, U1, U1, Z  
 confusion K, UH1, N, F, Y1, IU, U1, U1,  
 ZH, UH3, N  
 congratulations K, UH1, N, G, R, AE1, D, J,  
 UH3, L, A1, AY, SH, UH3, N, Z  
 connect K, UH1, N, EH1, EH3, K, T  
 console K, AH1, UH3, N, S, O1, U1, L  
 console-2 K, UH1, N, S, O1, O2, L  
 consult K, UH1, N, S, UH1, UH2, L, T  
 consume K, UH1, N, S, IU, U1, U1, M  
 contain K, UH3, UH3, N, T, A1, AY, Y, N  
 continue K, UH1, N, T, I1, I3, N, Y1, IU,  
 U1  
 contract K, AH1, UH3, N, T, R, AE1,  
 EH3, K, T  
 contrast K, AH1, UH3, N, T, R, AE1,  
 EH3, S, T  
 control K, UH1, N, T, R, O1, O2, L  
 convenient K, UH2, N, V, E1, N, AY, EH3,  
 N, T  
 copper K, AH1, UH3, P, ER  
 copy K, AH1, UH3, P, Y  
 correct K, O2, O2, R, EH1, EH3, K, T  
 correspond K, O1, R, I3, S, P, AH1, AH2,  
 N, D  
 cosine K, O1, U1, S, AH1, Y, N  
 cost K, AW2, AW1, S, T  
 could K, IU, IU, OO1, D  
 count K, AH1, UH3, W, N, T  
 country K, UH1, N, T, R, Y  
 couple K, UH3, UH1, P, UH3, L  
 courage K, ER, R, I3, D, J  
 course K, O1, O2, R, S  
 court K, O1, O2, R, T  
 cover K, UH1, UH3, V, ER  
 crane K, R, A1, AY, Y, N  
 crash K, R, AE1, EH3, SH  
 crease K, R, E1, Y, S  
 create K, R, Y, A1, Y, T  
 creation K, R, Y, A1, Y, SH, UH3, N

credit K, R, EH1, EH3, D, I1, T  
 crew K, R, IU, U1, U1  
 critical K, R, I1, T, I3, K, UH3, L  
 cross K, R, AW, S  
 crowd K, R, AH1, UH3, U1, D  
 cry K, R, AH1, EH3, I3, Y  
 cue (use "Q" program)  
 cup K, UH1, UH2, P  
 curious K, Y, ER, Y, UH1, S  
 current K, ER, R, EH3, N, T  
 currency K, ER, R, I2, N, DT, S, Y  
 curse K, ER, R, S  
 curve K, ER, R, V  
 customer K, UH1, UH2, S, T, UH1, M, ER  
 cut K, UH1, UH2, T  
 cycle S, UH3, AH2, Y, K, UH3, L  
 D D, E1, Y  
 daily D, A1, AY, Y, L, Y  
 damage D, AE1, EH3, M, I1, D, J  
 danger D, A1, AY, Y, N, D, J, ER  
 dark D, AH1, R, K  
 dash D, AE1, EH3, SH  
 data D, A1, Y, DT, UH1  
 date D, A1, AY, Y, T  
 day D, A1, I3, Y  
 dead D, EH1, EH3, F  
 dealer D, E1, AY, L, ER  
 dear D, AY, I3, R  
 debit D, EH1, EH3, B, I2, T  
 debt D, EH1, EH3, T  
 december D, Y, S, EH1, EH3, M, B, ER  
 decide D, Y, S, AH1, EH3, Y, D  
 decimal D, EH1, S, M, UH3, L  
 decision D, Y, S, I1, ZH, UH3, N  
 decline D, Y, K, L, AH1, EH3, Y, N  
 decrease D, Y, K, R, E1, Y, S  
 deduct D, Y, D, UH1, UH2, K, T  
 deep D, E1, Y, P  
 deer (use "dear" program)  
 defeat D, Y, F, E1, AY, T  
 defend D, Y, F, EH1, EH3, N, D  
 defensive D, Y, F, EH1, EH3, N, S, I1, V  
 defer D, E1, F, ER, R

deficit D, EH1, F, I3, S, I1, T  
 degree D, Y, G, R, E1, Y  
 delay D, I1, L, EH3, A1, Y  
 delete D, E1, L, E1, Y, T  
 deliver D, Y, L, I1, V, ER  
 delta D, EH2, EH3, L, T, UH1  
 demand D, Y, M, AE1, EH3, N, D  
 demonstrate D, EH1, M, UH3, N, S, T, R, A1, Y, T  
  
 deny D, Y, N, AH1, EH3, Y  
 destroy D, Y, S, T, R, O1, UH3, I3, AY  
 detail D, E, T, EH3, A1, I3, UH3, L  
 determine D, Y, T, ER, M, I1, N  
 device D, Y, V, UH3, AH2, Y, S  
 dew (use "do" program)  
 diagnostic D, AH1, AY, I3, G, N, AH1, UH3, S, T, I3, K  
  
 dial D, AH1, EH3, I3, UH3, L  
 dictionary D, I1, I3, K, SH, UH3, N, EH3, EH3, ER, Y  
  
 did D, I1, I3, D  
 die D, AH1, EH3, Y  
 diet D, AH1, EH3, AY, I2, T  
 differ D, I1, I3, F, ER  
 difference D, I1, F, R, EH3, N, DT, S  
 different D, I1, F, R, EH3, N, T  
 digit D, I1, D, J, I1, T  
 digital D, I1, D, J, I3, T, UH3, L  
 dime D, AH1, EH3, Y, M  
 diode D, AH1, EH3, AY, O1, U1, D  
 direct D, ER, EH1, EH3, K, T  
 directory D, ER, EH1, EH3, K, T, ER, Y  
 dirt D, ER, R, T  
 disagree D, I1, S, UH1, G, R, E1, Y  
 disappear D, I1, S, UH1, P, AY, I3, R  
 disconnect D, I1, S, K, UH1, N, EH1, EH3, K, T  
  
 discuss D, I1, I3, S, K, UH1, UH2, S  
 disk D, I1, I3, S, K  
 display D, I1, I3, S, P, L, A1, I3, Y  
 distance D, I1, S, T, EH3, N, T, S  
 divide D, I1, V, AH1, EH3, Y, D  
 dividend D, I1, V, I1, D, EH1, EH3, N, D  
 division D, I1, V, I1, ZH, UH3, N

do D, IU, U1, U1  
 dock D, AH1, UH3, K  
 doctor D, AH1, UH3, K, T, ER  
 document D, AH1, K, Y1, UH3, M, EH3, N, T  
  
 does D, UH2, UH1, Z  
 dollar D, AH1, UH3, L, ER  
 done D, UH1, UH3, N  
 door D, O1, O2, R  
 double D, UH3, UH1, B, UH3, L  
 doubt D, UH3, AH2, U1, T  
 down D, AH1, UH3, U1, N  
 draft D, R, AE1, EH3, F, T  
 draw D, R, AW  
 drill D, R, I1, I3, L  
 drink D, R, I1, I3, NG, K  
 drive D, R, AH1, EH3, Y, V  
 drop D, R, AH1, UH3, P  
 drum D, R, UH1, UH2, M  
 dry D, R, AH1, EH3, I3, Y  
 due (use "do" program)  
 dump D, UH1, UH2, M, P  
 duration D, ER, R, A1, Y, SH, UH3, N  
 during D, ER, R, I1, NG  
 duty D, IU, U1, U1, T, Y  
 dwell D, W, EH1, EH3, L

E E1, Y  
 each E1, AY, T, CH  
 ear E1, I2, R  
 early ER, R, L, Y  
 earn ER, R, N  
 east E1, AY, S, T  
 easy E1, AY, Z, Y  
 echo EH1, EH3, K, O1, U1  
 edge EH1, EH3, D, J  
 edit EH1, EH3, D, I2, T  
 educate EH1, D, J, U1, K, A1, Y, T  
 effect UH1, F, EH1, EH3, K, T  
 efficient E1, F, I1, SH, EH3, N, T  
 effort EH2, EH3, F, ER, T  
 eight A2, A2, Y, T  
 eighth A2, A2, Y, DT, DT, TH

eighty A2, A2, Y, T, Y  
 either E1, Y, THV, ER  
 electric EH3, L, EH1, K, T, R, I2, K  
 electrician EH3, L, EH1, K, PAO, T, R, I1, SH, UH3, N  
 electronic EH3, L, EH1, K, T, R, AH1, N, I2, K  
 elevator EH1, L, UH3, V, A2, AY, D, ER  
 eleven EH1, L, EH1, EH3, V, I2, N  
 eligible EH1, L, UH3, D, J, EH3, B, UH3, L  
 eliminate EH1, L, I1, M, I1, N, A1, Y, T  
 else EH1, EH3, L, S  
 emit Y, M, I1, I3, T  
 employ EH1, EH3, M, P, L, O1, UH3, I3, AY  
 empty EH1, EH3, M, P, T, Y  
 enable EH1, N, A1, Y, B, UH3, L  
 enclose EH1, EH3, N, K, L, O1, U1, Z  
 end EH1, EH3, N, D  
 engine EH1, EH3, N, D, J, I1, N  
 engineer EH1, N, D, J, I2, N, AY, I1, R  
 endorse EH1, EH3, N, D, O2, O2, R, S  
 english I1, NG, G, L, I2, SH  
 enter EH1, EH3, N, T, ER  
 entry EH1, EH3, N, T, R, Y  
 epsilon EH1, P, S, UH3, L, AH1, UH3, N  
 equal Y, K, W, UH3, L  
 equipment E1, K, W, IL, P, M, EH3, N, T  
 erase E1, R, A1, Y, S  
 error EH3, EH3, EH3, R, ER  
 escape EH1, EH3, S, K, A1, AY, Y, P  
 escrow EH1, EH3, S, K, R, O1, U1  
 establish UH1, S, T, AE1, EH3, B, L, I2, SH  
 estate EH1, EH3, S, T, A1, AY, Y, T  
 estimate EH1, S, T, EH3, M, I3, T  
 exact EH1, EH3, G, PAO, Z, AE1, EH3, K, T  
 examine EH1, EH3, G, PAO, Z, AE1, EH3, M, I1, N  
 exceed EH1, EH3, K, PAO, S, E1, Y, D  
 except EH1, EH3, K, PAO, S, EH1, EH3, P, T

exchange EH1, EH3, K, PAO, S, T, CH, A1, AY, Y, N, D, J  
 execute EH1, EH3, K, PAO, S, UH3, K, Y1, IU, U1, T  
 exempt EH1, EH3, G, PAO, Z, EH1, EH3, M, P, T  
 exit EH1, EH3, G, PAO, Z, I1, I3, T  
 expect EH1, EH3, K, PAO, S, P, EH1, EH3, K, T  
 expedite EH1, EH3, K, PAO, S, P, EH1, EH3, D, UH3, AH2, Y, T  
 expend EH1, EH3, K, PAO, S, P, EH1, EH3, N, D  
 experiment EH1, K, PAO, S, P, EH1, R, UH3, M, EH3, N, T  
 exponent EH1, K, PAO, S, P, O2, O2, N, EH3, N, T  
 express EH1, EH3, K, PAO, S, P, R, EH1, S  
 extension EH1, EH3, K, PAO, S, T, EH1, EH3, N, SH, UH3, N

F EH1, EH2, F  
 face F, A1, AY, Y, S  
 facility F, UH2, S, I1, L, I3, T, Y  
 fact F, AE1, EH3, K, T  
 fahrenheit F, EH1, R, I2, N, H, UH3, AH2, Y, T  
 fail F, A1, AY, I3, UH3, L  
 fall F, AW, L  
 false F, AW, L, S  
 familiar F, UH1, M, I1, L, Y1, ER  
 far F, AH1, UH3, R  
 farad F, EH3, EH3, ER, AE1, EH3, D  
 fast F, AE1, EH3, S, T  
 fault F, AW, L, T  
 feat (use "feet" program)  
 feature F, E1, AY, T, CH, ER  
 february F, EH1, B, Y1, IU, W, EH1, R, Y  
 federal F, EH1, EH3, D, R, UH3, L  
 fee F, E1, Y  
 feed F, E1, Y, D  
 feet F, E1, Y, T  
 female F, AY, Y, M, A1, AY, UH3, L

field F, E1, AY, UH3, L, D  
 fifteen F, I1, I3, F, T, E1, Y, N  
 fifth F, I1, I3, F, TH  
 fifty F, I1, I3, F, T, Y  
 file F, AH1, EH3, I3, UH3, L  
 fill F, I1, I3, L  
 final F, AH1, Y, N, UH3, L  
 finance F, AH1, EH3, Y, N, AE1, EH3, N, S  
 find F, AH1, EH3, Y, N, D  
 finger F, I1, I3, NG, G, ER  
 finish F, I1, N, I1, SH  
 fire F, AH1, EH3, AY, R  
 first F, ER, R, S, T  
 fit F, I1, I3, T  
 five F, AH1, EH3, Y, V  
 fix F, I1, I3, K, PAO, S  
 fixture F, I1, I3, K, PAO, S, T, CH, ER  
 flash F, L, AE1, EH3, SH  
 flat F, L, AE1, EH3, T  
 flight F, L, UH3, AH2, Y, T  
 flip F, L, I1, I3, P  
 floor F, L, O1, O2, R  
 flop F, L, AH1, UH3, P  
 flow F, L, O1, U1  
 fly F, L, AH1, EH3, Y  
 fold F, O2, O2, L, L, D  
 follow F, AH1, AW2, L, O1, U1  
 food F, U1, U1, D  
 foot F, OO1, OO1, T  
 for (use "four" program)  
 fore (use "four" program)  
 force F, O2, O2, R, S  
 foreman F, O2, O2, R, M, EH2, N  
 forget F, O2, O2, R, G, EH1, EH3, T  
 forgive F, O2, O2, R, G, I1, I3, V  
 form F, O2, O2, R, M  
 format F, O2, O2, R, M, AE1, EH3, T  
 forty F, O2, O2, R, T, Y  
 forward F, O2, O2, R, W, ER, D  
 found F, AH1, UH3, W, N, D  
 four F, O1, O2, R  
 fourth F, O1, O2, R, TH

fox trot F, AH1, UH3, K, PAO, S, T, R, AH1, UH3, T  
 frame F, R, A1, AY, Y, M  
 fraud F, R, AW, D  
 free F, R, E1, Y  
 french F, R, EH1, EH3, N, T, CH  
 frequency F, R, E1, K, W, EH3, N, DT, S, Y  
 frequent F, R, E1, K, W, EH3, N, T  
 friday F, R, AH1, EH3, Y, D, A1, I3, Y  
 fright F, R, UH3, AH2, Y, T  
 from F, R, UH1, UH3, M  
 front F, R, UH3, UH1, N, T  
 fruit F, R, IU, U1, T  
 fuel F, Y1, IU, U1, UH3, L  
 full F, OO1, L  
 function F, UH1, UH2, N, K, SH, UH3, N  
 fund F, UH1, UH2, N, D  
 furnace F, ER, R, N, EH3, S  
 further F, ER, R, THV, ER  
 future F, Y1, IU, U1, T, CH, ER  
  
 G D, J, E1, Y  
 gage (use "gauge" program)  
 gain G, A1, AY, Y, N  
 gait (use "gate" program)  
 gallon G, AE1, AH2, L, UH3, N  
 game G, A1, AY, Y, M  
 gamma G, AE1, EH3, M, UH2, UH3  
 gap G, AE1, EH3, P  
 garage G, UH1, R, AH1, UH3, ZH  
 gas G, AE1, EH3, S  
 gate G, A1, AY, Y, T  
 gauge G, A1, AY, Y, D, J  
 general D, J, EH1, EH3, N, ER, UH3, L  
 generate D, J, EH1, N, ER, A1, Y, T  
 gentlemen D, J, EH1, EH3, N, T, L, M, I2, N  
 german D, J, ER, R, M, EH2, N  
 get G, EH1, EH3, T  
 girl G, ER, R, L  
 give G, I1, I3, V  
 glass G, L, AE1, EH3, S  
 glitch G, L, I1, I3, T, CH  
 globe G, L, O1, U1, B  
 go G, OO1, O1, U1

golf G, AW2, AW2, UH3, L, F  
 good G, OO1, OO1, D  
 govern G, UH1, UH3, V, ER, N  
 grade G, R, A1, AY, Y, D  
 gram G, R, AE1, EH3, M  
 grand G, R, AE1, EH3, N, D  
 graph G, R, AE1, EH3, F  
 grate (use "great" program)  
 gray (use "grey" program)  
 great G, R, A1, Y, T  
 green G, R, E1, Y, N  
 greet G, R, E1, Y, T  
 grey G, R, A1, AY, Y  
 grind G, R, AH1, EH3, Y, N, D  
 grocery G, R, O1, U1, S, ER, Y  
 ground G, R, AH1, UH3, W, N, D  
 group G, R, U1, U1, P  
 grow G, R, O1, U1  
 guard G, AH1, R, D  
 guarantee G, EH1, R, I3, N, T, E1, Y  
 guess G, EH1, EH3, S  
  
 H A1, AY, Y, T, CH  
 had H, AE1, EH3, D  
 half H, AE1, EH3, F  
 halt H, AW, L, T  
 hammer H, AE1, EH3, M, ER  
 hand H, AE1, EH3, N, D  
 handle H, AE1, EH3, N, D, UH3, L  
 hang H, AE1, I3, NG  
 happy H, AE1, EH3, P, Y  
 hard H, AH1, R, D  
 has H, AE1, EH3, Z  
 have H, AE1, EH3, V  
 he H, E1, Y  
 head H, EH1, EH3, D  
 hear H, AY, I3, R  
 heart H, AH1, UH3, R, T  
 heat H, E1, AY, T  
 heavy H, EH1, V, Y  
 height H, UH3, AH2, Y, T  
 held H, EH1, UH3, L, D  
 hello H, EH1, UH3, L, UH3, O1, U1  
 help H, EH1, EH3, L, P

henry H, EH1, EH3, N, R, Y  
 her H, ER  
 here (use "hear" program)  
 hertz H, R, R, T, S  
 hex H, EH1, EH3, K, PAO, S  
 high H, AH1, EH3, Y  
 his H, I1, I3, Z  
 hold H, O2, O2, L, L, D  
 hole H, O1, U1, L  
 home H, O1, U1, M  
 hook H, OO1, OO1, K  
 host H, O1, U1, S, T  
 hot H, AH1, UH3, T  
 hotel H, O1, U1, T, EH2, EH2, L  
 hour AH1, UH3, W, ER  
 house H, UH3, AH2, U1, S  
 how H, AH1, O2, U1  
 human H, Y1, IU, U1, U1, M, EH2, N  
 hundred H, UH1, UH2, N, D, R, I3, D  
 hungry H, UH1, UH2, NG, G, R, Y  
  
 I AH1, EH3, I3, Y  
 idle AH1, Y, D, UH3, L  
 idol (use "idle" program)  
 if I1, I3, F  
 immediate I1, I3, M, E1, D, Y, EH3, T  
 important I1, I3, M, P, O2, O2, R, T, EH3,  
 N, T  
 improper I1, I3, M, P, R, AH1, UH3, P, ER  
 improve I1, I3, M, P, R, IU, U1, U1, V  
 in I1, I3, N  
 inch I1, I3, N, T, CH  
 include I1, I3, N, K, L, IU, U1, U1, D  
 income I1, I3, N, K, UH1, UH3, M  
 independent I1, N, D, E1, P, EH2, EH3, N, D,  
 EH3, N, T  
 index I1, I3, N, D, EH1, EH3, K, PAO, S  
 india I2, I3, N, D, Y, UH2  
 indicate I1, N, D, I3, K, A1, Y, T  
 industrial I1, I3, N, D, UH1, UH2, S, T, R,  
 AY, UH3, L  
 inform I1, I3, N, F, O2, O2, R, M  
 initial I1, I3, N, I1, SH, UH3, L  
 inn (use "in" program)

input I1, I3, N, P, OO1, OO1, T  
 inquire I1, I3, N, K, W, AH1, EH3, AY, R  
 insert I1, N, S, R, R, T  
 inspect I1, I3, N, S, P, EH1, EH3, K, T  
 install I1, I3, N, S, T, AW, L  
 instead I1, I3, N, S, T, EH1, EH3, D  
 instruct I1, I3, N, S, T, R, UH1, UH2, K, T  
 instrument I1, I3, N, S, T, R, UH1, M, EH1, EH3, N, T  
 insufficient I1, N, S, UH2, F, I1, SH, EH3, N, T  
 insurance I1, I3, N, SH, ER, R, EH3, N, T, S  
 interest I1, N, T, R, EH1, S, T  
 interface I1, I3, N, T, ER, F, A1, AY, Y, S  
 interpret I1, I3, N, T, ER, P, R, EH3, T  
 interrupt I1, N, T, ER, UH3, UH1, P, T  
 intrude I1, I3, N, T, R, IU, U1, U1, D  
 invalid I1, I3, N, V, AE1, AW2, L, I1, D  
 invent I1, I3, N, V, EH1, EH3, N, T  
 inventory I1, N, V, EH1, N, T, O1, R, Y  
 invest I1, I3, N, V, EH1, EH3, S, T  
 invoice I1, I3, N, V, O1, UH3, I3, AY, S  
 irregular I1, R, EH1, G, Y1, UH3, L, ER  
 is I1, I3, Z  
 it I1, I3, T  
 item AH2, UH3, Y, D, UH3, M  
 J D, J, EH3, A1, AY, Y  
 jack D, J, AE1, EH3, K  
 january D, J, AE1, EH3, N, Y1, UI, EH3, EH3, ER, Y  
 job D, J, AH1, UH3, B  
 join D, J, O1, UH3, I3, AY, N  
 jolt D, J, O2, O2, L, T  
 joy D, J, O1, UH3, I3, AY  
 judge D, J, UH1, UH2, D, J  
 juliet D, J, IU, U1, L, Y, EH2, EH3, T  
 july D, J, UH1, L, AH1, EH3, Y  
 jump D, J, UH1, UH2, M, P  
 june D, J, IU, U1, U1, N  
 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  
 kilo K, E1, AY, L, UH3, O2, U1  
 knew (use "new" program)  
 knot (use "not" program)  
 know (use "no" program)  
 knowledge N, AH1, UH3, L, I3, D, J  
 L EH1, EH3, UH3, L  
 lab L, AE1, EH3, B  
 labor L, A1, Y, B, ER  
 language L, AE1, EH3, NG, G, W, I1, D, J  
 lapse L, AE1, EH3, P, S  
 large L, AH1, R, D, J  
 last L, AE1, EH3, S, T  
 late L, A1, AY, Y, T  
 law L, AW  
 lead L, E1, Y, D  
 led L, EH1, EH3, D  
 left L, EH1, EH3, F, T  
 leg L, EH1, EH3, G  
 legal L, E1, G, UH3, L  
 lend L, EH1, EH3, N, D  
 length L, EH1, EH3, NG, TH  
 less L, EH1, EH3, S  
 let L, EH1, EH3, T  
 letter L, EH1, EH3, T, ER  
 level L, EH1, EH3, V, UH3, L  
 life L, UH3, AH2, Y, F  
 light L, UH3, AH2, Y, T  
 like L, UH3, AH2, Y, K  
 lima L, AY, Y, M, UH1  
 limit L, I1, M I1, T  
 line L, AH1, EH3, Y, N  
 linear L, I2, I3, N, AY, Y, ER  
 link L, I1, I3, NG, K  
 lip L, I1, I3, P  
 liquid L, I1, K, W, I1, D  
 list L, I1, I3, S, T  
 listen L, I1, I3, S, I2, N  
 little L, I1, I3, T, UH3, L  
 load L, UH3, O1, U1, D  
 loan L, UH3, O1, U1, N



local	L, 02, 02, K, UH3, L	memory	M, EH1, EH3, M, ER, Y
lock	L, AH1, UH3, K	men	M, EH1, EH3, N
log	L, AW, G	merchandise	M, ER, T, CH, EH3, N, D, AH1, EH3, Y, Z
long	L, AW, NG	merge	M, ER, R, D, J
look	L, 001, 001, K	message	M, EH1, EH3, S, I2, D, J
loss	L, AW, S	metal	M, EH1, EH3, T, UH3, L
lost	L, AW, S, T	meter	M, E1, Y, T, ER
lot	L, AH1, UH3, T	micro	M, UH3, AH2, AY, K, R, 01, U1
low	L, 01, U1	middle	M, I1, I3, D, UH3, L
M	EH1, EH2, M	mike	M, UH3, AH2, Y, K
machine	M, UH2, SH, E1, Y, N	mile	M, AH1, EH3, I3, UH3, L
mail	(use "male" program)	mill	M, I1, I3, L
maintenance	M, A1, Y, N, T, EH2, N, EH3, N, DT, S	milli	M, I1, I3, L, UH3
make	M, A1, AY, Y, K	million	M, I1, I3, L, Y, UH3, N
male	M, A2, A2, AY UH3, L	mini	M, I2, I2, N, Y
man	M, AE1, EH3, N	minus	M, AH1, Y, N, EH3, S
manage	M, AE1, EH3, N, I1, D, J	minute	M, I1, N, EH3, T
manual	M, AE1, EH3, N, Y1, U1, UH3, L	miscellaneous	M, I1, S, UH3, L, A1, AY, N, Y, UH3, S
manufacture	M, AE1, EH3, N, Y1, U1, F, AE1, EH3, K, T, CH, ER	miss	M, I1, I3, S
many	M, EH2, EH2, N, Y	mistake	M, I1, I3, S, T, A1, AY, Y, K
map	M, AE1, EH3, P	mode	M, 01, U1, D
march	M, AH1, R, T, CH	model	M, AH1, UH3, D, UH3, L
margin	M, AH1, UH3, R, D, J, I2, N	module	M, AH1, UH3, D, J, IU, U1, UH3, L
mark	M, AH1, R, K	monday	M, UH3, UH1, N, D, A1, I3, Y
market	M, AH1, R, K, EH3, T	money	M, UH3, UH1, N, AY, Y
match	M, AE1, EH3, T, CH	month	M, UH3, UH1, N, TH
mature	M, UH1, T, CH, IU, ER	more	M, 02, 02, R
maximum	M, AE1, EH3, K, PAO, S, EH3, M, UH2, M	morning	M, 02, 02, R, N, I1, I3, NG
may	M, A1, I3, Y	most	M, 01, U1, S, T
me	M, E1, Y	motor	M, 01, U1, T, ER
measure	M, EH3, EH1, ZH, ER	mount	M, AH1, UH3, W, N, T
meat	M, E1, AY, T	move	M, U1, U1, V
mechanical	M, UH1, K, AE1, EH3, N, I3, K, UH3, L	Mr.	M, I1, S, T, ER
media	M, E1, AY, D, Y, UH1	Mrs.	M, I1, S, I2, Z
medicine	M, EH2, EH3, D, I3, S, I1, N	Ms.	M, I1, I3, Z
medium	M, E1, D, AY, UH1, M	much	M, UH1, UH2, T, CH
meet	(use "meat" program)	multi	M, UH2, UH3, L, T, Y
mega	M, EH1, EH3, G, UH2, UH3	multiple	M, UH1, L, T, EH3, P, UH3, L
member	M, EH1, EH3, M, B, ER	multiply	M, UH1, L, T, I3, P, L, AH1, Y

N EH1, EH2, N  
 name N, A1, AY, Y, M  
 nano N, AE1, EH3, N, O1, U1  
 national N, AE1, EH3, SH, UH3, N, UH3, L  
 native N, A1, Y, T, I1, V  
 near N, AY, I1, R  
 neat N, E1, AY, T  
 neck N, EH1, EH3, K  
 need N, E1, Y, D  
 negative N, EH1, G, EH3, T, I1, V  
 net N, EH1, EH3, T  
 neutral N, IU, U1, T, R, UH2, L  
 new N, IU, U1, U1  
 next N, EH1, EH3, K, PAO, S, T  
 nice N, UH3, AH2, Y, S  
 nickel N, I1, I3, K, UH3, L  
 night N, UH3, AH2, Y, T  
 nine N, AH1, EH3, Y, N  
 ninety N, AH1, EH3, Y, N, T, Y  
 nineth N, AH1, Y, N, DT, TH  
 no N, O01, O1, U1  
 noise N, O1, UH3, I3, AY, Z  
 none N, UH1, UH3, N  
 noon N, IU, U1, U1, N  
 normal N, O2, O2, R, M, UH3, L  
 north N, O2, O2, R, TH  
 not N, AH1, UH3, T  
 note N, O1, U1, T  
 nothing N, UH1, TH, I1, I3, NG  
 notice N, O1, U1, T, I1, S  
 notify N, O1, U1, T, I1, F, AH1, EH3, Y  
 november N, O1, U1, V, EH1, EH3, M, B, ER  
 now N, AH1, UH3, U1  
 number N, UH1, UH2, M, B, ER  
 nurse N, ER, R, S  
 nut N, UH1, UH2, T  
 O O2, O1, U1  
 oar (use "or" program)  
 object UH1, B, D, J, EH1, EH3, K, T  
 object-2 AH1, UH3, B, D, J, EH2, EH2, K, T

obligation AH1, B, L, I3, G, A1, Y, SH, UH3, N  
 obsolete AH1, UH3, B, S, UH3, L, AY, Y, T  
 october AH1, UH3, K, T, O1, U1, B, ER  
 odd AH1, UH3, D  
 of UH1, UH3, V  
 off AW, F  
 office AW, F, I1, S  
 official UH1, F, I1, SH, UH3, L  
 often AW2, AW2, F, I3, N  
 ohm O2, O2, U1, M  
 oil O1, EH3, I3, UH3, L  
 old O2, O2, L, L, D  
 omega O1, U1, M, A1, Y, G, UH2  
 omit O1, U1, M, I1, I3, T  
 on AH1, UH3, N  
 once W, UH1, N, T, S  
 one W, UH1, UH2, N  
 only O1, O2, N, L, Y  
 open O1, P, I2, N  
 operable AH1, UH3, P, ER, UH3, B, UH3, L  
 operate AH1, UH3, P, ER, A1, Y, T  
 operator AH1, UH3, P, ER, A1, Y, T, ER  
 option AH1, UH3, P, SH, UH3, N  
 or O2, O2, R  
 orange O2, O2, R, I1, N, D, J  
 order O2, O2, R, D, ER  
 ore (use "or" program)  
 original O2, R, I2, I3, D, J, I3, N, UH3, L  
 oscar AH1, UH3, S, K, ER  
 other UH1, UH3, THV, ER  
 ounce AH1, UH3, W, N, S  
 out UH3, AH2, U1, T  
 oven UH1, V, I2, N  
 over O1, O2, V, ER  
 oxygen AH1, UH3, K, PAO, S, I3, D, J, I2, N  
 own O1, U1, N  
 P P, E1, Y  
 pack P, AE1, EH3, K  
 package P, AE1, EH3, K, I1, D, J  
 paid P, A1, AY, Y, D

pain P, A1, AY, Y, N  
 pane (use "pain" program)  
 panel P, AE1, EH3, N, UH3, L  
 papa P, AH1, UH3, P, UH3, UH3  
 paper P, A1, Y, P, ER  
 parcel P, AH1, R, S, UH3, L  
 paren P, EH3, EH3, ER, I2, N  
 part P, AH1, R, T  
 partial P, AH1, R, SH, UH2, L  
 pass P, AE1, EH3, S  
 passed (use "past" program)  
 past P, AE1, EH3, S, T  
 pat P, AE1, EH3, T  
 pattern P, AE1, EH3, T, ER, N  
 pause P, AW, Z  
 pay P, A2, A2, AY, Y  
 pea (use "P" program)  
 peace (use "piece" program)  
 peak P, E1, AY, K  
 peek (use "peak" program)  
 percent P, ER, S, EH1, EH3, N, T  
 period P, I1, R, Y, UH2, D  
 permanent P, ER, M, EH2, N, EH1, N, T  
 person P, ER, S, UH1, N  
 personal P, ER, S, UH3, N, UH2, L  
 personality P, ER, S, UH3, N, AE1, UH3, L, I3, T, Y  
 phase F, A1, AY, Y, Z  
 phone F, O1, U1, N  
 pick P, I1, I3, K  
 pico P, E1, Y, K, O2, U1  
 piece P, E1, Y, S  
 pint P, AH1, Y, N, T  
 pipe P, UH3, AH2, Y, P  
 place P, L, A1, AY, Y, S  
 plain (use "plane" program)  
 plan P, L, AE1, EH3, N  
 plane P, L, A1, AY, Y, N  
 plant P, L, AE1, EH3, N, T  
 play P, L, A1, I3, Y  
 please P, L, E1, Y, Z  
 plot P, L, AH1, UH3, T  
 plus P, L, UH1, UH2, S

pocket P, AH1, UH3, K, EH3, T  
 point P, O1, UH3, I3, AY, N, T  
 poke P, O1, U1, K  
 police P, UH1, L, AY, Y, S  
 plain (use "plane" program)  
 plan P, L, AE1, EH3, N  
 plane P, L, A1, AY, Y, N  
 plant P, L, AE1, EH3, N, T  
 play P, L, A1, I3, Y  
 please P, L, E1, Y, Z  
 plot P, L, AH1, UH3, T  
 plus P, L, UH1, UH2, S  
 pocket P, AH1, UH3, K, EH3, T  
 point P, O1, UH3, I3, AY, N, T  
 poke P, O1, U1, K  
 police P, UH1, L, AY, Y, S  
 policy P, AH1, UH3, L, I3, S, Y  
 poor (use "pour" program)  
 pop P, AH1, UH3, P  
 port P, O2, O2, R, T  
 position P, UH1, Z, I1, SH, UH3, N  
 positive P, AH1, UH3, Z, I1, T, I1, V  
 possible P, AH1, UH3, S, UH3, B, UH2, L  
 post P, O1, U1, S, T  
 potential P, O1, T, EH1, EH3, N, T, CH, UH3, L  
 pound P, AH1, UH3, W, N, D  
 pour P, O1, O2, R  
 power P, AH1, UH3, W, ER  
 practice P, R, AE1, EH3, K, T, I1, S  
 premium P, R, AY, Y, M, Y, UH1, M  
 prepare P, R, E1, P, EH1, EH3, R  
 press P, R, EH1, EH3, S  
 pressure P, R, EH1, SH, ER  
 prevent P, R, Y, V, EH1, EH3, N, T  
 previous P, R, Y, V, Y, UH1, S  
 price P, R, UH3, AH2, Y, S  
 principal (use "principle" program)  
 principle P, R, I1, N, DT, S, UH3, P, UH3, L  
 print P, R, I1, I3, N, T  
 prior P, R, AH1, Y, ER  
 priority P, R, AH1, Y, O1, R, I3, DT, Y

private P, R, AH1, EH3, Y, V, I3, T  
 probe P, R, 01, U1, B  
 problem P, R, AH1, UH3, B, L, UH3, M  
 procedure P, R, UH1, S, E1, D, J, ER  
 proceed P, R, 01, S, E1, Y, D  
 process P, R, AH1, UH3, S, EH1, EH3, S  
 produce P, R, UH1, D, IU, U1, U1, S  
 product P, R, AH1, UH3, D, UH1, UH2, K, T  
 progress P, R, AH1, UH3, G, R, EH1, S  
 profession P, R, UH1, F, EH1, EH3, SH, UH3, N  
 profit P, R, AH1, UH3, F, I1, T  
 program P, R, 01, G, R, AE1, EH3, M  
 project P, R, AH1, UH3, D, J, EH2, EH2, K, T  
 PROM P, R, AH1, UH3, M  
 promote P, R, UH1, M, 01, U1, T  
 propose P, R, UH1, P, 01, U1, Z  
 protect P, R, UH1, T, EH1, EH3, K, T  
 public P, UH1, UH3, B, L, I3, K  
 pull P, 001, 001, L  
 pulse P, UH1, UH2, L, S  
 punch P, UH1, UH2, N, T, CH  
 purpose P, R, R, P, EH2, S  
 purchase P, R, R, DT, CH, I2, S  
 pure P, Y1, IU, ER  
 push P, 001, IU, SH  
 put P, 001, 001, T

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  
 quart K, W, 01, R, T  
 quarter K, W, 01, R, T, ER  
 quebec K, W, I1, B, EH1, EH3, K  
 question K, W, EH1, EH3, S, T, CH, UH3, N  
 quick K, W, I1, I3, K  
 quiet K, W, AH1, EH3, AY, I2, T  
 quit K, W, I1, I3, T  
 quiz K, W, I1, I3, Z  
 quota K, W, 01, 02, T, UH1  
 quote K, W, 01, U1, T

R AH1, UH2, ER  
 rail R, A1, AY, I3, UH3, L  
 rain R, A1, AY, Y, N  
 raise R, A1, AY, Y, Z  
 range R, A1, AY, Y, N, D, J  
 radio R, A1, Y, D, Y, 01, U1  
 rate R, A1, AY, Y, T  
 ratio R, A1, Y, SH, Y, 01, U1  
 reach R, E1, Y, T, CH  
 read R, E1, Y, D  
 ready R, EH1, EH3, D, Y  
 real R, E1, AY, L  
 reason R, E1, Y, Z, UH1, N  
 rebate R, E1, B, A1, Y, T  
 recall R, E1, K, AW2, AW1, L  
 receipt R, E1, S, AY, Y, T  
 receive R, E1, S, E1, Y, V  
 record R, E1, K, 02, 02, R, D  
 record-2 R, EH1, EH3, K, ER, D  
 red R, EH1, EH3, D  
 reel (use "real" program)  
 refer R, E1, F, UH1, UH2, N, D  
 refuse R, E1, F, Y1, IU, U1 U1, Z  
 register R, EH1, D, J, I1, S, T, ER  
 regular R, EH1, G, Y1, IU, L, ER  
 rein (use "rain" program)  
 reject R, E1, D, J, EH1, EH3, K, T  
 relay R, E1, L, A1, I3, Y  
 release R, E1, L, E1, AY, S  
 remain R, E1, M, A1, AY, Y, N  
 remove R, E1, M, U1, U1, V  
 repair R, E1, P, EH2, EH2, R  
 repeat R, E1, P, E1, AY, T  
 replace R, E1, P, L, A1, AY, Y, S  
 report R, E1, P, 02, 02, R, T  
 represent R, EH1, P, R, I2, Z, EH1, EH3, N, T  
 request R, E1, K, W, EH1, EH3, S, T  
 require R, E1, K, W, AH1, EH3, AY, R  
 requisition R, EH1, K, W, I2, Z, I1, SH, UH3, N  
 rescue R, EH1, EH3, S, K, Y1, IU, U1

resemble R, E1, Z, EH1, EH3, M, B, UH3, L  
 reset R, E1, S, EH1, EH3, T  
 resistor R, E1, Z, I1, S, T, ER  
 respect R, E1, S, P, EH1, EH3, K, T  
 respond R, E1, S, P, AH1, UH3, N, D  
 responsible R, I2, S, P, AH1, UH3, N, DT, S, UH3, B, UH3, L  
 rest R, EH1, EH3, S, T  
 restrict R, E1, S, T, R, I1, I3, K, T  
 result R, E1, Z, UH1, UH2, L, T  
 resume R, E1, Z, IU, U1, U1, M  
 retail R, AY, E1, T, EH3, A1, I3, UH3, L  
 retain R, E1, T, A1, AY, Y, N  
 return R, E1, T, ER, R, N  
 revision R, E1, V, I1, ZH, UH3, N  
 revolve R, E1, V, AH1, UH3, L, V  
 ribbon R, I2, I3, B, UH3, N  
 right R, UH3, AH2, Y, T  
 romeo R, O1, U1, M, Y, O1, U1  
 room R, U1, U1, M  
 root R, U1, U1, T  
 round R, AH1, UH3, W, N, D  
 route R, UH2, AH2, U1, T  
 row R, O1, U1  
 run R, UH1, UH3, N  
 rush R, UH1, UH2, SH

S EH1, EH2, S  
 safe S, A1, AY, Y, F  
 sail (use "sale" program)  
 salary S, AE1, AH2, L, UH3, R, Y  
 sale S, A1, A2, AY, UH3, L  
 same S, A1, AY, Y, M  
 saturday S, AE1, EH3, T, ER, D, A1, Y  
 save S, A1, AY, Y, V  
 say S, A1, I3, Y  
 scan S, K, AE1, EH3, N  
 scent (use "cent" program)  
 schedule S, K, EH1, EH3, D, J, IU, U1, L  
 school S, K, U1, U1, L  
 science S, AH1, I3, Y, EH3, N, DT, S  
 score S, K, O2, O2, R

scrap S, K, R, AE1, EH3, P  
 screw S, K, R, IU, U1, U1  
 sea (use "C" program)  
 seat S, E1, AY, T  
 second S, EH1, EH3, K, UH1, N, D  
 secret S, E1, K, R, I3, T  
 section S, EH1, EH3, K, SH, UH3, N  
 security S, EH1, EH3, K, Y, ER, I1, T, Y  
 see (use "C" program)  
 seize S, E1, Y, Z  
 select S, UH1, L, EH1, EH2, K, T  
 sell S, EH1, EH3, L  
 semi S, EH1, M, AH1, Y  
 semicolon S, EH1, M, AH1, Y, K, OO1, O1, L, I2, N  
 send S, EH1, EH3, N, D  
 sent (use "cent" program)  
 sentence S, EH1, N, T, I2, N, DT, S  
 separate S, EH1, EH3, P, UH1, R, A1, AY, T  
 separate-2 S, EH1, EH3, P, R, I2, T  
 september S, EH1, EH3, P, T, EH1, EH3, M, B, ER  
 sequence S, E1, K, W, EH1, EH3, N, S  
 serial S, I1, R, Y, UH3, L  
 series S, I1, R, Y, Z  
 service S, ER, V, I1, S  
 set S, EH1, EH3, T  
 seven S, EH1, EH3, V, I2, N  
 seventh S, EH1, EH3, V, I2, N, DT, TH  
 seventy S, EH1, V, I2, N, D, Y  
 several S, EH1, V, ER, UH3, L  
 sew (use "so" program)  
 share SH, EH3, EH3, ER  
 sharp SH, AH1, R, P  
 shift SH, I1, I3, F, T  
 ship SH, I1, I3, P  
 shop SH, AH1, UH3, P  
 short SH, O2, O2, R, T  
 should SH, IU, IU, IU, D  
 shunt SH, UH1, UH2, N, T  
 shut SH, UH1, UH2, T  
 side S, AH1, EH3, Y, D  
 sierra S, E1, I3, EH1, R, UH1

signal S, I1, I3, G, N, UH3, L  
 silver S, I1, I3, L, V, ER  
 single S, I1, I3, NG, G, UH3, L  
 six S, I1, I3, K, PAO, S  
 sixth S, I1, I3, K, PAO, S, TH  
 sixty S, I1, I3, K, PAO, T, Y  
 size S, AH1, EH3, Y, Z  
 skin S, K, I1, I3, N  
 sky S, K, AH1, EH3, I3, Y  
 slang S, L, AE1, EH3, NG  
 slash S, L, AE1, EH3, SH  
 slave S, L, A1, AY, Y, V  
 slip S, L, I1, I3, P  
 slow S, L, O1, U1  
 small S, M, AW, L  
 smell S, M, EH1, EH3, L  
 smile S, M, AH1, EH3, I3, UH3, L  
 smoke S, M, O1, U1, K  
 snow S, N, OO1, O2, U1  
 so S, OO1, O2, U1  
 soft S, AW, F, T  
 sold S, O2, O2, L, L, D  
 solid S, AH1, UH3, L, I1, D  
 son (use "sun" program)  
 some (use "sum" program)  
 sorry S, AW, R, Y  
 sort S, O2, O2, R, T  
 sound S, AH1, UH3, W, N, D  
 source S, O1, O2, R, S  
 south S, AH1, UH3, U1, TH  
 space S, P, A1, AY, Y, S  
 spark S, P, AH1, R, K  
 speak S, P, E1, AY, K  
 special S, P, EH1, EH3, SH, UH3, L  
 speed S, P, E1, Y, D  
 speech S, P, E1, Y, T, CH  
 spell S, P, EH1, EH3, L  
 spend S, P, EH1, EH3, N, D  
 split S, P, L, I1, I3, T  
 spoon S, P, U1, U1, N  
 spring S, P, R, I1, I3, NG  
 square S, K, W, EH1, R  
 stack S, T, AE1, EH3, K  
 stair (use "stare" program)

stand S, T, AE1, EH3, N, D  
 standard S, T, AE1, EH3, N, D, ER, D  
 star S, T, AH1, UH3, R  
 stare S, T, EH3, EH3, ER  
 start S, T, AH1, R, T  
 state S, T, A1, AY, Y, T  
 station S, T, A1, Y, SH, UH3, N  
 status S, T, AE1, EH3, T, I2, S  
 steal (use "steel" program)  
 steel S, T, E1, Y, L  
 step S, T, EH1, EH3, P  
 stick S, T, I1, I3, K  
 stock S, T, AH1, UH3, K  
 stop S, T, AH1, UH3, P  
 store S, T, O2, O2, R  
 strait (use "straight" program)  
 straight S, T, R, A1, AY, Y, T  
 street S, T, R, E1, Y, T  
 stress S, T, R, EH1, EH3, S  
 string S, T, R, I1, I3, NG  
 structure S, T, R, UH1, K, T, CH, ER  
 style S, T, AH1, EH3, AY, UH3, L  
 subject S, UH1, UH2, B, D, J, EH1, EH3, K, T  
 substitute S, UH1, UH3, B, S, T, I3, T, IU, U1, T  
 subtract S, UH1, UH2, B, T, R, AE1, EH3, K, T  
 sufficient S, UH1, F, I1, SH, EH3, N, T  
 suggest S, UH1, UH2, G, D, J, EH1, EH3, S, T  
 suit S, IU, U1, T  
 suite S, W, AY, Y, T  
 sum S, UH1, UH2, M  
 summary S, UH2, UH2, M, ER, Y  
 summer S, UH1, UH2, M, ER  
 sun S, UH1, UH2, N  
 sunday S, UH1, UH2, N, D, A1, I3, Y  
 super S, IU, U1, P, ER  
 supply S, UH2, P, L, AH1, Y  
 surface S, ER, F, I2, S  
 surge S, ER, R, D, J  
 surgery S, ER, D, J, ER, Y

surgical S, ER, D, J, UH3, K, UH3, L  
 surplus S, ER, P, L, UH1, S  
 suspend S, UH1, S, P, EH1, EH3, N, D  
 sweep S, W, E1, Y, P  
 sweet (use "suite" program)  
 switch S, W, I1, I3, T, CH  
 syntax S, I1, N, T, AE1, EH3, K, PAO, S  
 system S, I1, S, T, UH3, M

T T, E1, AY, Y  
 table T, A1, Y, B, UH3, L  
 tail (use "tale" program)  
 tale T, A1, Y, UH3, L  
 talk T, AW, K  
 tangent T, AE1, EH3, N, D, J, EH3, N, T  
 target T, AH1, UH3, R, G, I2, T  
 tea (use "T" program)  
 team T, E1, Y, M  
 technical T, EH1, EH3, K, N, I3, K, UH3, L  
 tee (use "T" program)  
 temperature T, EH1, EH3, M, P, ER, UH1, T, CH, ER

ten T, EH1, EH3, N  
 terminal T, ER, M, EH3, N, UH2, L  
 test T, EH1, EH3, S, T  
 than THV, EH1, EH3, N  
 the THV, UH1, UH3  
 then. (use "than" program)  
 theory TH, AY, I2, R, Y  
 thin TH, I1, I3, N  
 thing TH, I1, I3, NG  
 think TH, I1, I3, NG, K  
 third TH, ER, R, D  
 thirteen TH, ER, T, T, E1, Y, N  
 thirty TH, ER, R, D, Y  
 thousand TH, AH1, UH3, U1, Z, EH3, N, D  
 three TH, R, E1, Y  
 threw (use "through" program)  
 through TH, R, IU, U1  
 thursday TH, ER, R, Z, D, A1, I3, Y  
 ticket T, I1, I3, K, EH3, T  
 till T, I1, I3, L  
 time T, AH1, EH3, Y, M

tire T, AH1, EH3, AY, R  
 title T, UH3, AH2, Y, T, UH3, L  
 to (use "two" program)  
 today T, U1, D, A1, I3, Y  
 toilet T, O1, EH3, I3, L, I3, T  
 toll T, O2, O2, OO1, L  
 tomorrow T, U1, M, AH1, R, O1, U1  
 ton T, UH1, UH2, N, N  
 tone T, O1, U1, N  
 too (use "two" program)  
 tool T, U1, U1, L  
 total T, O1, U1, T, UH3, L  
 touch T, UH1, UH3, T, CH  
 towel T, AH1, W, UH3, L  
 trace T, R, A1, AY, Y, S  
 trade T, R, A1, AY, Y, D  
 train T, R, A1, AY, Y, N  
 transact T, R, AE1, EH3, N, S, AE1, EH3, K, T  
 transfer T, R, AE1, EH3, N, S, F, ER  
 transistor T, R, AE1, N, Z, I1, S, T, ER  
 transmit T, R, AE1, EH3, N, Z, M, I1, I3, T  
 transport T, R, AE1, EH3, N, S, P, O2, O2, R, T  
 transportation T, R, AE1, N, S, P, ER, T, A1, AY, SH, UH3, N  
 travel T, R, AE1, EH3, V, UH3, L  
 triangle T, R, AH1, I3, AE1, EH3, NG, G, UH3, L  
 trouble T, R, UH3, UH1, B, UH3, L  
 truck T, R, UH1, UH2, K  
 true T, R, IU, U1, U1  
 trust T, R, UH1, UH2, S, T  
 try T, R, AH1, EH3, I3, Y  
 tuesday T, IU, U1, U1, Z, D, A1, Y  
 tune T, IU, U1, U1, N  
 turn T, ER, R, N  
 twelve T, W, EH1, EH3, UH3, L, V  
 twenty T, W, EH1, EH3, N, T, Y  
 two T, IU, U1, U1  
 type T, UH3, AH2, Y, P

U Y1, IU, U1, U1  
 ultra UH3, UH2, L, T, R, UH1  
 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  
 use-2 Y1, IU, U1, S

V V, E1, AY, Y  
 vacant V, A1, Y, K, EH3, N, T  
 valid V, AE1, UH3, L, I1, D  
 vary (use "very" program)  
 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  
 way (use "weigh" program)  
 we W, E1, Y  
 weak (use "week" program)  
 weapon W, EH2, EH2, P, UH1, N  
 wear (use "where" program)  
 wednesday W, EH1, N, Z, D, A1, I3, Y  
 week W, E1, Y, K

weigh W, A2, A2, Y  
 weight (use "wait" program)  
 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  
 whole (use "hole" program)  
 why (use "Y" program)  
 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  
 won (use "one" program)  
 word W, ER, R, D  
 work W, ER, R, K  
 write (use "right" program)  
 wrong R, AW, NG

X EH1, EH2, K, PAO, S  
 x-ray EH1, EH2, K, PAO, 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



you (use "U" program)  
 your Y, O2, O2, R  
 you're (use "your" program)

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

**Prefixes**

con... K, UH1, N  
 dis... D, I1, S  
 en... EH1, N  
 in... I1, N  
 non... N, AH1, UH3, N  
 pre... P, R, E1  
 re... R, E1  
 un... UH1, N

**Suffixes**

...d D  
 ...ed I2, D  
 ...er ER  
 ...es I2, Z  
 ...ful F, UH3, L  
 ...ing I2, NG  
 ...less L, EH2, S  
 ...ly L, Y  
 ...ment M, EH3, N, T  
 ...ness N, EH3, S  
 ...s S  
 ...t (...ed) T  
 ...tion (...sion) SH, UH3, N  
 ...teen T, E1, Y, N  
 ...ward W, ER, D  
 ...y Y  
 ...z (...es) Z