

Votrax[®]

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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

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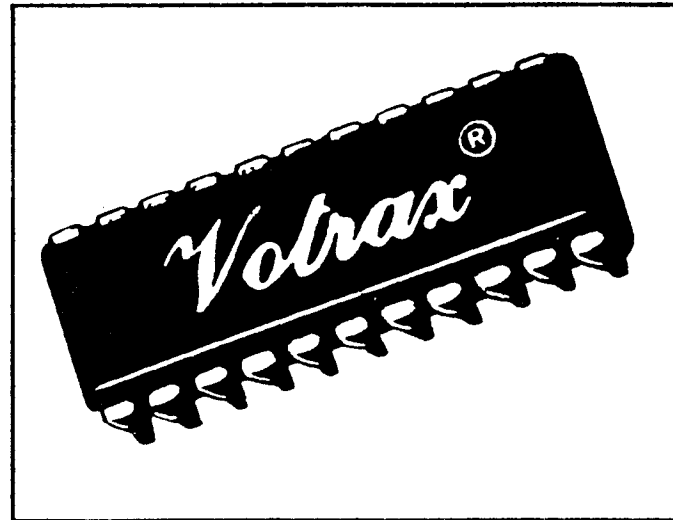


Figure 1. Votrax[®] SC-01 Speech Synthesizer

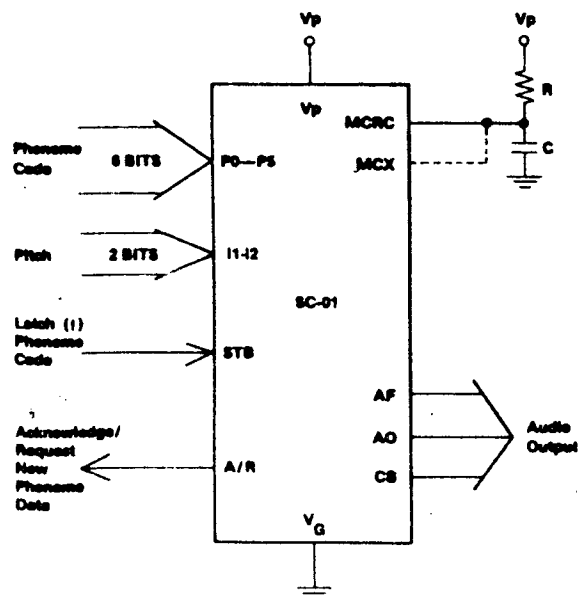


Figure 2. SC-01 Flow Diagram

CMOS technology, which offers high input impedance and low power drain.

ELECTRICAL DESCRIPTION

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

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

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

PHONEME PROGRAMMING

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

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

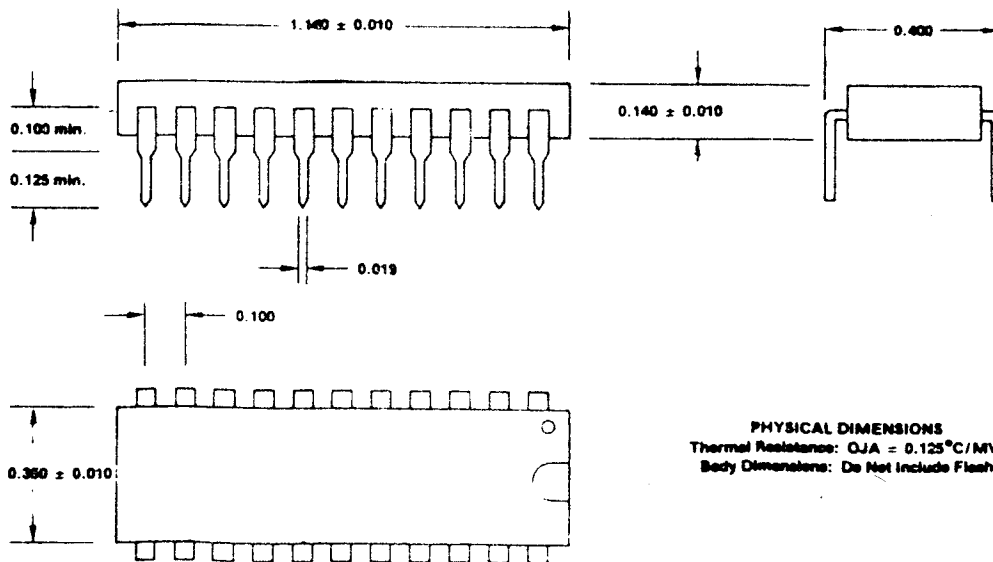
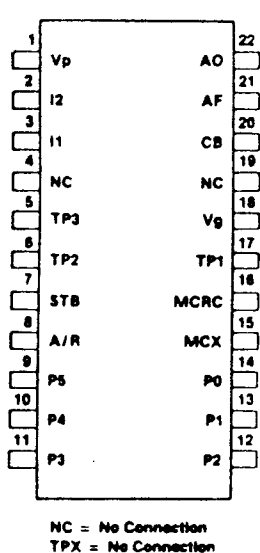


Table 1. Phoneme Chart

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	✓	59	jacket
01	EH2	✓	71	enlist
02	EH1	✓	121	heavy
03	PA0	NS	47	no sound
04	DT	FS	47	butter
05	A2	✓	71	made
06	A1	✓	103	made
07	ZH	VF	90	azure
08	AH2	✓	71	honest
09	I3	✓	55	inhibit
0A	I2	✓	80	inhibit
0B	I1	✓	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	✓	146	lawful
14	NG	N	121	thing
15	AH1	✓	146	father
16	OO1	✓	103	looking
17	OO	✓	185	book
18	L	✓	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	✓	185 day
21	AY	✓	65 day
22	Y1	✓	80 yard
23	UH3	✓	47 mission
24	AH	✓	250 mop
25	P	FS	103 past
26	O	✓	185 cold
27	I	✓	185 pin
28	U	✓	185 move
29	Y	✓	103 any
2A	T	FS	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	VF	80 the
39	TH	F	71 thin
3A	ER	✓	146 bird
3B	EH	✓	185 get
3C	E1	✓	121 be
3D	AW	✓	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						

SIGNAL DESCRIPTION (See Figures 4 and 5)

NOTE

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

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.

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)

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

NOTE

NOTE \bar{A}/R  5.0. 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_i to STB)	T_S	450			NS
Input Hold Time (P_i to STB)	T_H	0			NS
Rise Time of STB Edge (.8V to 4V)	T_{RS}			100	NS
A/R Width (\bar{A}/R Connected to STB) *	T_{ARW}	1	1.3	2	μs
STB Width	T_{SW}	200			NS
STB Low *	T_{SL}				NS
Propagation Delay (STB to \bar{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	μs
Time of Phoneme Duration *	T_{PH}	47	107	250	MS

* Dependent on Master Clock frequency: 720kHz

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

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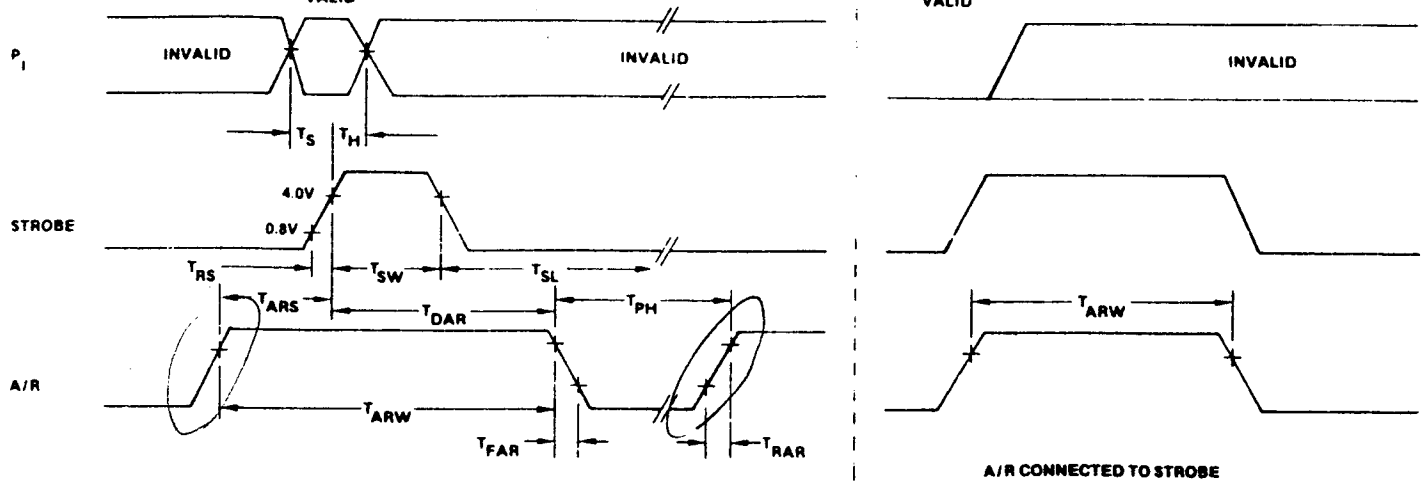


Figure 4. Timing Diagram

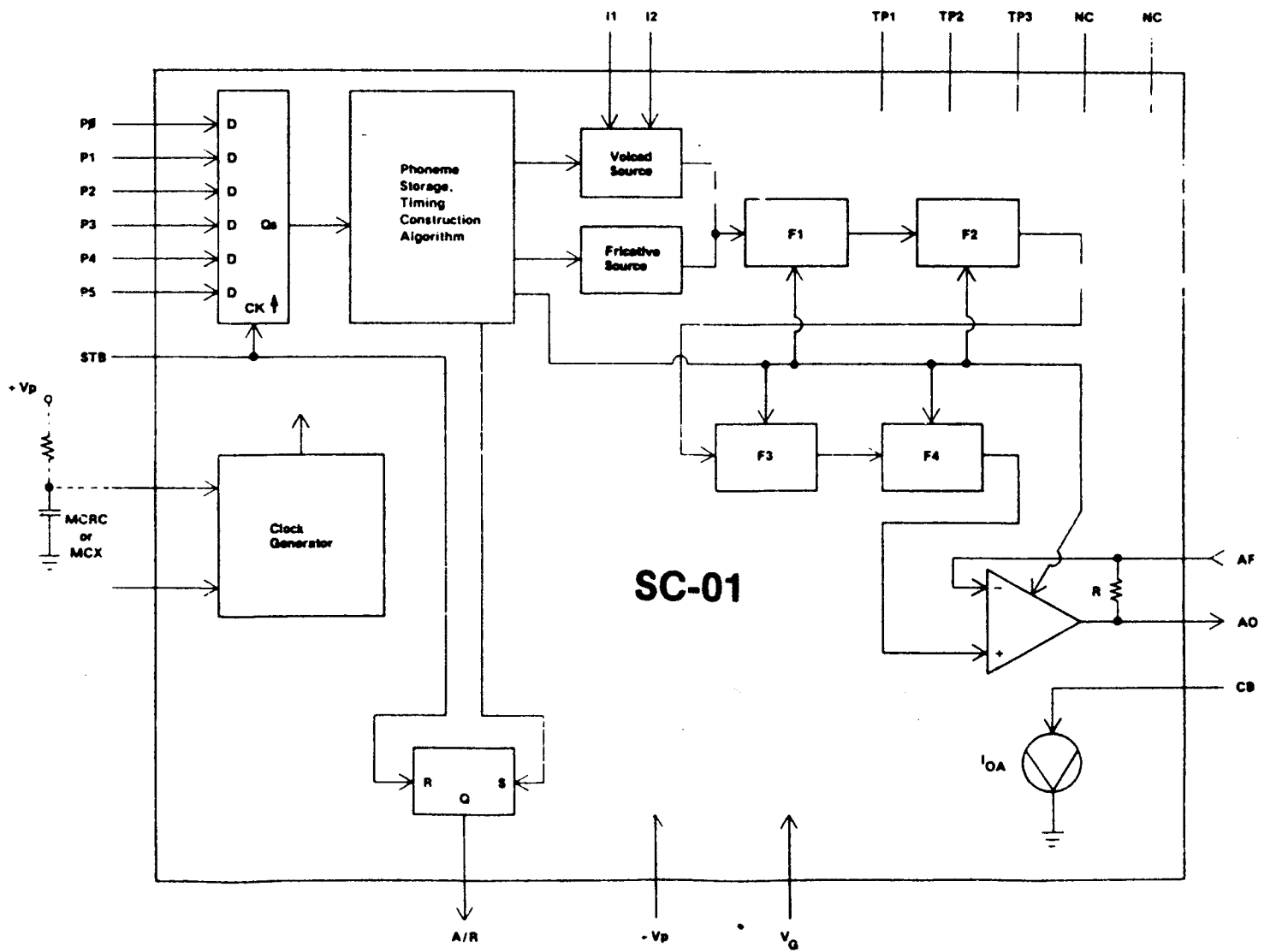


Figure 5. SC-01 Block Diagram

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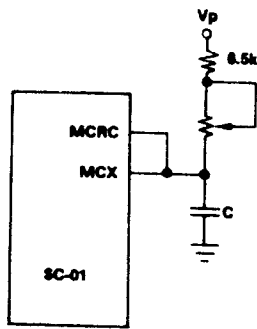


Figure 6. Variable Voice by Potentiometer Control

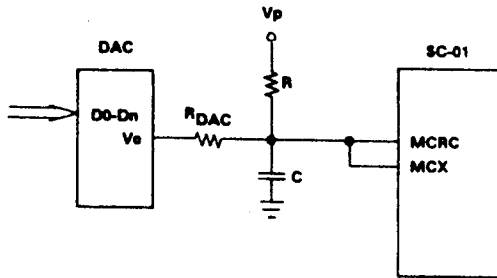


Figure 7. Variable Voice by DAC Current Injection

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 μ f capacitor to TP3 to insure power up reset of SC-01.

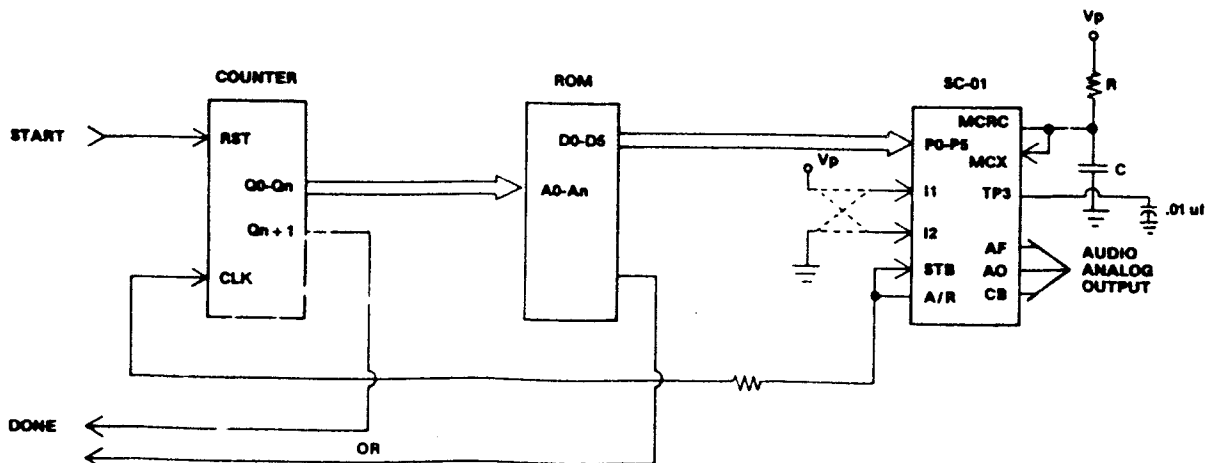


Figure 8. Single Message System

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.

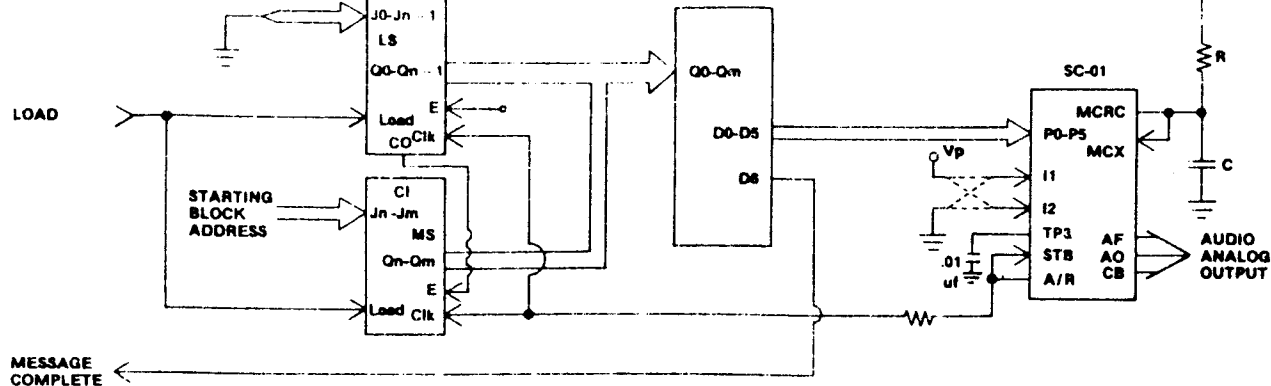


Figure 9. Multiple Message, Fixed Block Size

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.

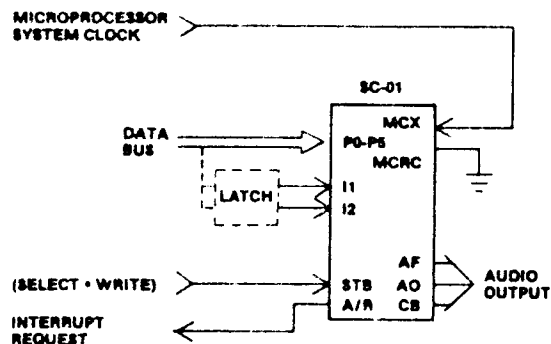


Figure 10. Multiple Message, Variable Block Size

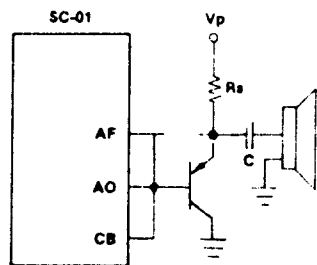


Figure 11. Class A Amplifier

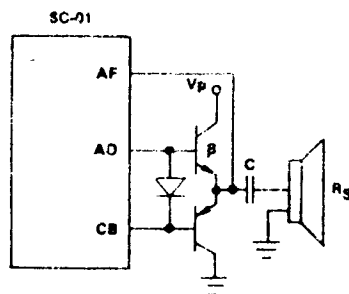


Figure 12. Class B Amplifier *

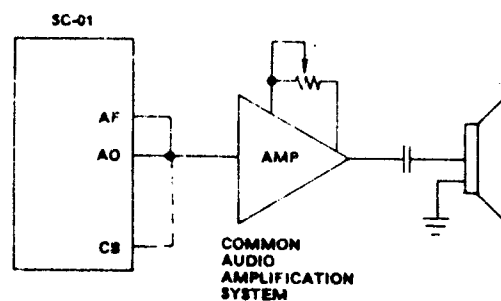


Figure 13. Controlling Audio Output Power

*For Class B Amplifier: $(\beta) \times (R_s \text{ min.}) = 81.6 \times (V_p)$ where β is beta or current gain of transistor. The AO line is protected by an internal series current limiting resistor of 90 ohms maximum. If more current is required of the SC-01, then the above formula

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

ELECTRICAL CHARACTERISTICS: T_o = 0 to 70°C, V_p = 7 to 14 V_{DC}

CHARACTERISTIC	MIN	TYP	MAX	UNIT
Digital Input Impedance	1 meg.			Ohm
Input Capacitance (P ₁ , STB)			3	pf
Input Capacitance (I1, I2, MCX)			8	pf
Digital Input Logic "0" (except I1, I2, MCX)	V _G - 0.5		V _G + 0.8	V _{DC}
Digital Input Logic "0" (MCX)			V _G + 1.0	V _{DC}
Digital Input Logic "0" (I1, I2)			.2 x V _p	V _{DC}
Digital Input Logic "1" (except I1, I2, MCX)	V _G + 4.0		V _p + 0.5	V _{DC}
Digital Input Logic "1" (I1, I2)	.8 x V _p			V _{DC}
Digital Input Logic "1" (MCX)	4.6			V _{DC}
Digital Output Logic "0" (I sink = 0.8mA)			V _G + 0.5	V _{DC}
Digital Output Logic "1" (I source = 0.5mA)	V _p - 0.5			V _{DC}
Power Supply Current	V _p = 9V	9.1		mA
	V _p = 9V**	11	18	mA
	V _p = 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_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: $7v \leq V_p \leq 14v$, $0^\circ C \leq T_o \leq 70^\circ C$

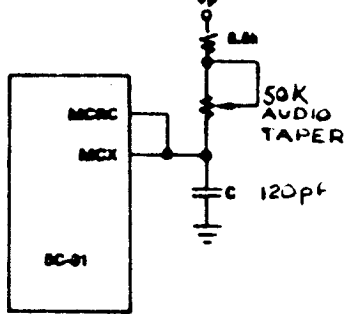


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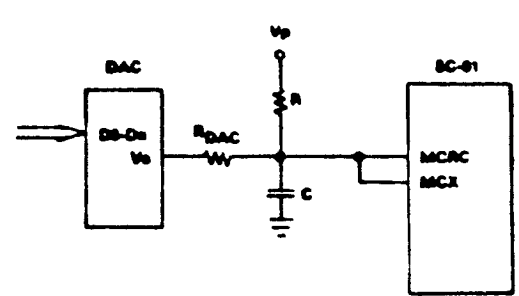


Figure 7. Variable Voice by DAC Current Injection

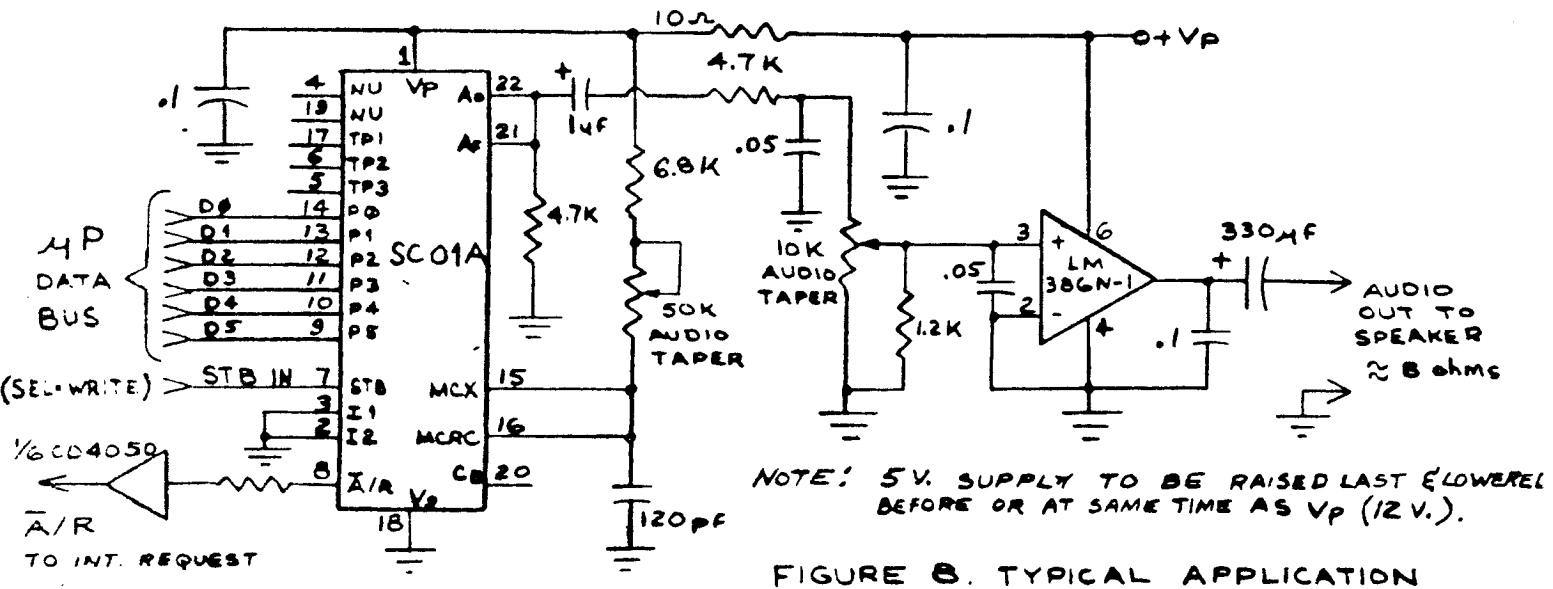


FIGURE 8. TYPICAL APPLICATION

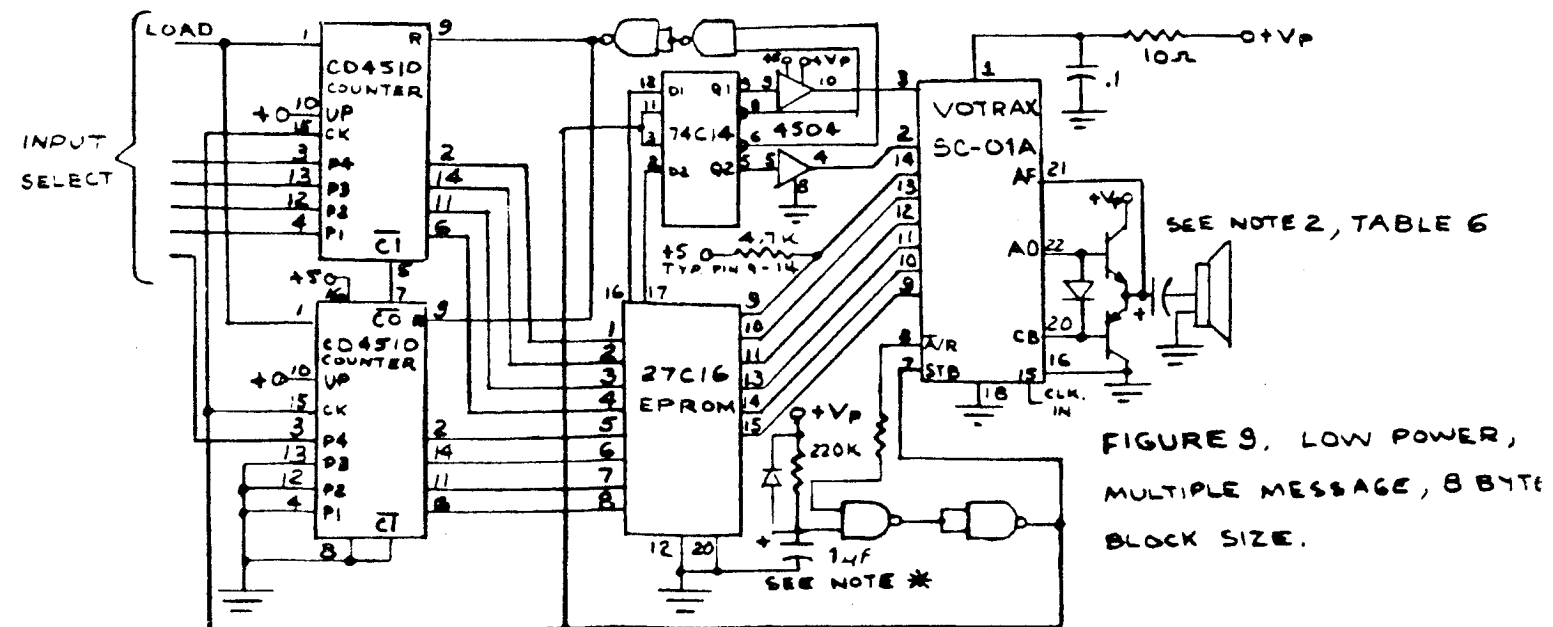


FIGURE 9. LOW POWER, MULTIPLE MESSAGE, 8 BYTE BLOCK SIZE.

NOTE * : CIRCUIT USES A/R LINE AS STROBE. R-C PROVIDES AN INITIAL

Votrax[®]

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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.

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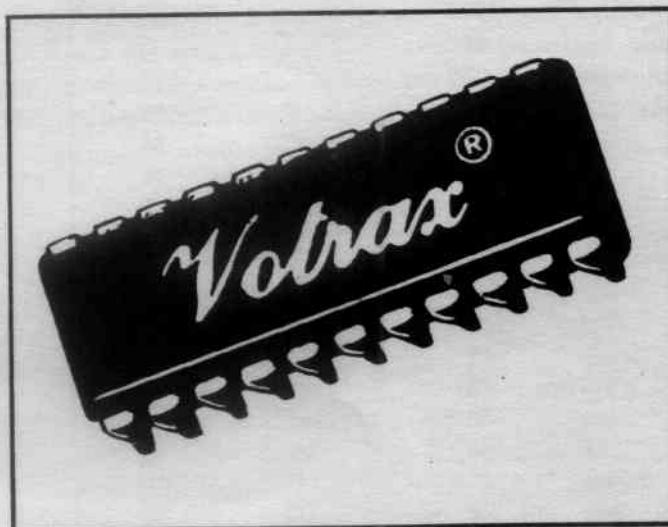


Figure 1. Votrax[®] SC-01 Speech Synthesizer

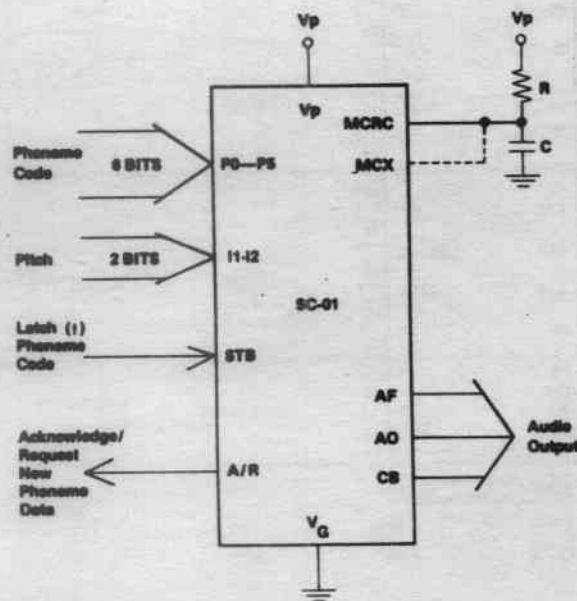


Figure 2. SC-01 Flow Diagram

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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[®] 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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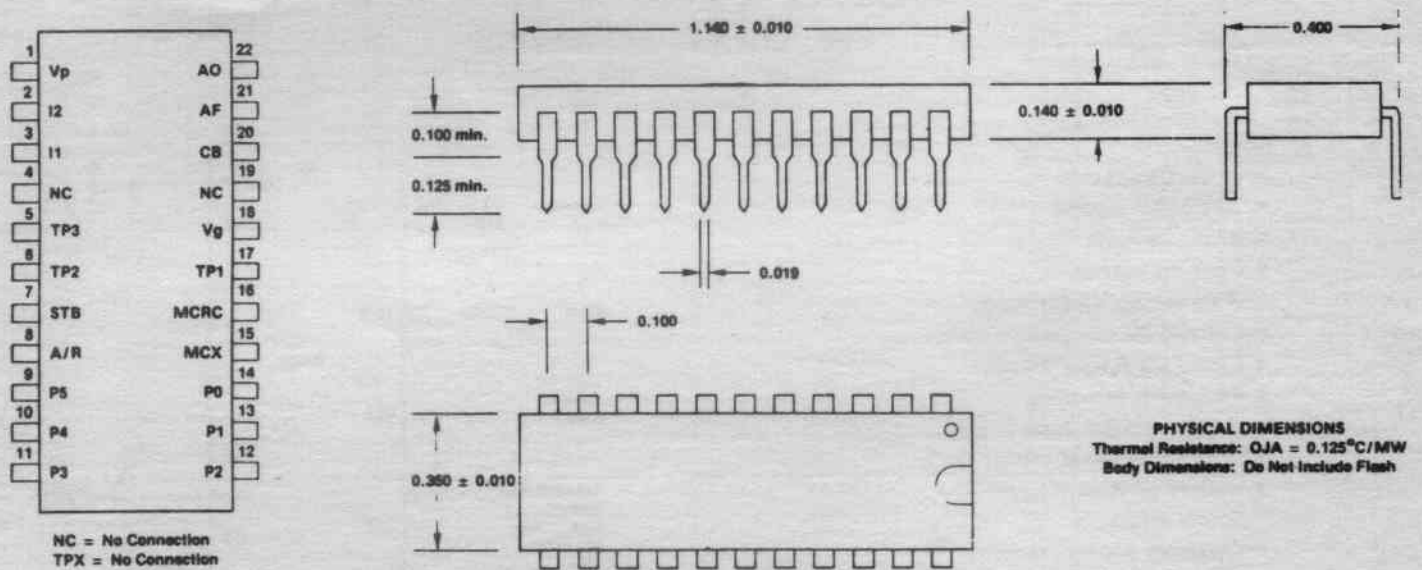


Figure 3. SC-01 Footprint and Outline Dimensions

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Table 1. Phoneme Chart

Phoneme Code	Phoneme Symbol	Duration (ms)	Example Word
00	EH3	59	jack <u>e</u> t
01	EH2	71	en <u>e</u> list
02	EH1	121	he <u>a</u> vy
03	PA0	47	no sound
04	DT	47	but <u>t</u> er
05	A2	71	ma <u>d</u> e
06	A1	103	ma <u>d</u> e
07	ZH	90	azu <u>r</u> e
08	AH2	71	honest
09	I3	55	in <u>h</u> ibit
0A	I2	80	in <u>h</u> ibit
0B	I1	121	in <u>h</u> ibit
0C	M	103	ma <u>t</u>
0D	N	80	su <u>n</u>
0E	B	71	ba <u>g</u>
0F	V	71	va <u>n</u>
10	CH*	71	ch <u>i</u> p
11	SH	121	sh <u>o</u> p
12	Z	71	zoo
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	OO1	103	loo <u>k</u> ing
17	OO	185	bo <u>o</u> k
18	L	103	la <u>n</u> d
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	g <u>e</u> t
1D	F	103	fa <u>s</u> t
1E	D	55	pa <u>i</u> d
1F	S	90	pa <u>s</u> s

Phoneme Code	Phoneme Symbol	Duration (ms)	Example Word
20	A	185	da <u>y</u>
21	AY	65	da <u>y</u>
22	Y1	80	ya <u>r</u> d
23	UH3	47	mi <u>s</u> sion
24	AH	250	mo <u>p</u>
25	P	103	pa <u>s</u> t
26	O	185	co <u>l</u> d
27	I	185	pi <u>n</u>
28	U	185	mo <u>v</u> e
29	Y	103	an <u>y</u>
2A	T	71	ta <u>p</u>
2B	R*	90	re <u>d</u>
2C	E	185	me <u>e</u> t
2D	W	80	wi <u>n</u>
2E	AE	185	da <u>d</u>
2F	AE1	103	af <u>t</u> er
30	AW2	90	sa <u>l</u> ty
31	UH2	71	ab <u>o</u> ut
32	UH1	103	un <u>c</u> le
33	UH	185	cu <u>p</u>
34	O2	80	fo <u>r</u>
35	O1	121	ab <u>o</u> ard
36	IU	59	yo <u>u</u>
37	U1	90	yo <u>u</u>
38	THV	80	th <u>e</u>
39	TH	71	th <u>i</u> n
3A	ER	146	bi <u>r</u> d
3B	EH	185	g <u>e</u> t
3C	E1	121	be <u>l</u>
3D	AW	250	ca <u>l</u>
3E	PA1	185	no sound
3F	STOP	47	no sound

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

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

Table 2. Phoneme Categories According to Production Features

Voiced					'Voiced' Fricat.	'Voiced' Stop	Fricative Stop	Fricative	Nasal	No Sound
E	EH	AE	UH	OO1	Z	B	T	S	M	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 (.8V to 4V)	T_{RS}			100	NS
A/R Width (\bar{A}/R Connected to STB) ⁺	T_{ARW}	1	1.3	2	μs
STB Width	T_{SW}	200			NS
STB Low [*]	T_{SL}				NS
Propagation Delay (STB 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	μs
Time of Phoneme Duration ⁺	T_{PH}	47	107	250	MS

⁺ Dependent on Master Clock frequency: 720kHz

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

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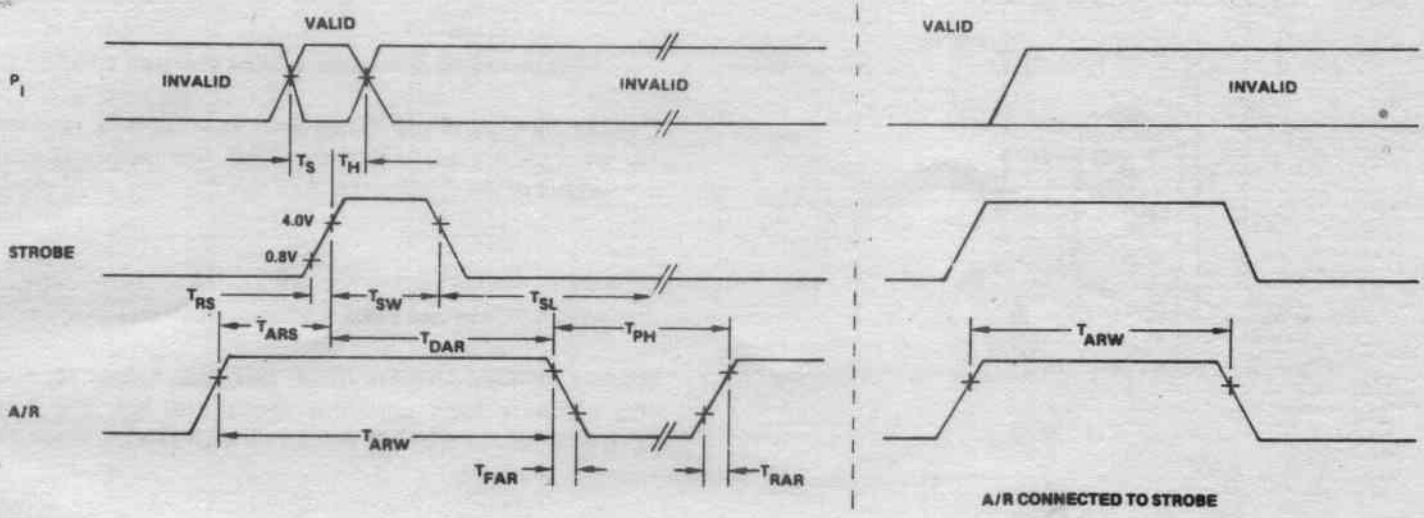


Figure 4. Timing Diagram

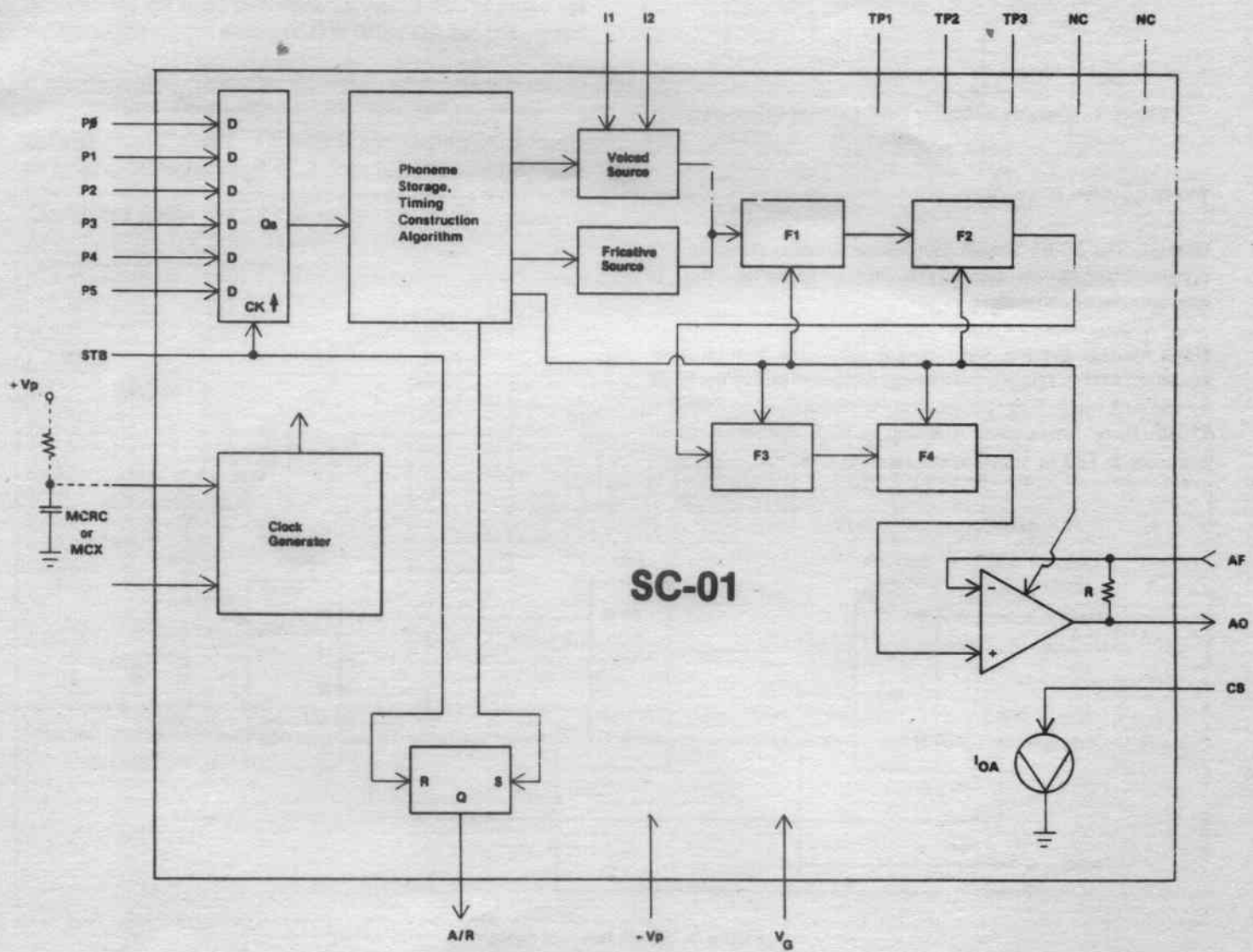


Figure 5. SC-01 Block Diagram

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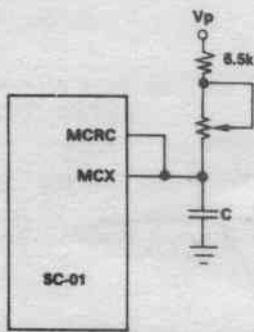


Figure 6. Variable Voice by Potentiometer Control

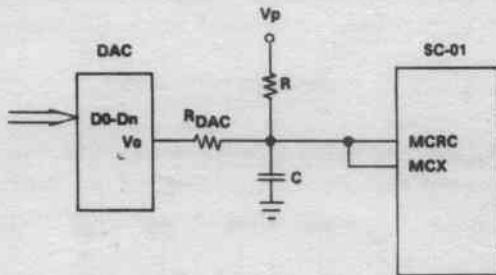


Figure 7. Variable Voice by DAC Current Injection

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 μ f capacitor to TP3 to insure power up reset of SC-01.

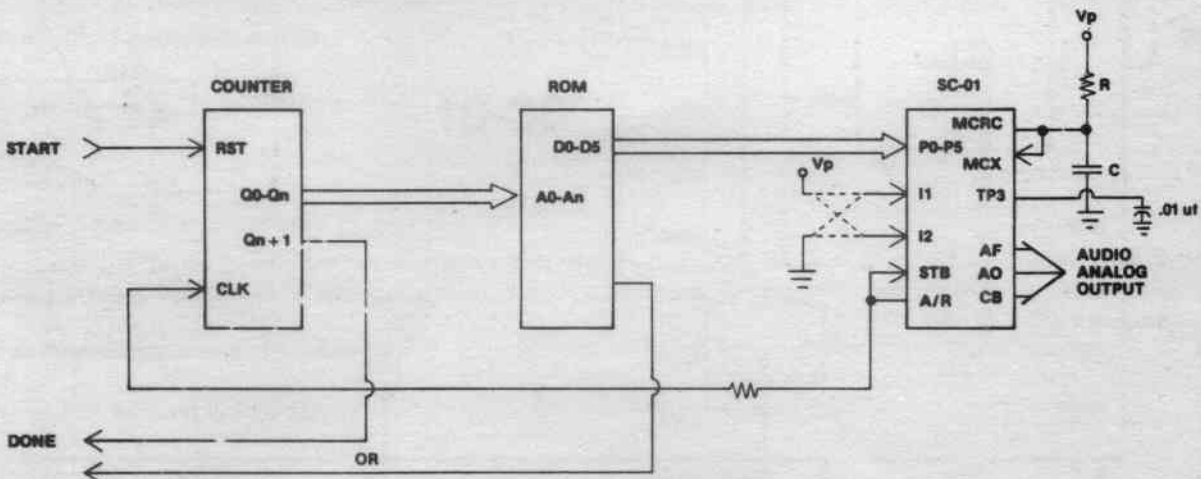


Figure 8. Single Message System

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.

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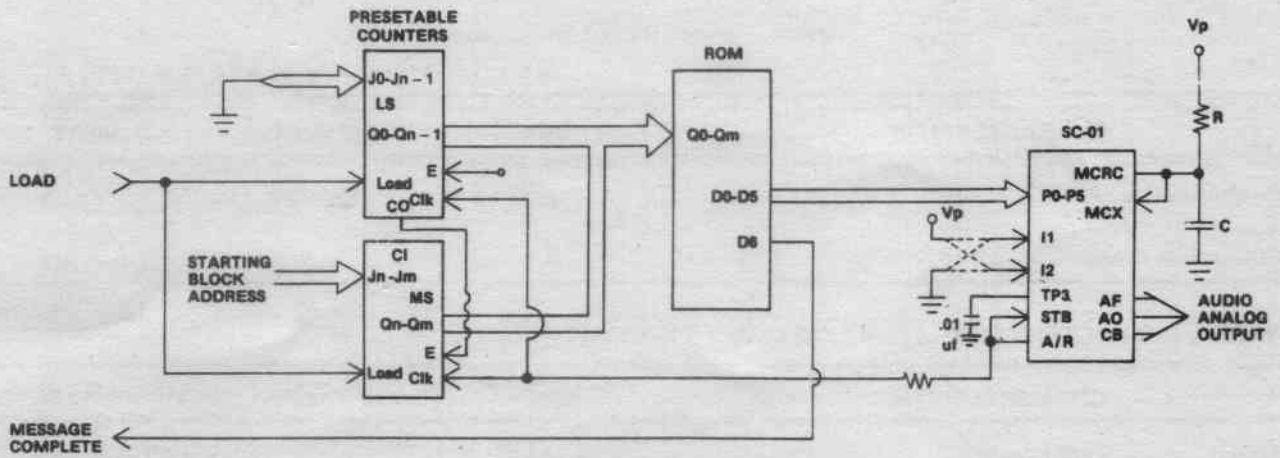


Figure 9. Multiple Message, Fixed Block Size

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.

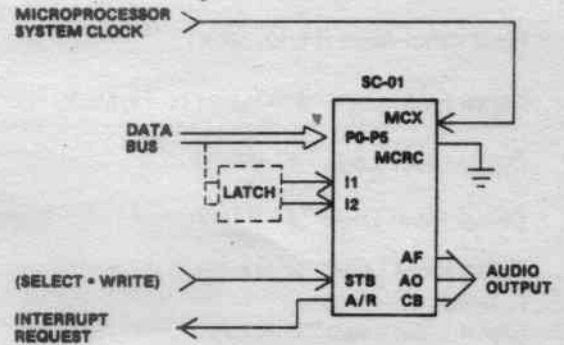


Figure 10. Multiple Message, Variable Block Size

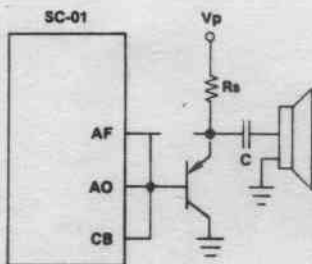


Figure 11. Class A Amplifier

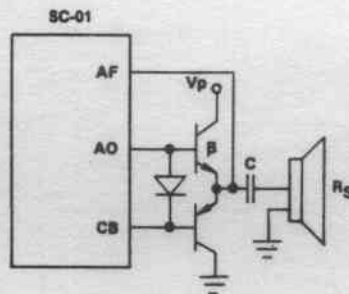


Figure 12. Class B Amplifier*

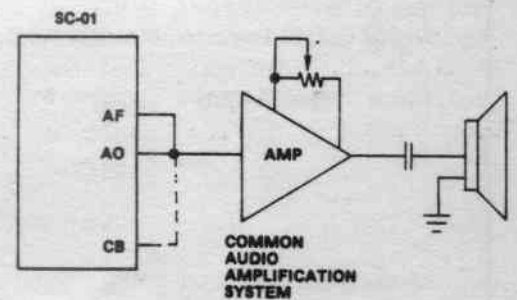


Figure 13. Controlling Audio Output Power

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

Table 4. Analog Output Specifications

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

ELECTRICAL CHARACTERISTICS: T_o = 0 to 70°C, V_p = 7 to 14 V_{DC}

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

VOTRAX[®] Speech Synthesis Technology produces each of the 45 basic speech sounds, called phonemes. This handy dictionary gives you quick access to the VOTRAX[®] phoneme sequences used to create approximately 1400 words. Because VOTRAX[®] 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[®] 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™ 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	ja <u>ck</u> et
Ø1	EH2	71	en <u>l</u> ist
Ø2	EH1	121	heav <u>y</u>
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	ho <u>n</u> est
Ø9	I3	55	in <u>h</u> ibit
ØA	I2	80	in <u>h</u> ibit
ØB	I1	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>
IØ	CH*	71	ch <u>i</u> p
I1	SH	121	sh <u>o</u> p
I2	Z	71	z <u>o</u> o
I3	AW1	146	la <u>w</u> ful
I4	NG	121	th <u>i</u> ng
I5	AH1	146	fa <u>t</u> her
I6	ØØ1	103	loo <u>k</u> ing
I7	ØØ	185	bo <u>o</u> k
I8	L	103	la <u>n</u> d
I9	K	80	tr <u>i</u> ck
IA	J*	47	ju <u>d</u> ge
IB	H	71	he <u>l</u> lo
IC	G	71	ge <u>t</u>
ID	F	103	fa <u>s</u> t
IE	D	55	pa <u>i</u> d
IF	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
2∅	A	185	<u>day</u>
21	AY	65	<u>day</u>
22	Y1	80	<u>yard</u>
23	UH3	47	<u>mission</u>
24	AH	250	<u>mop</u>
25	P	103	<u>past</u>
26	O	185	<u>cold</u>
27	I	185	<u>pin</u>
28	U	185	<u>move</u>
29	Y	103	<u>any</u>
2A	T	71	<u>tap</u>
2B	R	90	<u>red</u>
2C	E	185	<u>meet</u>
2D	W	80	<u>win</u>
2E	AE	185	<u>dad</u>
2F	AE1	103	<u>after</u>
30	AW2	90	<u>salty</u>
31	UH2	71	<u>about</u>
32	UH1	103	<u>uncle</u>
33	UH	185	<u>cup</u>
34	O2	80	<u>for</u>
35	O1	121	<u>aboard</u>
36	IU	59	<u>you</u>
37	U1	90	<u>you</u>
38	THV	80	<u>the</u>
39	TH	71	<u>thin</u>
3A	ER	146	<u>bird</u>
3B	EH	185	<u>get</u>
3C	E1	121	<u>be</u>
3D	AW	253	<u>call</u>
3E	PA1	185	no sound
3F	STOP	47	no sound

TABLE 2: DIPHTHONG CHART

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

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
adjacent 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
(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
(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	check	T, CH, EH1, EH3, K
bye	B, AH1, EH3, I3, Y	cheer	T, CH, AY, I2, R
byte	(use "bite" program)	chip	T, CH, I1, I3, P
C	S, E1, Y	choice	T, CH, O1, UH3, I3, AY, S
cable	K, A1, Y, B, UH3, L	circle	S, ER, R, K, UH3, L
calendar	K, AE1, UH3, L, I3, N, D, ER	circuit	S, R, R, K, I2, T
calibrate	K, AE1, UH3, L, UH3, B, R, A1, Y, T	city	S, I1, T, Y
call	K, AW2, AW1, L	claim	K, L, A1, AY, Y, M
came	K, A1, AY, Y, M	class	K, L, AE1, EH3, S
can	K, AE1, EH3, N	clean	K, L, E1, AY, N
cancel	K, AE1, EH3, N, S, UH3, L	clear	K, L, AY, I3, R
capable	K, A1, Y, P, UH3, B, UH3, L	clerk	K, L, ER, K
capacitor	K, UH2, P, AE1, EH3, S, EH3, T, ER	clip	K, L, I1, I3, P
capacity	K, UH2, P, AE1, EH3, S, I3, DT, Y	clock	K, L, AH1, UH3, K
car	K, AH1, UH3, R	close	K, L, UH3, O1, U1, Z
card	K, AH1, R, D	close-2	K, L, UH3, O2, U1, S
care	K, EH3, EH3, ER	cloud	K, L, AH1, UH3, W, D
carpenter	K, AH1, R, P, I3, N, D, ER	coarse	K, O1, O2, R, S
carriage	K, EH2, EH3, R, I1, D, J	code	K, OO1, O2, U1, D
carry	K, EH2, EH3, R, Y	coin	K, O1, UH3, I3, AY, N
carton	K, AH1, R, T, I3, N	collar	K, AH1, UH3, L, ER
case	K, A1, AY, Y, S	collect	K, UH1, L, EH1, K, T
cash	K, AE1, EH3, SH	colon	K, OO1, O2, U1, L, I2, N
cassette	K, UH1, S, EH1, EH3, T	color	K, UH2, UH2, L, ER
cassette-2	K, A2, AY, S, EH1, EH2, T	column	K, AH1, UH3, L, UH3, M
category	K, AE1, EH3, DT, UH3, G, O1, R, Y	combine	K, UH2, M, B, AH1, EH3, Y, N
catalog	K, AE1, EH3, DT, UH3, L, AW2, AW2, G	comma	K, AH1, UH3, M, UH1
caution	K, AW2, AW1, SH, UH3, N	command	K, UH2, M, AE, EH3, N, D
cent	S, EH1, EH3, N, T	commerce	K, AH1, UH3, M, ER, S
center	S, EH1, EH3, N, T, ER	commercial	K, UH1, UH3, M, ER, SH, UH3, L
centi	S, EH1, EH3, N, T, I1, I3	communicate	K, UH2, M, Y1, IU, U1, N, I3, K, A1, Y, T
centigrade	S, EH1, N, T, I3, G, R, A1, Y, D	company	K, UH1, UH3, M, P, EH3, N, Y
certify	S, R, R, T, I3, F, AH1, Y	compare	K, UH1, UH3, M, P, EH3, EH3, ER
change	T, CH, A1, AY, Y, N, D, J	compile	K, UH1, UH3, M, P, AH1, EH3, I3, UH3, L
character	K, EH1, R, EH1, K, T, ER	complete	K, UH1, UH3, M, P, L, AY, Y, T
charge	T, CH, AH1, R, D, J	comply	K, UH1, UH3, M, P, L, AH1, EH3, Y
charlie	T, CH, AH1, R, L, Y	component	K, UH2, M, P, O2, O1, N, EH2, N, T
chart	T, CH, AH1, R, 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
 fernale 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)
 here H, R, R, T, S
 hertz H, EH1, EH3, K, PAO, S
 hex H, AH1, EH3, Y
 high H, I1, I3, Z
 his H, O2, O2, L, L, D
 hold H, O1, U1, L
 hole H, O1, U1, M
 home H, OO1, OO1, K
 hook H, O1, U1, S, T
 host H, AH1, UH3, T
 hot H, O1, U1, T, EH2, EH2, L
 hotel AH1, UH3, W, ER
 hour H, UH3, AH2, U1, S
 house H, AH1, O2, U1
 how H, Y1, IU, U1, U1, M, EH2, N
 human H, UH1, UH2, N, D, R, I3, D
 hundred H, UH1, UH2, NG, G, R, Y
 hungry

 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

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

N	EH1, EH2, N	obligation	AH1, B, L, I3, G, A1, Y, SH, UH3, N
name	N, A1, AY, Y, M	obsolete	AH1, UH3, B, S, UH3, L, AY, Y, T
nano	N, AE1, EH3, N, O1, U1	october	AH1, UH3, K, T, O1, U1, B, ER
national	N, AE1, EH3, SH, UH3, N, UH3, L	odd	AH1, UH3, D
native	N, A1, Y, T, I1, V	of	UH1, UH3, V
near	N, AY, I1, R	off	AW, F
neat	N, E1, AY, T	office	AW, F, I1, S
neck	N, EH1, EH3, K	official	UH1, F, I1, SH, UH3, L
need	N, E1, Y, D	often	AW2, AW2, F, I3, N
negative	N, EH1, G, EH3, T, I1, V	ohm	O2, O2, U1, M
net	N, EH1, EH3, T	oil	O1, EH3, I3, UH3, L
neutral	N, IU, U1, T, R, UH2, L	old	O2, O2, L, L, D
new	N, IU, U1, U1	omega	O1, U1, M, A1, Y, G, UH2
next	N, EH1, EH3, K, PAO, S, T	omit	O1, U1, M, I1, I3, T
nice	N, UH3, AH2, Y, S	on	AH1, UH3, N
nickel	N, I1, I3, K, UH3, L	once	W, UH1, N, T, S
night	N, UH3, AH2, Y, T	one	W, UH1, UH2, N
nine	N, AH1, EH3, Y, N	only	O1, O2, N, L, Y
ninety	N, AH1, EH3, Y, N, T, Y	open	O1, P, I2, N
nineth	N, AH1, Y, N, DT, TH	operable	AH1, UH3, P, ER, UH3, B, UH3, L
no	N, O01, O1, U1	operate	AH1, UH3, P, ER, A1, Y, T
noise	N, O1, UH3, I3, AY, Z	operator	AH1, UH3, P, ER, A1, Y, T, ER
none	N, UH1, UH3, N	option	AH1, UH3, P, SH, UH3, N
noon	N, IU, U1, U1, N	or	O2, O2, R
normal	N, O2, O2, R, M, UH3, L	orange	O2, O2, R, I1, N, D, J
north	N, O2, O2, R, TH	order	O2, O2, R, D, ER
not	N, AH1, UH3, T	ore	(use "or" program)
note	N, O1, U1, T	original	O2, R, I2, I3, D, J, I3, N, UH3, L
nothing	N, UH1, TH, I1, I3, NG	oscar	AH1, UH3, S, K, ER
notice	N, O1, U1, T, I1, S	other	UH1, UH3, THV, ER
notify	N, O1, U1, T, I1, F, AH1, EH3, Y	ounce	AH1, UH3, W, N, S
november	N, O1, U1, V, EH1, EH3, M, B, ER	out	UH3, AH2, U1, T
now	N, AH1, UH3, U1	oven	UH1, V, I2, N
number	N, UH1, UH2, M, B, ER	over	O1, O2, V, ER
nurse	N, ER, R, S	oxygen	AH1, UH3, K, PAO, S, I3, D, J, I2, N
nut	N, UH1, UH2, T	own	O1, U1, N
O	O2, O1, U1	P	P, E1, Y
oar	(use "or" program)	pack	P, AE1, EH3, K
object	UH1, B, D, J, EH1, EH3, K, T	package	P, AE1, EH3, K, I1, D, J
object-2	AH1, UH3, B, D, J, EH2, EH2, K, T	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	R	AH1, UH2, ER
probe	P, R, 01, U1, B	rail	R, A1, AY, I3, UH3, L
problem	P, R, AH1, UH3, B, L, UH3, M	rain	R, A1, AY, Y, N
procedure	P, R, UH1, S, E1, D, J, ER	raise	R, A1, AY, Y, Z
proceed	P, R, 01, S, E1, Y, D	range	R, A1, AY, Y, N, D, J
process	P, R, AH1, UH3, S, EH1, EH3, S	radio	R, A1, Y, D, Y, 01, U1
produce	P, R, UH1, D, IU, U1, U1, S	rate	R, A1, AY, Y, T
product	P, R, AH1, UH3, D, UH1, UH2, K, T	ratio	R, A1, Y, SH, Y, 01, U1
progress	P, R, AH1, UH3, G, R, EH1, S	reach	R, E1, Y, T, CH
profession	P, R, UH1, F, EH1, EH3, SH, UH3, N	read	R, E1, Y, D
profit	P, R, AH1, UH3, F, I1, T	ready	R, EH1, EH3, D, Y
program	P, R, 01, G, R, AE1, EH3, M	real	R, E1, AY, L
project	P, R, AH1, UH3, D, J, EH2, EH2, K, T	reason	R, E1, Y, Z, UH1, N
PROM	P, R, AH1, UH3, M	rebate	R, E1, B, A1, Y, T
promote	P, R, UH1, M, 01, U1, T	recall	R, E1, K, AW2, AW1, L
propose	P, R, UH1, P, 01, U1, Z	receipt	R, E1, S, AY, Y, T
protect	P, R, UH1, T, EH1, EH3, K, T	receive	R, E1, S, E1, Y, V
public	P, UH1, UH3, B, L, I3, K	record	R, E1, K, 02, 02, R, D
pull	P, 001, 001, L	record-2	R, EH1, EH3, K, ER, D
pulse	P, UH1, UH2, L, S	red	R, EH1, EH3, D
punch	P, UH1, UH2, N, T, CH	reel	(use "real" program)
purpose	P, R, R, P, EH2, S	refer	R, E1, F, UH1, UH2, N, D
purchase	P, R, R, DT, CH, I2, S	refuse	R, E1, F, Y1, IU, U1 U1, Z
pure	P, Y1, IU, ER	register	R, EH1, D, J, I1, S, T, ER
push	P, 001, IU, SH	regular	R, EH1, G, Y1, IU, L, ER
put	P, 001, 001, T	rein	(use "rain" program)
Q	K, Y1, IU, U1, U1	reject	R, E1, D, J, EH1, EH3, K, T
qualify	K, W, AW1, L, I1, F, AH1, EH3, Y	relay	R, E1, L, A1, I3, Y
quantity	K, W, AH1, N, T, I3, T, Y	release	R, E1, L, E1, AY, S
quart	K, W, 01, R, T	remain	R, E1, M, A1, AY, Y, N
quarter	K, W, 01, R, T, ER	remove	R, E1, M, U1, U1, V
quebec	K, W, I1, B, EH1, EH3, K	repair	R, E1, P, EH2, EH2, R
question	K, W, EH1, EH3, S, T, CH, UH3, N	repeat	R, E1, P, E1, AY, T
quick	K, W, I1, I3, K	replace	R, E1, P, L, A1, AY, Y, S
quiet	K, W, AH1, EH3, AY, I2, T	report	R, E1, P, 02, 02, R, T
quit	K, W, I1, I3, T	represent	R, EH1, P, R, I2, Z, EH1, EH3, N, T
quiz	K, W, I1, I3, Z	request	R, E1, K, W, EH1, EH3, S, T
quota	K, W, 01, 02, T, UH1	require	R, E1, K, W, AH1, EH3, AY, R
quote	K, W, 01, U1, T	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	scrap	S, K, R, AE1, EH3, P
reset	R, E1, S, EH1, EH3, T	screw	S, K, R, IU, U1, U1 (use "C" program)
resistor	R, E1, Z, I1, S, T, ER	sea	S, E1, AY, T
respect	R, E1, S, P, EH1, EH3, K, T	seat	S, EH1, EH3, K, UH1, N, D
respond	R, E1, S, P, AH1, UH3, N, D	second	S, E1, K, R, I3, T
responsible	R, I2, S, P, AH1, UH3, N, DT, S, UH3, B, UH3, L	secret	S, EH1, EH3, K, SH, UH3, N
rest	R, EH1, EH3, S, T	section	S, EH1, EH3, K, Y, ER, I1, T, Y (use "C" program)
restrict	R, E1, S, T, R, I1, I3, K, T	see	S, E1, Y, Z
result	R, E1, Z, UH1, UH2, L, T	seize	S, UH1, L, EH1, EH2, K, T
resume	R, E1, Z, IU, U1, U1, M	select	S, EH1, EH3, L
retail	R, AY, E1, T, EH3, A1, I3, UH3, L	sell	S, EH1, M, AH1, Y
retain	R, E1, T, A1, AY, Y, N	semi	S, EH1, M, AH1, Y, K, OO1, O1, L, I2, N
return	R, E1, T, ER, R, N	semicolon	S, EH1, EH3, N, D (use "cent" program)
revision	R, E1, V, I1, ZH, UH3, N	send	S, EH1, N, T, I2, N, DT, S
revolve	R, E1, V, AH1, UH3, L, V	sentence	S, EH1, EH3, P, UH1, R, A1, AY, T
ribbon	R, I2, I3, B, UH3, N	separate	S, EH1, EH3, P, R, I2, T
right	R, UH3, AH2, Y, T	separate-2	S, EH1, EH3, P, T, EH1, EH3, M, B, ER
romeo	R, O1, U1, M, Y, O1, U1	september	S, E1, K, W, EH1, EH3, N, S
room	R, U1, U1, M	sequence	S, I1, R, Y, UH3, L
root	R, U1, U1, T	serial	S, I1, R, Y, Z
round	R, AH1, UH3, W, N, D	series	S, ER, V, I1, S
route	R, UH2, AH2, U1, T	service	S, EH1, EH3, T
row	R, O1, U1	set	S, EH1, EH3, V, I2, N
run	R, UH1, UH3, N	seven	S, EH1, EH3, V, I2, N, DT, TH
rush	R, UH1, UH2, SH	seventh	S, EH1, V, I2, N, D, Y
S	EH1, EH2, S	seventy	S, EH1, V, ER, UH3, L (use "so" program)
safe	S, A1, AY, Y, F	several	SH, EH3, EH3, ER
sail	(use "sale" program)	sew	SH, AH1, R, P
salary	S, AE1, AH2, L, UH3, R, Y	share	SH, I1, I3, F, T
sale	S, A1, A2, AY, UH3, L	sharp	SH, I1, I3, P
same	S, A1, AY, Y, M	shift	SH, AH1, UH3, P
saturday	S, AE1, EH3, T, ER, D, A1, Y	ship	SH, O2, O2, R, T
save	S, A1, AY, Y, V	short	SH, IU, IU, IU, D
say	S, A1, I3, Y	should	SH, UH1, UH2, N, T
scan	S, K, AE1, EH3, N	shunt	SH, UH1, UH2, T
scent	(use "cent" program)	shut	S, AH1, EH3, Y, D
schedule	S, K, EH1, EH3, D, J, IU, U1, L	side	S, E1, I3, EH1, R, UH1
school	S, K, U1, U1, L	sierra	
science	S, AH1, I3, Y, EH3, N, DT, S		
score	S, K, O2, O2, R		

signal	S, I1, I3, G, N, UH3, L	stand	S, T, AE1, EH3, N, D
silver	S, I1, I3, L, V, ER	standard	S, T, AE1, EH3, N, D, ER, D
single	S, I1, I3, NG, G, UH3, L	star	S, T, AH1, UH3, R
six	S, I1, I3, K, PAO, S	stare	S, T, EH3, EH3, ER
sixth	S, I1, I3, K, PAO, S, TH	start	S, T, AH1, R, T
sixty	S, I1, I3, K, PAO, T, Y	state	S, T, A1, AY, Y, T
size	S, AH1, EH3, Y, Z	station	S, T, A1, Y, SH, UH3, N
skin	S, K, I1, I3, N	status	S, T, AE1, EH3, T, I2, S (use "steel" program)
sky	S, K, AH1, EH3, I3, Y	steal	S, T, E1, Y, L
slang	S, L, AE1, EH3, NG	steel	S, T, EH1, EH3, P
slash	S, L, AE1, EH3, SH	step	S, T, I1, I3, K
slave	S, L, A1, AY, Y, V	stick	S, T, AH1, UH3, K
slip	S, L, I1, I3, P	stock	S, T, AH1, UH3, P
slow	S, L, O1, U1	stop	S, T, O2, O2, R (use "straight" program)
small	S, M, AW, L	store	S, T, R, A1, AY, Y, T
smell	S, M, EH1, EH3, L	street	S, T, R, E1, Y, T
smile	S, M, AH1, EH3, I3, UH3, L	stress	S, T, R, EH1, EH3, S
smoke	S, M, O1, U1, K	string	S, T, R, I1, I3, NG
snow	S, N, OO1, O2, U1	structure	S, T, R, UH1, K, T, CH, ER
so	S, OO1, O2, U1	style	S, T, AH1, EH3, AY, UH3, L
soft	S, AW, F, T	subject	S, UH1, UH2, B, D, J, EH1, EH3, K, T
sold	S, O2, O2, L, L, D	substitute	S, UH1, UH3, B, S, T, I3, T, IU, U1, T
solid	S, AH1, UH3, L, I1, D (use "sun" program)	subtract	S, UH1, UH2, B, T, R, AE1, EH3, K, T
son	(use "sum" program)	sufficient	S, UH1, F, I1, SH, EH3, N, T
some	(use "sum" program)	suggest	S, UH1, UH2, G, D, J, EH1, EH3, S, T
sorry	S, AW, R, Y	suit	S, IU, U1, T
sort	S, O2, O2, R, T	suite	S, W, AY, Y, T
sound	S, AH1, UH3, W, N, D	sum	S, UH1, UH2, M
source	S, O1, O2, R, S	summary	S, UH2, UH2, M, ER, Y
south	S, AH1, UH3, U1, TH	summer	S, UH1, UH2, M, ER
space	S, P, A1, AY, Y, S	sun	S, UH1, UH2, N
spark	S, P, AH1, R, K	sunday	S, UH1, UH2, N, D, A1, I3, Y
speak	S, P, E1, AY, K	super	S, IU, U1, P, ER
special	S, P, EH1, EH3, SH, UH3, L	supply	S, UH2, P, L, AH1, Y
speed	S, P, E1, Y, D	surface	S, ER, F, I2, S
speech	S, P, E1, Y, T, CH	surge	S, ER, R, D, J
spell	S, P, EH1, EH3, L	surgery	S, ER, D, J, ER, Y
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)		

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
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
vacant V, E1, AY, Y
valid V, A1, Y, K, EH3, N, T
vary V, AE1, UH3, L, I1, D
(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
wage D, UH1, B, UH3, L, Y1, IU, U1
wait W, A1, AY, Y, D, J
want W, A1, AY, Y, T
was W, AH1, UH3, N, T
wash W, UH1, UH3, Z
water W, AW, SH
watt W, AH1, UH3, T, ER
watt W, AH1, UH3, T
wave W, A1, AY, Y, V
way (use "weigh" program)
we W, E1, Y
(use "week" program)
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
x-ray EH1, EH2, K, PAO, S
EH1, EH2, K, PAO, S, R, A1,
I3, Y

Y
yankee W, AH1, EH3, I3, Y
yard Y1, AE1, EH3, NG, K, E1, Y
year Y1, AH1, R, D
yellow Y1, AY, I3, R
yes Y1, EH1, EH3, L, O1, U1
yesterday Y1, EH3, EH1, S
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