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THE DIGITAL GROUP/ VOTRAX®™ VOICE SYNTHESIZER

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THE DIGITAL GROUP/VOTRAX®™* VOICE SYNTHESIZER

INTRODUCTION

Now you can verbally command your computer . . . it will listen . . . and it can answer you. With the Digital Group Voice Synthesizer card you can now use your computer in applications for which a machine-generated voice would be useful: control systems, educational aids, ham repeater systems, games . . .

Voice Synthesizer software is available in the form of cassette and program listings for the Z80 microprocessor and includes a "talking Basic", "talking CW" for HAM operations, a Latin and Spanish "talking voice" and a program tape for testing and demonstration of the Voice Synthesizer. Voice input software to program your Digital Group microcomputer to understand your voice for translation, command, or control functions will also be available.

The Digital Group/Votrax®™ Voice Synthesizer card is designed to plug directly into an available I/O slot of a Digital Group system using 36- and 22-pin dual edge connectors. Other computer configurations will work with the Voice Synthesizer card, but will require some hardware and software programming effort by the user. The software developed assumes a Digital Group Z80 system with at least 18K of memory, a 1024 character TV and cassette interface card, and the synthesizer card connected to input and output port 3. The port assignment can be changed as desired by the user.

The Voice Synthesizer card uses one 8-bit parallel output port, one 8-bit parallel input port, and also requires +5V @ 400ma and ± 12V @ 1 amp. For voice input a high impedance microphone is required. An external 8 ohm speaker is required for voice synthesis. The card has a built-in audio amplifier for driving the speaker and has potentiometers on-board for controlling the output level and adjusting the gain and threshold levels of the microphone input.

The documentation provided with the Digital Group/Votrax®™ Voice Synthesizer card includes a technical description of the card, a schematic and parts placement diagram, theory of operation and description of the software, assembly instructions, cabling and hook-up information, and a diagnostic testing procedure on audio tape. Also included is an assembly language listing of an "English voice" implementation, with a program on audio cassette. The "English voice" program has a vocabulary of over 600 English words. Information on use of the program tape and expansion of the vocabulary of the Voice Synthesizer card is provided.

The Digital Group and Votrax®™ would like to know how you use the Voice Synthesizer. If you have an interesting application, please send a brief description of it and how it works to:

Dr. Robert V. Suding
Director of Research
The Digital Group
P.O. Box 6528
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TECHNICAL DESCRIPTION

The circuitry on the Digital Group/Votrax®™ Voice Synthesizer card consists of two sections: one for voice synthesis and one for simple voice recognition.

Voice Synthesis

The voice synthesis section is centered around a module built by Votrax®™ which takes six "bits" of data and produces 64 different human sounds called "phonemes". These 64 different phonemes are then combined to form words. The collective sounds, words, and composite sentences could be in English, Latin, Spanish, Russian, or any number of different languages, although the sounds have been optimized for English speech. The module, approximately 4" by 8", connects to a single 16-pin plug soldered on the card.

In addition to the module, the card uses: two FIFO (first in-first out) memory buffer chips (3351-2) reducing processor overhead, a single chip audio amplifier (LM384) to drive an externally mounted speaker, and a dual retriggerable "one shot" (74L123) to indicate the buffer status to the microprocessor. Characters in the form of phoneme codes enter the memory buffer chips via the single 8-bit parallel output port. The extra two bits of the port are used for clearing out the memory buffers: one for master reset (MSB-1, pin 15, IC2 and IC3) and one for strobing phonemes into memory (MSB, pin 17, IC2). Phonemes propagate or advance through the buffers and are input to the Votrax®™ Module. The Votrax®™ Module produces an audio output tone corresponding to the phoneme code input.

The Votrax®™ Module signals the memory buffers when it is ready for another phoneme. This signal line at pin 13 of the module and IC3 varies in frequency, depending on the phoneme just produced. The memory buffers (IC2 and IC3) hold up to 80 phonemes. Essentially the microprocessor can output phoneme characters to the card independently of the timing required to output phonemes to the Voice Synthesizer Module.

The audio output of the Votrax®™ module can either be used as an auxiliary input to an external audio amplifier (pin 25) or to drive IC4 (LM384), an on-board audio amplifier. The output of IC4 (pin 8) will drive an external 8 ohm speaker connected to pins 35 and 36 of the card's 36-pin connector. A 5K potentiometer R3 is used to control the volume level of IC4.

IC1, a dual retriggerable "one shot" (74L123), is used to indicate to the microprocessor through the input port whether or not the memory buffers are empty or are half full. In addition, a line from IC2 (pin 16) indicates whether or not the buffers are completely full. The microprocessor monitors the input port and feeds phonemes into the memory buffers whenever necessary.

Voice Input

The voice input section allows the microprocessor to be used for interpreting "voices" or commands it has been programmed to understand. A high impedance microphone connected to pins on the card's 36-pin connector provides a voice input to the "voice recognition" circuitry. The input circuitry, consisting of two quad "op" amps (IC's 5 and 6) and appropriate biasing networks, separates the frequencies above and below 1000 Hz and converts the resulting frequencies to "zero crossing" pulses that are input to the microprocessor.

IC6 (LM324) is connected as a high impedance input amplifier and zero crossing detector. Both IC5 and IC6 contain four separate "op" amp circuits. The first section of IC6 with output at pin 8 is used as a high impedance input, low impedance output amplifier. The section of IC6 with output at pin 7 is used as a high impedance input amplifier with R2 controlling the gain of the microphone signal output. As a result various microphones with different output levels can be used with the gain being adjusted for maximum performance. The section of IC6 with output at pin 1 is used as a zero crossing comparator. When its input signal makes a positive to negative transition through zero volts, the output at pin 1 changes from a TTL logic "one" to "zero". When the input makes a negative to positive voltage transition through zero volts, the output at pin 1 changes from a "zero" to a logic "one".

The section of IC6 with output at pin 14 is used as a "voice" threshold detector. The 5K potentiometer (R1) adjusts the level at which the output at pin 14 switches from 0 to 1. This detector level sets a noise immunity margin indicating to the microprocessor that zero crossings present at IC6 pin 1 are the result of a legitimate "voice", and not simply input noise.

IC5 (LM324), the second quad "op" amp on the card, is connected as separate high and low band-pass filters and zero crossing detectors. The section of IC5 with output at pin 7 is used as a "low pass" active filter for frequencies between approximately 300 Hz and just above 1000 Hz. The section of IC5 with output at pin 1 will indicate zero crossing pulses from the "low pass" filter. The section of IC5 with output at pin 8 is used as a "high pass" active filter for frequencies just below 1000 Hz to approximately 5000 Hz. The section of IC5 with output at pin 14 will indicate zero crossing pulses from the "high pass" filter.

The output of the zero crossing detectors of both IC5 and IC6 (pins 1 and 14 of both IC's) go back to the input port for sampling and logic analysis by the microprocessor. The connections to the input ports pins are made to the card's 36-pin connector as with the output port pins and as shown in Figure 1. The microphone input is connected to pins U and V on the 36-pin connector. Pin T can be connected for microphones using an off-on switch, and is also connected to the LSB of the input port.

The recommended procedure for installing and operating the Votrax®™ Voice Synthesizer is described briefly below, with more explanation and figures provided in later documentation.

Steps

PART I

1. Assembly of Votrax®™ Voice Synthesizer card
   Component Installation (Votrax®™ module not installed on card until initial testing is completed)
2. Voice Synthesizer card testing - ohmmeter checks
3. Votrax®™ Cabling
   a. I/O port connections
   b. Speaker mounting and hook-up
   c. Microphone connection

4. Operation and Diagnostic Testing Procedure
   a. Installation of the Voice Synthesizer card in an I/O slot wired for the card
   b. Voltage testing
   c. Audio amplifier testing
   d. Votrax®™ module installation on the card
   e. Execution of programmed test procedure for the Voice Synthesizer (directions appear on the screen)
   f. Voice input testing
      1. Audio generator input to microphone connection leads
      2. Microphone hookup - observation at zero crossing pulses on oscilloscope
      3. Execution of programmed test procedure for the voice input circuitry

PART II - Digital Group Votrax®™ Programming Rules

1. Description of phonetic word structures
2. Vowel and consonant Votrax®™ equivalents: phoneme codes
3. Typical phoneme usage
4. Continuous speech - aids to reproducing "normal" sounds
5. Digital Group Voice Synthesizer vocabulary - "English Voice"
6. Listing of input/output phonetic codes: octal and hex

PART III - English Demonstration Program

1. Description of subroutines and program listing
2. Using phonemes to build words
3. Extending the Votrax®™ Synthesizer vocabulary list
4. Assembly program listing with current vocabulary
5. Hardware problems and possible cures

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ASSEMBLY

To build the Digital Group/Votrax®™ Voice Synthesizer you will need the following tools and equipment:

Fine-tipped low wattage soldering iron (approximately 25 watt)
Solder - 60/40 resin wire solder, 20-30 gauge (approx.)
Do not use acid core solder!
Diagonal cutters - small micro-shear type preferred
Long nosed pliers
Small screwdriver
Flux remover or alcohol
Small brush

Test Equipment:
Ohmmeter
Audio generator
10 mHz or better triggered sweep scope
Microprocessor

Before beginning to mount and solder components inspect the Voice Synthesizer circuit board. Compare the areas where IC sockets will be inserted with the layout to see that there are no shorts occurring between either the traces leaving the IC's or the IC pads or holes in which the IC's are mounted. While plating errors like this are a rare occurrence and The Digital Group tries to inspect and maintain the quality of its printed circuit boards, once the IC sockets are inserted it is very difficult to find such a problem.

Next, identify the components that will be used on the synthesizer card. The most difficult task is generally identifying capacitor values and types. Disk capacitors may be identified in general by their disk-like shape and usually by their ceramic covering. Note that the operating voltage specified for capacitors is the minimum acceptable rating. Capacitors supplied with specific cards may have a higher voltage rating than called for in the parts list but should be used despite the variance and will not affect the circuit operation. Mica capacitors can be identified by a slightly wider lead spacing and a more rectangular shape. Electrolytics generally come in tubular casings and should be clearly marked with the polarity indicated by a "+" on one end or by arrows indicating polarity. Tantalum capacitors have a polarity which is indicated by a leg which is a different color than that of the capacitor body or by a "+" marking. When installing capacitors on the card, match the polarity with the screened label on the card.

All resistors have standard color code markings bearing the value and tolerance of the resistor. The parts list calls for ¼ watt resistors.

To aid identification of components after assembly, install them so that values and markings can be clearly read.

Finally, when beginning construction of the synthesizer card it is important to have a clean working area that is well lighted and ventilated since these conditions can affect the quality of your assembly. Also, make sure that your soldering iron tip is hot enough, is kept tinned, and is cleaned periodically with a sponge or similar material.

Most problems that arise with newly assembled boards are related to either solder shorts or splashes, improperly soldered joints ('cold' solder joints) or missed (unsoldered) pins. Properly soldered joints are shiny; solder on an IC socket should extend slightly from the pad or socket hole to the component lead or pin. All IC's are socketed on The Digital Group boards so the sockets may be installed prior to mounting IC's to avoid damaging the heat-sensitive IC's and to aid troubleshooting. **NOTE:** Probably the second most frequent problem with newly assembled boards is incorrectly installed parts (polarity, pin orientation, etc.) or wrong-valued parts being installed.

Estimated Construction Time: 1-3 hours

1. ☐ Refer to Figure 1 — Parts Placement Diagram. Insert two 28-pin sockets, one 16-pin socket, and three 14-pin sockets into the PC board from the component side. If the sockets have a pin 1 indication, orient this away from the connector (or bottom of the card).
   NOTE: The component side of the card is indicated by The Digital Group label appearing just above the card's dual 22-pin connector.

2. ☐ Refer to Figures 1 and 2. Insert the 16-pin synthesizer connector on the top side of the card, with the short pins on the connector into the card. Carefully invert the card and solder the IC sockets and connector. Avoid solder bridges on adjacent pins, particularly near the synthesizer connector area.

3. ☐ Refer to Figure 1 — Parts Placement Diagram. Insert and solder the three potentiometers, R1, R2, and R3 (3-lead square packages). Note that the middle potentiometer is a 50K and that R1 and R3 are 5K potentiometers.

4. ☐ Insert three upright 220 electrolytic mfd capacitors (C4, C5, and C6). Do not mistake "feed-through" holes for lead holes! Also note the polarity of these capacitors.

5. ☐ Insert and solder five 22 mfd capacitors (C2, C3, C8, C11, and C20). Note the polarity of these five capacitors.

6. ☐ Insert and solder the 4.7 mfd (or 5 mfd) capacitor (C7). Note that either the striped side of this capacitor or a small "+" indicates the positive lead.

7. ☐ Insert three 1 mfd capacitors (C24, C25, and C28). Note that either the striped side of these capacitors or a small "+" indicates the positive lead.

8. ☐ Insert three .01 mfd disk capacitors (C23, C26, and C27) next to the 1 mfd capacitors.

9. ☐ Insert the remaining 13 capacitors: two .001 mfd silver mica (C13 and C21), five .005 mfd mylar (C1, C14 - C17), four .01 mfd mylar (C10, C18, C19, and C22), and two .1 mfd mylar (C9 and C12).

10. ☐ Insert the remaining 30 resistors (R4 - R33).

11. ☐ Solder all components. Cut off the excess leads.

Testing The Digital Group/Votrax®™ Voice Synthesizer Card

1. ☐ Measure the resistance between ground and +5V (pin 2 and pin 1 on the 22-pin connector). A resistance of less than 15K indicates a bad bypass capacitor or a "solder bridge" short.

2. ☐ Measure the resistance between pin 2 and pin 22, and between pin 2 and pin Z. A low resistance indicates a bad bypass capacitor or a "solder bridge" short on the +12V and/or -12V bus line respectively.

3. ☐ Insert the six IC's. Note that the notch or dot indicating the pin 1 end is oriented away from the connectors (toward the top of the card).

4. ☐ Measure the resistance between pin 2 and pin 1 (+5V supply), noting the value. Reverse the ohmmeter leads and re-measure. A "shorted" reading indicates a bad IC, and near equal readings indicate a reversed IC.

5. ☐ Similarly, measure between pin 2 and pin 22 on the 22-pin connector, and between pin 2 and pin Z on the bottom side of this connector. A "shorted" reading indicates a bad IC.

6. ☐ Referring to Figure 3, run cables from the microprocessor's I/O board, port 3, to the input and output connectors of the synthesizer card in the I/O slots to be used. Be sure to have output port pins going to the lettered pins of the card (pins A through J, circuit side) and the input port pins from the microprocessor to the numbered pins (pins 1 through 8, component side) of the synthesizer board.

7. ☐ Mount a five-inch speaker at the left rear of the CPU cabinet, if desired. A five-inch speaker will fit nicely at the spare holes beside the 22-pin external I/O connectors. Mount a single pole, single throw (SPST) push on/push off speaker switch at the rear of the microprocessor below the speaker as well as a closed circuit jack for use with external speakers. Wire the speaker, switch, and jack as shown in Figure 3. If the Voice Synthesizer board is used with the ham interface board, the same speaker may be used for both applications by mounting a single pole, double throw (SPDT) switch underneath the speaker beside the on/off switch.

8. ☐ If you wish to use voice input, mount a microphone connector at the rear of the CPU cabinet where convenient and wire as shown in Figure 3.

9. ☐ Insert the Voice Synthesizer board in The Digital Group microprocessor I/O slot which has been wired for it. Unplug any other I/O device, such as the Digital Group Printer, attached to I/O port 3.
NOTE: The Votrax®™ Module is not plugged in yet.

10. ☐ Turn on the microprocessor. Carefully measure the voltages on the Votrax®™ Module connector pins that plug into the Votrax®™ Synthesizer Module. Refer to Figure 1 for the range of voltages on the module's connector pins. Pins with no voltage indicated in Figure 1 should measure between 0 and +5V. Either a voltmeter or an oscilloscope may be used for these voltage measurements. It is imperative that a wrong polarity voltage or a wrong level of voltage is not applied to the sealed Votrax®™ Module.

11. ☐ The audio amplifier portion of the Voice Synthesizer card may be tested by inputting a 5V peak-to-peak audio signal to pin 25 (next to the .01 mfd mylar at bottom) of the synthesizer card's 36-pin connector. Be sure that the speaker switch is on and slowly turn up the volume control (R3 - the potentiometer nearest the synthesizer module). An audio note should be heard distinctly as the audio generator is swept through the audio range (30 Hz - 20K Hz) to test the output of the system.

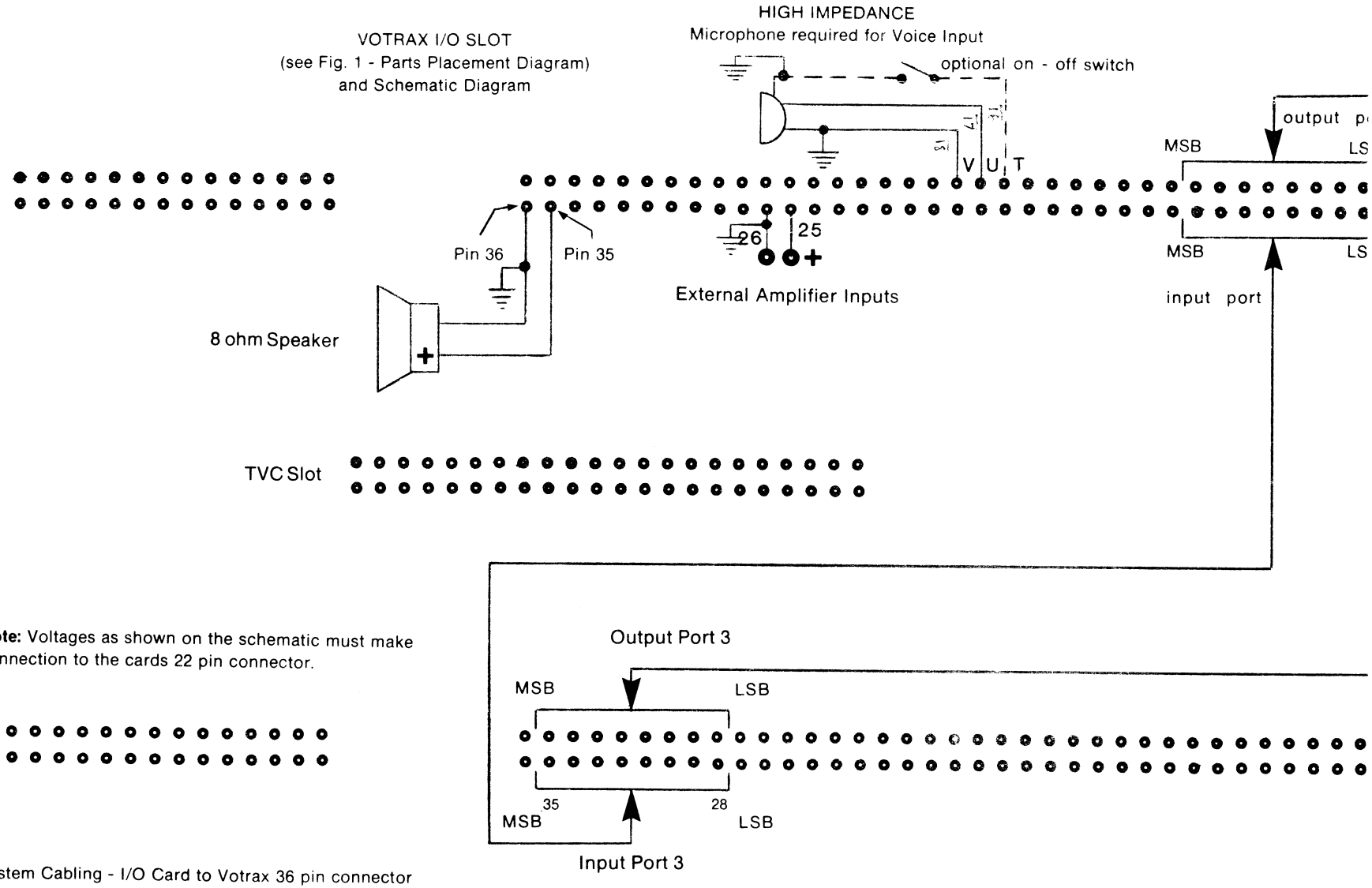
12. ☐ Turn off power to the microprocessor. Remove the Voice Synthesizer card from its I/O slot and plug in the Voice Synthesizer Module. First align the socket and connector module pins and mount the module with four 6-32 × ¼" screws. Be careful not to bend any pins on the connector or to damage the internal socket of the synthesizer module by misalignment.

13. ☐ Plug The Digital Group/Votrax®™ Voice Synthesizer card to its I/O slot. Turn on power. Depending on the particular bit pattern that occurs randomly in the two FIFO memories and the 74100 output latch of port 3 on the I/O board, the synthesizer should voice random sounds. Load the Voice Synthesizer diagnostic program into the microprocessor. Press Option 7. The program will analyze and exercise the Voice Synthesizer. Follow the directions that appear on the screen.

14. ☐ Test the voice input sections of the Voice Synthesizer card by temporarily connecting an audio generator to the microphone jack leading to pin U of the synthesizer card. Input a low level signal (about .1V p-p at 1000 Hz) and adjust the microphone gain control (the 50K potentiometer) until you see an output level of 1V p-p at pin 7 of IC6. Next, measure the level at pin 1 of IC6 with the oscilloscope and verify that a square wave at TTL levels is being produced. Look at pin 14 of IC6 and adjust R1 (the 5K potentiometer farthest from the voice module) until only a slight number of negative going pulses are seen. Next, measure the output at pin 7 of IC5. Sweep the audio generator between 300 Hz and 4000 Hz. You should notice that the audio output drops off above 1000 Hz. Measure the output at pin 8 of IC5. The output should drop below 1000 Hz. Check the zero crossing detections at pin 1 and pin 14 of IC5. You will notice that most zero crossings above 1K Hz are detected at pin 14. Below 1K Hz, more zero crossings are detected at pin 1 than at pin 14.

15. ☐ Connect a high impedance, high output microphone to the input to the Voice Synthesizer card. Connect an oscilloscope to pin 7 of IC6. Adjust R2 (middle potentiometer) until an output level of 1V p-p is seen when you speak closely into the microphone. Adjust R1 (the potentiometer farthest from the synthesizer module) until you can just detect negative going pulses at pin 14 of IC6 when speaking closely into the microphone. With these initial levels you should be able to see zero crossings at pin 1 of IC6 and pins 1 and 14 of IC5. This completes the initial adjustment of the voice input circuitry.

This completes the testing of The Digital Group/Votrax®™ Voice Synthesizer card.



Note: Voltages as shown on the schematic must make connection to the cards 22 pin connector.

System Cabling - I/O Card to Votrax 36 pin connector

I/O Pins 28 thru 35 connected to Pins 1 thru 8 respectively on the Votrax Card

I/O Pins $\bar{F}$ thru $\bar{P}$ connected to Pins A thru J respectively on the Votrax Card

Note: Single wire or 8 position cable can be used to make these I/O connections.

Figure 3 - Votrax I/O Cabling
Underside of Digital Group Motherboard

PART II — THE DIGITAL GROUP/VOTRAX®™ VOICE SYNTHESIZER CARD

Programming Rules — Using Phonemes for Words of the English Language

Sixty-three (63) phoneme commands provide the user with unique synthesizer inputs with which he may program the synthesizer in any desired sequential order. There are, for instance, $(252)^4$ or over 4 billion possible utterances containing four (4) phonemes! The phonetic rules are based on the actual acoustic content of human speech. These rules do not necessarily correlate with dictionary phonetics or with phonetics as taught in the public schools. Thus, the following rules may appear alien to the uninitiated; but once the user becomes acquainted with them, determining the optimum programming for any word or phrase is quite easy and considerably easier than in some synthesizer models.

The Votrax1®™ module has been optimized for the Mid-Western or standard American English dialect, which is the dialect used almost exclusively by the nationwide media. It is also the native dialect of the Central United States, West Coast, and mid-Eastern states excluding the East Coast. This dialect is spoken by the majority of U.S. citizens and to a large extent by central and western Canadians. It is important that the following programming rules be adhered to closely. The Votrax1®™ electronics, as well as the phonetic alphabet itself, have been designed around these phonetic rules. With very few exceptions, the Votrax1®™ performance as judged by the majority of U.S. and Canadian residents will be degraded if these rules are not followed.

Such caution is necessary because ultimately the synthesizer is subjectively judged by a human listener during manual optimization of a word or phrase. The user may ask the question, "What if breaking the rules produces an apparent improvement in naturalness?" This will occasionally happen, but the user is strongly cautioned in this area. The problem is that with phonetic substitutions, what is acceptable to one listener is not necessarily acceptable to the next — particularly to one who speaks another dialect. A dialect trains our ears as well as our mouths.

For instance, in the Great Lakes area, many people consider OTTO an acceptable pronunciation of the word AUTO. People from other areas will perceive this pronunciation as an error. Another example is the New York City area residents' pronunciation of the NG phoneme. In this substitution, THING becomes THING-G with a hard G at the end of the word. A New Yorker could perceive this substitution as acceptable, but the rest of the North American continent would not.

A Southerner would accept the prefix NON as an acceptable pronunciation of the number NINE, but people in other areas would not.

The phonetic structure of any language is much more complicated than most of us realize. There are many pronunciation habits which we acquire as we grow up which we are not aware of, but we use them anyway. Proper synthesized speech must take into account all subconscious or automatic articulatory habits as well as the rules of which we are consciously aware.

Perhaps the most common of these unlearned habits of English is gliding of vowels, particularly the long vowels. This gliding is called dipthongization. It means that a vowel ends as a different sound than it was when it started. The "long" vowels, A, E, I, O, and U, have glides which are sounded independently of preceding and following phonemes, even if these sounds are spoken alone. These vowels are programmed as follows on the Votrax1®™:

VOWEL	TYPICAL USAGE	VOTRAX1®™ EQUIVALENT
A	name	A, AY
E	tree	E or I3 E1
I	high	AH, E1
O	note	UH1, 01
U	two	IU, U

The "short" vowels are as follows:

VOWEL	TYPICAL USAGE
AW	awful
EH	ten
ER	her (R, usually a consonant, can be a vowel in some cases)
UH	but
AE	hat
Y	Mary
I	kit
AH	hot
OO	book

These vowels also glide from beginning to end, but their glides are normally determined by the preceding and following phonemes. These glides are generated *automatically* by the Votrax1®™. However, the programmer may find that occasional use of coupling vowels I3, EH3, or UH3 in conjunction with a short vowel is an aid to naturalness or intelligibility.

The numbered vowels such as UH1, UH2, and UH3 are of increasingly shorter duration. The higher the number, the shorter the duration. As a syllable is stressed less and less, a higher and higher number must be selected. The numbered vowels are also used in the "long" vowel phoneme pairs. For instance, A,AY is the vowel in MAIN; A1,AY or A2,AY would be the vowel in the same syllable in the word MAINTAIN. This rule applies to all numbered vowels except Y1.

Y1 is Y used as a consonant such as in the word YES. It is also found at the beginning of a syllable such as the second syllable in the word UN*U*SUAL. Y1 is a different kind of sound than Y as is evidenced when these phonemes are sounded continuously. However, all other numbered vowels are exactly like their unnumbered, fully stressed counterparts if sounded continuously. As the number on a vowel increases, its time interval shortens, and its dynamic interaction between the preceding and following phoneme commands changes. Thus, two short-duration phonemes will not have quite the same sound as one longer one of equal time duration. These differences are not evident if the phoneme is sounded continuously.

In addition to the syllabic stress factor affecting vowel length, the following phoneme is also a factor. If it is a sustained fricative (a fricative being a consonant pronounced by forcing breath through a narrow opening between the teeth and/or lips), such as S, the preceding vowel may be shortened. If it is a fricative stop such as T, the vowel may be shortened still further. Of course, subjective judgment should still be the final factor in determining vowel stress.

There are three classes of dipthongs, or distinctively two-part vowels:

DIPTHONG	TYPICAL USAGE	VOTRAX1 EQUIVALENTS
I	high	AH, E1
I	height	AH2, E1
OW, OU	cow	AH1, O1*
		AH1, U1
OI, OY	noise	O1, EH3, E1*
		O1, I3, E1
		O, E1

*Preferred

The consonants are as follows:

CONSONANT	TYPICAL USAGE
TH	three
THV	then (the voiced TH)
W	won
R	area
T	tea
P	pot
Y1	yes
S	see
D	day
F	fire
G	get (not the G in George)
H	hay, ahead
J	jet, George (J is D, J or DT,J)
K	key, sick, car
	queer (Q is KW)
L	lie, well
NG	bring
Z	zero
SH	shy
CH	match, chair (CH is T, CH or DT,CH)
V	seven
B	bob
N	nine
M	my
ZH	azure (the Z)
	measure (the S)
DT	butter (DT is merely a tongue flap in this word)

There are two affricates in English. An affricate is a two-consonant combination with a fricative stop. The voiced affricate J is programmed D, J, or DT, J. The unvoiced affricate CH is programmed T, CH or DT, LCH.

All phonemes in English fall into seven (7) categories:

1. Voiced
   a All vowels and dipthongs of vowels
   A, E, I, O, U, AW, EH, ER, UH, AE, Y, I, AH, OO, and OI, OY, OU, OW dipthongs.
   b. All liquid consonants
   R, L, W, Y1

2. Voiced stops B, D, G

3. Nasal closures M, N, NG

4. Unvoiced
   a. Fricatives S, SH, F, TH
   b. Aspirant H

5. Voiced fricatives Z, ZH, V, THV

6. Fricative stops T, P, K

7. Affricates
   a. Voiced J
   b. Unvoiced CH

There are several particular cases of interest which should be mentioned. The letter combination NG doesn't necessarily call for the NG phoneme. If the N forms the end of one syllable and the G forms the beginning of the following syllable, as in the word ENGAGE, the N and G are sounded separately. Thus, in this case, NG is programmed N,G.

In the word FINGER, the NG can be programmed as N,G, or as NG,G.

In the word THANK, the N can be programmed as N or NG. The A in THANK is half-way between A and AE. It is best programmed as AE1, I3. This is a classic example of an aliphone.

An aliphone is a variation of a basic phoneme. All phonemes in speech context are modified by their phonetic "environment." That is, whatever is going on before and after the phoneme affects its characteristics — its duration, amplitude, frequency components, etc. This effect is the dynamic continuum of which speech is composed. A phoneme is merely an operator on the human acoustic output which, in turn, gets operated upon.

To produce intelligible synthetic speech, the proper aliphone must be generated. This is usually done automatically in the Votrax1®™. Another example of aliphones (perhaps the most extreme) is the numerous forms of K: the K in KEY, the K in LOOK, and the K sound in Q which is programmed K,W such as in the word QUIT. At times, the Votrax1®™ needs some help from the programmer to produce the proper aliphone.

A particular class of phonemes, the liquid — R,L,W, and Y1, largely depend on the transitions into and out of these sounds for their recognition. These transitions, important as they are, depend a great deal on dialect. It is therefore necessary for the programmer to insert transitional phonemes around these sounds in some cases to maximize naturalness and intelligibility.

Transitions around W and Y1 are dependent enough on surrounding phonemes for the Votrax1®™ to generate them automatically.

The pre-vocalic R (R at the beginning of an utterance) normally doesn't require a transitional phoneme after it. However, the post-vocalic R (R at the end of an utterance) may require it, depending on the preceding vowel, as in the word AIR. This is programmed A,I3,R. Again, note the similarity in spelling. EH3 in place of I3 is also acceptable here.

The pre-vocalic L is enhanced by following it with UH3,EH3, or I3, depending on the following vowel. For instance, the word LAY is programmed L,EH3,A1,AY. The post-vocalic L is likewise enhanced by preceding it with UH3,EH3, or I3 as in the word AIL. This is programmed as A,I3,L. Again, note the similarity in spelling. EH3 instead of I3 is also acceptable here.

The above suggests a need for more phonemes. Increasing the phoneme vocabulary size would enhance naturalness, but at the expense of increased hardware costs and greatly increased programming effort.

To lengthen the time duration of the last phoneme, the PA1 or pause one must be placed at the end of the utterance. The PAØ or short pause may be used instead but the last phoneme in the utterance will be a little shorter. The PAØ is normally used between words in a sentence where very short pauses are desired. The PA1 is normally used at the end of an entire utterance, even if there is only a single word in the utterance. A word must not be followed by a binary zero command. If binary zeros are part of a phonetic data stream driving the synthesizer, a PAØ or PA1 must precede a binary zero to prevent chopping off part of the last phoneme before the binary zero.

The synthesizer is designed to generate continuous speech which means that the words in a sentence have little or no gap in between. This is consistent with conversational English habits. In conversation it is usual for words within a phrase or clause to be strung together while phrases and clauses are separated by a gap. There is no doubt that intelligibility in either human or synthesized speech is enhanced by short gaps between words. This is accomplished merely by placing a PAØ after each word. The resulting speech is somewhat choppy, but highly intelligible. Use of such gaps will slow the output rate of the synthesizer accordingly. Of course, the speech rate may be increased to compensate for this but the resulting speech segments will be articulated faster than normal.

For continuous speech the synthesizer's built-in speech rules correspond to those in human speech. For instance, if two stop phonemes are adjacent, only the second phoneme is sounded. In the word FACT the K sound of the letters C and T are both fricative stops and thus only the second one in the pair is sounded. In this case, the only acoustical output attributable solely to these phonemes is the voiceless release of the T. The same rule applies if two adjacent stop phonemes are in different words. Examples of this are TACK-BOARD and CREDIT-BALANCE. If a pause command is programmed in between the two words in each pair, then both stop phonemes are sounded — the K and B in the first example, and the T and B in the second set. Note that in these examples the first phoneme of the pair in question is voiceless while the second phoneme is voiced. However, this is irrelevant — the rule still applies. It is optional whether or not to sound the first stop phoneme. Although it is more natural, it is less intelligible whether the speech is human or synthetic. This example is a classic case of naturalness opposed to intelligibility. Thus, the option is left to the user.

We are thus given several programming choices at word boundaries:

1. PA1 for separation of phrases and clauses and sentences.
2. PAØ for optional separation of words.
3. PAØ for enhancement of pronunciation of closure phoneme pairs.
4. PAØ or PA1 followed by a null as a word boundary indicator.

The Digital Group Votrax1®™ Synthesizer Demonstration English Word Vocabulary

NOTES

1. This list consists primarily of verbs, adverbs and adjectives found with some frequency in spoken English. Those nouns included were selected due to their frequency of occurrence, but may not be adequate to accommodate the vocabulary needs of any one specific environment.
2. In general, single syllable words — those words containing only one vowel sound with or without consonant sounds — are to be considered of low intelligibility when presented in isolation. Words like "code", "eight", "life", "self", and "guess" are included in this category. Even though they are recognizable out of context, their intelligibility is enhanced when used in context, as it would be with a human speaker. Words like "be", "a", "the", "of" and "is" (open-ended single syllable words) are, by the nature of spoken English, short in duration and take on characteristics to enhance the word(s) they modify. Often, this may require a change in their pronunciation to accommodate the rhythm and accent of the contextual flow. Thus, these words are low in intelligibility when presented in isolation. When words are selected for Votrax1®™ use, it is recommended that single syllable words be given the advantage of a contextual environment for maximizing their intelligibility, whenever possible.
3. The asterisk (*) following certain words indicates that there is more than one pronunciation for that spelling or more than one meaning for that spelling.

4. The following list is made up of words *not* found on the 500 list, but whose programs are (followed by their location word).

accept	(except)	maid	(made)
ate	(eight)	no	(know)
awl	(all)	new	(knew)
"B"	(be)	"R"	(are)
bee	(be)	rap	(wrap)
buy	(by)	red	(read (*))
bye	(by)	reed	(read (*))
"C"	(see)	rite	(right)
cell	(sell)	scene	(seen)
cent	(sent)	sea	(see)
dew	(do)	sense	(cents)
due	(do)	sine	(sign)
eye	("I")	their	(there)
fore	(for)	they're	(there)
forth	(fourth)	too	(to)
four	(for)	two	(to)
grate	(great)	"U"	(you)
hart	(heart)	wait	(weigh(t))
herd	(heard)	way	(weigh(t))
here	(hear)	wear	(where)
hi	(high)	witch	(which)
higher	(hire)	wood	(would)
hour(s)	(our(s))	wright	(right)
inn	(in)	write	(right)
knot	(not)	won	(one)
leased	(least)	"Y"	(why)

Input/Output Phonetic Codes

PHONEME	HEX	OCTAL	PHONEME	HEX	OCTAL
PA0	03	003	IU	36	066
PA1	3E	076	J	1A	032
A	20	040	K	19	031
A1	06	006	L	18	030
A2	05	005	M	0C	014
AE	2E	056	N	0D	015
AE1	2F	057	NG	14	024
AH	24	044	O	26	046
AH1	15	025	O1	35	065
AH2	08	010	O2	34	064
AW	3D	075	OO	17	027
AW1	13	023	OO1	16	026
AW2	30	060	P	25	045
AY	21	041	R	2B	053
B	0E	016	S	1F	037
CH	10	020	SH	11	021
D	1E	036	T	2A	052
DT	04	004	TH	39	071
E	2C	054	THV	38	070
E1	3C	074	U	28	050
EH	3B	073	U1	37	067
EH1	02	002	UH	33	063
EH2	01	001	UH1	32	062
EH3	00	000	UH2	31	061
ER	3A	072	UH3	23	043
F	1D	035	V	0F	017
G	1C	034	W	2D	055
H	1B	033	Y	29	051
I	27	047	Y1	22	042
I1	0B	013	Z	12	022
I2	0A	012	ZH	07	007
I3	09	011	SILENCE	3F	077

Character	Binary Code	Octal	Hex	Decimal Equiv.
blank	10 100 000	240	AØ	160
!	10 100 001	241	A1	161
"	10 100 010	242	A2	162
#	10 100 011	243	A3	163
$	10 100 100	244	A4	164
%	10 100 101	245	A5	165
&	10 100 110	246	A6	166
'	10 100 111	247	A7	167
(	10 101 000	250	A8	168
)	10 101 001	251	A9	169
*	10 101 010	252	AA	170
+	10 101 011	253	AB	171
,	10 101 100	254	AC	172
-	10 101 101	255	AD	173
.	10 101 110	256	AE	174
/	10 101 111	257	AF	175
Ø	10 110 000	260	BØ	176
1	10 110 001	261	B1	177
2	10 110 010	262	B2	178
3	10 110 011	263	B3	179
4	10 110 100	264	B4	180
5	10 110 101	265	B5	181
6	10 110 110	266	B6	182
7	10 110 111	267	B7	183
8	10 111 000	270	B8	184
9	10 111 001	271	B9	185
:	10 111 010	272	BA	186
;	10 111 011	273	BB	187
>	10 111 100	274	BC	188
=	10 111 101	275	BD	189
<	10 111 110	276	BE	190
?	10 111 111	277	BF	191
@	11 000 000	300	CØ	192
A	11 000 001	301	C1	193
B	11 000 010	302	C2	194
C	11 000 011	303	C3	195
D	11 000 100	304	C4	196
E	11 000 101	305	C5	197
F	11 000 110	306	C6	198
G	11 000 111	307	C7	199
H	11 001 000	310	C8	200
I	11 001 001	311	C9	201
J	11 001 010	312	CA	202
K	11 001 011	313	CB	203
L	11 001 100	314	CC	204
M	11 001 101	315	CD	205
N	11 001 110	316	CE	206
O	11 001 111	317	CF	207

Character	Binary Code	Octal	Hex	Decimal Equiv.
P	11 010 000	320	DØ	208
Q	11 010 001	321	D1	209
R	11 010 010	322	D2	210
S	11 010 011	323	D3	211
T	11 010 100	324	D4	212
U	11 010 101	325	D5	213
V	11 010 110	326	D6	214
W	11 010 111	327	D7	215
X	11 011 000	330	D8	216
Y	11 011 001	331	D9	217
Z	11 011 010	332	DA	218
[	11 011 011	333	DB	219
\	11 011 100	334	DC	220
]	11 011 101	335	DD	221
¬	11 011 110	336	DE	222
—	11 011 111	337	DF	223
	11 100 000	340	EØ	224
a	11 100 001	341	E1	225
b	11 100 010	342	E2	226
c	11 100 011	343	E3	227
d	11 100 100	344	E4	228
e	11 100 101	345	E5	229
f	11 100 110	346	E6	230
g	11 100 111	347	E7	231
h	11 101 000	350	E8	232
i	11 101 001	351	E9	233
j	11 101 010	352	EA	234
k	11 101 011	353	EB	235
l	11 101 100	354	EC	236
m	11 101 101	355	ED	237
n	11 101 110	356	EE	238
o	11 101 111	357	EF	239
p	11 110 000	360	FØ	240
q	11 110 001	361	F1	241
r	11 110 010	362	F2	242
s	11 110 011	363	F3	243
t	11 110 100	364	F4	244
u	11 110 101	365	F5	245
v	11 110 110	366	F6	246
w	11 110 111	367	F7	247
x	11 111 000	370	F8	248
y	11 111 001	371	F9	249
z	11 111 010	372	FA	250
{	11 111 011	373	FB	251
:	11 111 100	374	FC	252
}	11 111 101	375	FD	253
~	11 111 110	376	FE	254
solid	11 111 111	377	FF	255

PART III — English Demonstration Program Listing

The Demonstration Program's assembler listing has been included to assist the programmer in building new programs by showing how phonemes are combined to make words, and by giving an initial vocabulary base which may be easily extended.

Subroutines of Interest for Votrax®™ Program Development

STROBE, located at 006047 to 006061.

This subroutine is used when first entering the voice routines. The FIFOs are reset to stop any stray phonemes from "talking".

START, located at 006003 to 006046.

This is the generalized output subroutine used to voice a string of phonemes. The H and L registers are used as pointers to the beginning of a phoneme buffer. A 377, 077, 177 or 277 character is used to define the end of the string, and produce a "silence" phoneme. In the case of continuing speech, the subroutine should be entered at "PHON" so that the speech in process will not be terminated. The subroutine will try to keep 80 phonemes ahead of the synthesizer module by continually sampling the "Full" line. The subroutine also checks the empty line continually, and inserts a "pause" phoneme to begin the refill of the FIFOs. This prevents clipping short an initial voiced phoneme due to the asynchronous sampling system of the Votrax®™ module.

BEGIN1, located at 006062 to 007117.

This is a somewhat simplistic approach to a keyboard entry to ASCII Table lookup subroutine. After the ASCII entry is detected, the phonemes associated with the desired word are loaded into the phoneme buffer. When a "Return" character is detected, the phoneme pointer is reset, and speech begins.

Combining Phonemes to Build Words

Some Possible Hardware Troubles and Their Cures

Module hangs up in speaking "AH" phoneme (044) or erroneous half full analysis:

The 74L123 is designed to time-out if continuous data strobes do not occur. Some modules speak more slowly than others. A very slow one may go even more slowly than anticipated, and hangs up on the longest phoneme, "AH". This may be fixed by replacing R5 and R6 (68K) with slightly larger (e.g.68K + 10K) value resistors.

No voice output:

Speaker switch turned off. Another port 3 I/O device plugged in.

Doesn't "talk" right:

Missing a data line from port 3 output to synthesizer board input. Check connectors.

Hum or intermodulating audio:

+12V, -12V, or +5V supplies overloaded; add capacitors. Possible ground loop. Avoid multiple grounding points.

Active filter won't tune:

Resistors in wrong holes. .005 mfd capacitors out of "specs" or shorted. LM324 quad op amp defective.

Audio amp oscillates:

Check the 4.7 mfd and .1 mfd capacitors installed on the card. Try a different LM384.

Digital Group/Votrax®™ Voice Synthesizer Parts List

	Label	Description	Qty.	Digital Group Part #
☐		Votrax®™ module	1	205-000
☐		Synthesizer printed circuit board	1	090-052
☐		Synthesizer module connector plug, 16-pin	1	088-006
☐		36-pin dual edge connector	1	080-001
☐		22-pin dual edge connector	1	080-000
☐	S2, S3	28-pin socket	2	060-005
☐	S1	16-pin socket	1	060-002
☐	S4, S5, S6	14-pin socket	3	060-001
☐	IC2, IC3	3351-2 memory (28-pin), FIFO buffer	2	073-019
☐	IC1	74L123, dual retriggerable "one shot"	1	075-029
☐	IC4	LM384 operational amplifier	1	078-010
☐	IC5, IC6	LM324 operational amplifier	2	078-000
☐		Votrax®™ introductory tape	1	299-911
☐	R1, R3	5K potentiometer, square package	2	005-001
☐	R2	50K potentiometer, square package	1	005-002
☐	R4, R22	10K ¼ watt carbon film resistor	2	001-037
☐	R5, R6	68K ¼ watt carbon film resistor	2	001-044
☐	R7	39K ¼ watt carbon film resistor	1	001-042
☐	R8	2.7 ohm ¼ watt carbon film resistor	1	001-003
☐	R9, R15, R16, R18, R19, R21, R26, R27, R28, R33	100K ¼ watt carbon film resistor	10	001-045
☐	R10 - R12	150K ¼ watt carbon film resistor	3	001-046
☐	R13, R25, R30, R31	2.2K ¼ watt carbon film resistor	4	001-029
☐	R14, R23	47K ¼ watt carbon film resistor	2	001-043
☐	R17, R20, R24, R32	10 megohm ¼ watt carbon film resistor	4	001-001
☐	R29	1 megohm ¼ watt carbon film resistor	1	001-049
☐	C1, C14 - C17	.005 mfd, mylar capacitor	5	016-003
☐	C2, C3, C8, C11, C20	22 mfd, 15V tantalum capacitor	5	010-004
☐	C4 - C6	220 mfd, electrolytic capacitor	3	012-011
☐	C7	4.7 mfd, 35V tantalum capacitor	1	010-002
☐	C9, C12	.1 mfd, mylar capacitor	2	016-010
☐	C10, C18, C19, C22	.01 mfd, mylar capacitor	4	014-002
☐	C13, C21	.001 mfd, silver mica capacitor	2	018-000
☐	C24, C25, C28	1 mfd, 35V tantalum capacitor	3	010-001
☐	C23, C26, C27	.01 mfd, ceramic disk capacitor	3	014-002

Ø	1	2	3
4	5	6	7
8	9	A	B
C	D	E	F
G	H	I	J
K	L	M	N
O	P	Q	R
S	T	U	V
W	X	Y	Z
ABLE	ACCOUNT	ACTIVE	ADD
ADDRESS	ADJUST	ADVANCE	AFTER
AFTERNOON	AGAIN	AIR	ALL
ALPHA	AM	AMERICA	AMOUNT
AMPS	AN	AND	ANSWER
ANY	APPLICATION	APPROVE	APRIL
ARE	ASSIGN	ASSIST	AT
ATLANTIC	AUGUST	AVAILABLE	AVAILABLE
AVERAGE	AWAY	BACK	BAD
BE	BECAUSE	BEEN	BEFORE
BEGIN	BENEFIT	BETWEEN	BRAVO
BUDDY	BUT	BUY	BY
CALL	CAN	CAR	CARE
CAREFUL	CASE	CAUTION	CENTS
CHANGE	CHARGE	CHARLIE	CHECK
CITY	CLASS	CLASSIFICATION	CLEAR
CLEARANCE	CLOCK	CLOSE	CODE
COLLECT	COMPLETE	COMPUTE	COMPUTER
CONDENSER	CONDITION	CONFIRM	CONTACT
CORRECT	COST	CUSTOMER	CQ
DAILY	DASH	DATA	DATE
DAY	DECEMBER	DEDUCT	DEFER
DELIVER	DELTA	DEMAND	DEPARTURE
DEPOSIT	DETERMINE	DID	DIFFERENCE
DIGITAL	DIRECT	DIRECTION	DISTANCE
DIVIDE	DO	DOES	DOLLAR
DOLLARS	DOWN	EAST	EASY
ECHO	ECONOMIC	EFFECTIVE	EIGHT
EIGHTEEN	EIGHTY	ELECTRIC	ELEVEN
EMPLOYEE	EMPTY	ENJOY	ENTER
EVEN	EXCEPT	EXCEPTION	EXCHANGE
EXCUSE	EXPAND	EXPENSE	EXPERIENCE
EXPRESS	EXTEND	EXTENSIVE	FACE
FAR	FAST	FEBRUARY	FEET
FEW	FIFTEEN	FIFTY	FIGHT
FILE	FILL	FIND	FINAL
FINE	FIVE	FOR	FORCE
FORM	FORTY	FORWARD	FOUR
FOURTEEN	FOURTH	FOXTROT	FREQUENCY
FRIDAY	FROM	FRONT	FUTURE
GASOLINE	GLIDE	GOING	GOLF
GOOD	GOODBYE	GOVERNMENT	GRADE
GREAT	GROUND	GROUP	GUARANTEE
GUARD	GUESS	GUIDE	HA
HAHA	HAD	HAIR	HAM
HAND	HANDLE	HAPPEN	HAPPY
HARDWARE	HAS	HAVE	HE
HEADLIGHT	HEAH	HEAR	HEARD
HEART	HELLO	HELP	HER
HERTZ	HIGH	HI	HIM
HIRE	HIS	HOPE	HOTEL
HOW	HOWEVER	HUNDRED	HURRY

I	IF	IMPATIENT	IMPERATIVE
IMPLY	IMPOSSIBLE	IMPRESS	IMPROVEMENT
IN	INCH	INCLUDE	INCONSISTENT
INCONVENIENCE	INCREASE	INDEPENDENT	INDIA
INDICATE	INFERIOR	INFLUENCE	INFORM
INFORMATION	INITIAL	INQUIRE	INSERT
INSIDE	INSTEAD	INSTRUCT	INSUFFICIENT
INSURANCE	INTELLIGIBILITY	INTEND	INTEREST
INTERRUPT	INTO	INTRODUCED	INVESTIGATE
IS	IT	JACKET	JANUARY
JOINT	JULIET	JULY	JUNE
JUSTICE	KEEP	KEY	KILO
KILOHERTZ	KILOWATTS	KIND	KNEW
KNOW	KNOWLEDGE	LATER	LEAD
LEAST	LEAVE	LEFT	LIFE
LIGHT	LIMA	LIMIT	LIST
LIVE	LOCATION	MADE	MANAGE
MARCH	MARK	MATERIAL	MAXIMUM
MAY	ME	MEASUREMENT	MECHANIC
MEDIUM	MEGAHERTZ	MEGOHMS	MEMBER
MEN	MERGE	MICROAMPS	MIKE
MILE	MILLIAMPS	MILLION	MIND
MINUS	MINUTES	MISTAKE	MONDAY
MONTH	MORE	MR	MRS
MUCH	MUST	MY	NAME
NATION	NECESSITATE	NEVER	NEWSPAPER
NINE	NO	NOBODY	NORTH
NOT	NOVEMBER	NOW	NUMBER
OBSERVE	OCLOCK	OCTOBER	OF
OHMS	ON	ONCE	ONE
OPERATE	OSCAR	OUR	OURS
OVER	OWE	PACIFIC	PAGE
PAPA	PAPER	PARALLEL	PART
PARTS	PASS	PATTERN	PAVEMENT
PAY	PERCENT	PERCENTAGE	PERFORMANCE
PERIOD	PERTAIN	PHONE	PHRASE
PLACE	PLACEMENT	PLAN	PLEASE
PLUS	PM	POINT	POLICY
POSITION	POSSIBLE	POSTAGE	POTENTIAL
POTENTIOMETER	POWER	PRACTICE	PREFERENCE
PREPARATION	PREPARE	PRESENT	PRESSURE
PRICE	PRINT	PROBLEM	PROBLEMS
PRODUCE	PROGRAM	PROGRESS	PUBLIC
PUPIL	QUANITY	QUART	QUEBEC
QUESTION	QUICK	QUIET	QUITE
QUOTATION	QUOTE	RADIO	RANGE
RAPID	REACTION	READ	RECEIVE
RECOGNITION	RECOMMEND	RECOMMENDATION	REFUND
REGISTER	RELEASE	REMARK	REMEMBER
REMIND	REORGANIZE	REPEAT	REPLACE
REPLACEMENT	REPORT	REPRESENT	REQUEST
RESISTOR	RETURN	RIGHT	ROBERT
ROBERTS	ROGER	ROMEO	ROTATION
RUNAWAY	SAD	SAID	SAME
SATURDAY	SAVE	SAY	SCHOOL
SCREEN	SEARCH	SEASON	SECOND
SECONDS	SECTION	SECURE	SEE
SEEN	SELECT	SELF	SELL
SEND	SENT	SEPARATE	SEPARATION
SEPTEMBER	SERVE	SEVEN	SEVENTEEN
SEVENTY	SEVERAL	SHE	SHIPMENT

SHORT	SHORTAGE	SHOULD	SIDE
SIERRA	SIGN	SIGNAL	SIGNATURE
SIGNIFICANT	SINCE	SINGLE	SITUATION
SIX	SIXTEEN	SIXTY	SIZE
SKETCH	SLOW	SO	SORRY
SORT	SOUND	SOUTH	SPEAKER
SPECIFIC	SPEED	SPEND	SPRING
SQUARE	STAMP	STANDARD	START
STATE	STATES	STATEMENT	STATISTICS
STOCK	STOP	STORE	SUBJECT
SUBJECTIVE	SUBSTITUTE	SUCCESS	SUCH
SUFFICIENT	SUGGEST	SUNDAY	SUPPLY
SUPPORT	SURPLUS	SYNTHESIZER	TALKING
TANGO	TAUGHT	TEACHER	TECHNICAL
TECHNIQUE	TELEPHONE	TELEVISION	TEN
TERMINATE	TEST	THAT	THE
THEM	THEN	THERE	THESE
THIRD	THIRTEEN	THIS	THREE
THURSDAY	TIME	TO	TODAY
TOPIC	TOUCH	TRAFFIC	TRANSACTION
TRANSFER	TUESDAY	TUNE	TURN
TWO	TYPE	UNCONSCIOUS	UNDERSTAND
UNDERSTOOD	UNIFORM	UNITE	UNKNOWN
UNLIMITED	UNTIL	UNUSUAL	UP
UPON	URGENT	USE	VACANCY
VALID	VERIFY	VERY	VICTOR
VOICE	VOLTS	VOLUME	VOTRAX
WALK	WANT	WAREHOUSE	WATCH
WATTS	WEDNESDAY	WEIGH	WELCOME
WELL	WENT	WERE	WEST
WHAT	WHEN	WHERE	WHICH
WHISKEY	WHITE	WHY	WILL
WIND	WITH	WITHIN	WITHOUT
WON	WORK	WOULD	WOUND
WRAP	WRITE	XRAY	YALL
YES	YESTERDAY	YOU	ZERO
ZONE			

```
FILE  060000  253055
READY
ASSM

006000                  0100        ST   006000
006000 303 117 006 0102        JP   BEGIN
006003                  0104 * GENERAL OUTPUT SUBROUTINE
006003                  0106 *   HL POINT TO PHONEME STRING
006003                  0108 *   END OF PHONEME STRING INDICATED BY 377
006003                  0110 *
006003 315 047 006 0112 START  CALL STROBE AWAIT DATA COMMAND
006006 333 003     0114 PHON   IN   PORT       CHECK FOR FIFO FULL
006010 313 177     0116        BIT  7,A
006012 050 372     0118        JR   Z,PHON     LOOP WHILE FULL
006014 313 157     0120        BIT  5,A        CHECK FOR FIFO EMPTY
006016 040 010     0122        JR   NZ,PHON2   NOT EMPTY; PROCEED
006020 076 303     0124        LD   A,303      INSERT DUMMY PAUSE
006022 323 003     0126        OUT  PORT
006024 313 277     0128        RES  7,A        RESET STROBE PULSE
006026 323 003     0130        OUT  PORT
006030 176         0132 PHON2  LD   A,(HL)     GET THE DATA CHAR
006031 366 300     0134        OR   300        MASK OFF RESET AND SET STROBE
006033 323 003     0136        OUT  PORT       SEND A PHONEME
006035 313 277     0138        RES  7,A        TURN OFF STROBE
006037 323 003     0140        OUT  PORT
006041 043         0142        INC  HL         NEXT PHONEME
006042 376 177     0144        CP   177        END?
006044 310         0146        RET  Z
006045 030 337     0148        JR   PHON
006047             0150 *
006047             0152 * INITIALIZE OUTPUT REG TO NO SOUND
006047             0154 *
006047 365         0156 STROBE PUSH AF
006050 076 000     0158        LD   A,000          RESET FIFO'S
006052 323 003     0160        OUT  PORT
006054 076 100     0162        LD   A,100          PREPARE FOR DATA ENTRYRY
006056 323 003     0164        OUT  PORT
006060 361         0166        POP  AF
006061 311         0168        RET
006062             0170 *
006062             0172 PORT   EQU  3    PORT 3 USED FOR VOX-1
006062             0174 PA0    EQU  003  PA0 IS THE PAUSE PHONEME
006062             0176 DECODE EQU  077  SILENCE COMMAND
006062             0178 ERASE  EQU  000346  ERASE SUBROUTINE
006062             0180 SPACE  EQU  000370  SPACE
006062             0182 TV     EQU  000372  TV
006062             0184 KEYBRD EQU  001250  KEYBOARD
006062             0186 TVED   EQU  002000  TV EDITOR
006062             0188 *
006062             0190 *   KEYBOARD ENTRY OF WORDS TO BE SPOKEN
006062             0192 *
006062 315 250 001 0194 BEGIN1 CALL KEYBRD         CHECK FOR A SAME REQUEST
006065 376 215     0196        CP   215           RETURN CHARACTER?
006067 312 257 007 0198        JP   Z,RETRY       REPEAT THE MESSAGE IN BUFFER
006072 365         0200        PUSH AF            SAVE THE NEW CHARACTER
006073 315 346 000 0202        CALL ERASE
006076 041 211 007 0204        LD   HL,INSTRC     PUT INSTRUCTIONS ON SCREEN
006101 315 000 002 0206        CALL TVED
006104 041 270 007 0208        ID   HL,CALLDT     SET POINTERS TO BUFFER
006107 036 377     0210        LD   E,377         255 CHARACTERS MAX
006111 315 370 000 0212        CALL SPACE
006114 361         0214        POP  AF            RESTORE NEW CHAR
006115 030 034     0216        JR   KEY2
006117 041 270 007 0218 BEGIN  LD   HL,CALLDT     SET POINTERS
006122 036 377     0220        LD   E,377         255 CHARACTERS MAX
006124 345         0222 ENTER  PUSH HL            SAVE POINTERS
006125 315 346 000 0224        CALL ERASE         CLEAR SCREEN & SHOW INSTR
006130 041 211 007 0226        LD   HL,INSTRC
006133 315 000 002 0228        CALL TVED
006136 341         0230        POP  HL            RESTORE POINTERS
006137 076 337     0232 KEY    LD   A,337         UNDERLINE CHAR FOR CURSOR
006141 315 372 000 0234        CALL TV
006144 315 250 001 0236 KEY3   CALL KEYBRD        GET A CHARACTER
006147 376 215     0238        CP   215           RETURN CHAR? (END?)
006151 050 154     0240        JR   Z,RET
006153 376 240     0242 KEY2   CP   240           SPACE CHARACTER?
006155 050 106     0244        JR   Z,CHAR
006157 376 241     0246        CP   '!'           CHECK FOR SENTENCE PUNCTU
006161 050 102     0248        JR   Z,CHAR
006163 376 254     0250        CP   254           (COMMA)
006165 050 076     0252        JR   Z,CHAR
006167 376 256     0254        CP   '.'
006171 050 072     0256        JR   Z,CHAR
006173 376 272     0258        CP   ':'
006175 050 066     0260        JR   Z,CHAR
006177 376 273     0262        CP   ';'
006201 050 062     0264        JR   Z,CHAR
006203 376 277     0266        CP   '?'
006205 050 056     0268        JR   Z,CHAR
006207 376 260     0270        CP   260           CHECK FOR A NUMERIC CHAR
006211 070 324     0272        JR   C,KEY         IGNORE SPECIAL CHAR
006213 376 272     0274        CP   272           LESS THAN 9?
006215 070 046     0276        JR   C,CHAR        ACCEPT IF A NUMBER
006217 376 301     0278        CP   'A'           ALPHA?
006221 070 314     0280        JR   C,KEY         IGNORE SPECIAL CHAR
006223 346 337     0282        AND  337           CONVERT LOWER CASE TO UP
006225 376 337     0284        CP   337           DELETE LAST ENTRY?
006227 040 030     0286        JR   NZ,KEY1
006231 053         0288        DEC  HL            ERASE LAST ENTRY
006232 076 002     0290        LD   A,002         BACKSPACE TV
006234 315 372 000 0292        CALL TV
006237 315 370 000 0294        CALL SPACE
006242 076 002     0296        LD   A,002
006244 315 372 000 0298        CALL TV
006247 076 002     0300        LD   A,002
006251 315 372 000 0302        CALL TV
006254 034         0304        INC  E
006255 050 240     0306        JR   Z,BEGIN       IF BUFFER AT 0, RESTART
006257 030 256     0308        JR   KEY           OTHERWISE CONTINUE
006261 376 333     0310 KEY1   CP   333           >Z?
006263 060 252     0312        JR   NC,KEY        IGNORE SPECIAL CHAR
006265 107         0314 CHAR   LD   B,A           SAVE CHAR
006266 076 002     0316        LD   A,002         BACKSPACE TV
006270 315 372 000 0318        CALL TV
006273 170         0320        ID   A,B           RESTORE CHAR
006274 315 372 000 0322        CALL TV            PRINT CHAR
006277 170         0324        LD   A,B           RESTORE CHAR
006300 376 260     0326        CP   '0'           LESS THAN #?
006302 070 014     0328        JR   C,CHAR1       YES
006304 376 272     0330        CP   ':'
006306 050 010     0332        JR   Z,CHAR1
```

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006310 376 273      0334        CP   ';'
006312 050 004      0336        JR   Z,CHAR1
006314 376 277      0338        CP   '?'
006316 040 002      0340        JR   NZ,CHAR2
006320 076 240      0342 CHAR1  LD   A,240          PUNCTUATION = SPACE PHONEME
006322 167          0344 CHAR2  LD   (HL),A         PUT NEW CHAR IN BUFFER
006323 043          0346        INC  HL             INCREMENT BUFFER PONTER
006324 035          0348        DEC  E              REDUCE BUFFER COUNTER
006325 040 210      0350        JR   NZ,KEY         LOOP FOR MORE ENTRY
006327 066 240      0352 RET    LD   (HL),240       END OF WORD MARK
006331 043          0354        INC  HL
006332 066 377      0356        LD   (HL),377       END OF SENTENCE MARK
006334 021 270 007  0358 LOOK   LD   DE,CALLDT
006337 041 366 011  0360        LD   HL,TABLE
006342 001 367 010  0362        LD   BC,CODE
006345 032          0364 STRING LD   A,(DE)
006346 376 377      0366        CP   377
006350 312 124 006  0368        JP   Z,ENTER
006353 041 267 010  0370 CMPR   LD   HL,TEMP
006356 032          0372        LD   A,(DE)
006357 376 240      0374        CP   240   SPACE YET?
006361 050 005      0376        JR   Z,CMPR1
006363 167          0378        LD   M,A     FILL BUFFER
006364 043          0380        INC  HL
006365 023          0382        INC  DE
006366 030 366      0384        JR   CMPR+3
006370 167          0386 CMPR1  LD   M,A
006371 023          0388        INC  DE
006372 325          0390        PUSH DE
006373 041 366 011  0392        LD   HL,TABLE
006376 021 267 010  0394        LD   DE,TEMP
007001 032          0396 CMPR2  LD   A,(DE)   LOOK FOR MATCH
007002 276          0398        CP   M
007003 040 004      0400        JR   NZ,CMPR3
007005 043          0402        INC  HL
007006 023          0404        INC  DE
007007 030 370      0406        JR   CMPR2
007011 376 240      0408 CMPR3  CP   240   WAS IT A FULL MATCH?
007013 040 017      0410        JR   NZ,RESET  NO!
007015 176          0412        LD   A,M
007016 313 177      0414        BIT  7,A
007020 040 012      0416        JR   NZ,RESET
007022 176          0418 OK     LD   A,M
007023 313 177      0420        BIT  7,A
007025 040 123      0422        JR   NZ,NEXT FINISHED LOADING VOTRAX CODES
007027 002          0424        LD   (BC),A
007030 003          0426        INC  BC
007031 043          0428        INC  HL
007032 030 366      0430        JR   OK
007034 176          0432 RESET  LD   A,M
007035 313 177      0434        BIT  7,A  AM I ON ASCII OR V CODES?
007037 050 003      0436        JR   Z,RESET1  IF V CODES
007041 043          0438        INC  HL
007042 030 370      0440        JR   RESET
007044 176          0442 RESET1 LD   A,M
007045 313 177      0444        BIT  7,A  AM I THROUGH V CODES?
007047 040 003      0446        JR   NZ,RESET2  YES
007051 043          0448        INC  HL
007052 030 370      0450        JR   RESET1
007054 376 377      0452 RESET2 CP   377
007056 040 316      0454        JR   NZ,CMPR2-3 CHECK NEXT WORD IF NOT AT TAB END
007060 315 346 000  0456        CALL 346
007063 041 267 010  0458        LD   HL,TEMP
007066 176          0460 CKWORD LD   A,M
007067 376 240      0462        CP   240
007071 050 006      0464        JR   Z,DONIT
007073 315 372 000  0466        CALL 372
007076 043          0468        INC  HL
007077 030 365      0470        JR   CKWORD
007101 041 120 007  0472 DONIT  LD   HL,NTFND
007104 315 000 002  0474        CALL 002000
007107 076 020      0476        LD   A,020
007111 315 173 001  0478        CALL 001173  TIME DELAY
007114 321          0480        POP  DE
007115 303 117 006  0482        JP   BEGIN
007120              0484 NTFND  DB   001
  001
007121                          0486        DC   ' NOT FOUND IN WORD TABLE'
  240   316   317   324   240
  306   317   325   316   304
  240   311   316   240   327
  317   322   304   240   324
  301   302   314   305
007151                          0488        DB   0
  000
007152 076 003      0490 NEXT   LD   A,003        PAUSE BETWEEN WORDS
007154 002          0492        LD   (BC),A
007155 003          0494        INC  BC         NEXT WORD
007156 321          0496        POP  DE   NOW WHERE WAS I IN THE INPUT
007157 032          0498        LD   A,(DE)  WAS IT END OF ENTRIES?
007160 376 240      0500        CP   240       MULTIPLE SPACES?
007162 040 004      0502        JR   NZ,NEXT1
007164 023          0504        INC  DE         INCREMENT BUFFER POINTE
007165 325          0506        PUSH DE         SAVE BUFFER POINTER
007166 030 362      0508        JR   NEXT
007170 376 377      0510 NEXT1  CP   377
007172 041 367 010  0512        LD   HL,CODE
007175 302 353 006  0514        JP   NZ,CMPR  NO - GET NEXT WORD
007200 076 377      0516        LD   A,377
007202 002          0518        LD   (BC),A  PUT 377 AFTER FINAL V COD
007203 315 003 006  0520        CALL START  SEND OUT THE SENTENCE
007206 303 062 006  0522        JP   BEGIN1
007211              0524 INSTRC DC   'ENTER SENTENCE  HIT RETURN '
  305   316   324   305   322
  240   323   305   316   324
  305   316   303   305   240
  240   310   311   324   240
  322   305   324   325   322
  316   240
007244                          0526        DC   'WHEN DONE'
  327   310   305   316   240
  304   317   316   305
007255                          0528        DC   142,0
  142   000
007257                          0530 ****************
007257 041 367 010  0532 RETRY  LD   HL,CODE      RETRY THE PHONEMES
007262 315 003 006  0534        CALL START
007265 303 062 006  0536        JP   BEGIN1
007270              0538 ****************
007270              0540 CALLDT DS   377
010267              0542 TEMP   DS   100
010367              0544 CODE   DS   377
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011366                          0546 TABLE  DB   0
  000
011367                          0548        DC   '0',22,41,11,53,43,64,67
  260   022   041   011   053
  043   064   067
011377                          0550        DC   '1',55,43,61,61,15,15
  261   055   043   061   061
  015   015
012006                          0552        DC   '2',52,66,66,67,67
  262   052   066   066   067
  067
012014                          0554        DC   '3',71,53,54,51
  263   071   053   054   051

012021                          0556        DC   '4',35,65,65,53
  264   035   065   065   053

012026                          0558        DC   '5',35,10,25,11,51,17,17
  265   035   010   025   011
  051   017   017
012036                          0560        DC   '6',37,13,11,31,3,37
  266   037   013   011   031
  003   037
012045                          0562        DC   '7',37,0,1,17,1,15,15
  267   037   000   001   017
  001   015   015
012055                          0564        DC   '8',5,5,41,51,52
  270   005   005   041   051
  052
012063                          0566        DC   '9',15,25,1,51,15
  271   015   025   001   051
  015
012071                          0568        DC   'A',6,5,41,51
  301   006   005   041   051

012076                          0570        DC   'B',16,74,54
  302   016   074   054
012102                          0572        DC   'C',37,74,54
  303   037   074   054
012106                          0574        DC   'D',36,74,54
  304   036   074   054
012112                          0576        DC   'E',74,74,74
  305   074   074   074
012116                          0578        DC   'F',1,2,61,35
  306   001   002   061   035

012123                          0580        DC   'G',36,32,74,54
  307   036   032   074   054

012130                          0582        DC   'H',5,5,5,41,51,52,20
  310   005   005   005   041
  051   052   020
012140                          0584        DC   'I',25,10,0,11,74
  311   025   010   000   011
  074
012146                          0586        DC   'J',36,32,0,40,41,41
  312   036   032   000   040
  041   041
012155                          0588        DC   'K',31,0,40,41,41
  313   031   000   040   041
  041

012163                          0590        DC   'L',1,2,0,30,30
  314   001   002   000   030
  030
012171                          0592        DC   'M',1,2,0,14,14
  315   001   002   000   014
  014
012177                          0594        DC   'N',2,2,15,15
  316   002   002   015   015

012204                          0596        DC   'O',26,64,65,50
  317   026   064   065   050

012211                          0598        DC   'P',45,54,41,51
  320   045   054   041   051

012216                          0600        DC   'Q',31,51,66,67,67
  321   031   051   066   067
  067
012224                          0602        DC   'R',44,43,72
  322   044   043   072
012230                          0604        DC   'S',1,2,11,37,37
  323   001   002   011   037
  037
012236                          0606        DC   'T',52,74,54
  324   052   074   054
012242                          0608        DC   'U',51,66,66,67,67
  325   051   066   066   067
  067
012250                          0610        DC   'V',17,74,54
  326   017   074   054
012254                          0612        DC   'W',36,62,16,30,42,66,67
  327   036   062   016   030
  042   066   067
012264                          0614        DC   'X',1,2,11,31,3,37
  330   001   002   011   031
  003   037
012273                          0616        DC   'Y',55,25,0,11,51
  331   055   025   000   011
  051
012301                          0618        DC   'Z',22,74,54
  332   022   074   054
012305                          0620        DC   'ABLE',5,5,51,16,30
  301   302   314   305   005
  005   051   016   030
012316                          0622        DC   'ACCOUNT',61,31,25,67,15,52
  301   303   303   317   325
  316   324   061   031   025
  067   015   052
012333                          0624        DC   'ACTIVE',57,0,31,3,52,12,17
  301   303   324   311   326
  305   057   000   031   003
  052   012   017
012350                          0626        DC   'ADD',56,0,36
  301   304   304   056   000
  036
012356                          0628        DC   'ADDRESS',61,36,53,2,37
  301   304   304   322   305
  323   323   061   036   053
  002   037
012372                          0630        DC   'ADJUST',61,36,32,43,62,37,52
  301   304   312   325   323
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  324   061   036   032   043
  062   037   052
013007                      0632   DC   'ADVANCE',1,36,17,57,0,15,37
  301   304   326   301   316
  303   305   001   036   017
  057   000   015   037
013025                      0634   DC   'AFTER',55,35,52,72
  301   306   324   305   322
  056   035   052   072
013036                      0636   DC   'AFTERNOON',57,35,52,53,15,66,50,15
  301   306   324   305   322
  316   317   317   316   057
  035   052   053   015   066
  050   015
013057                      0638   DC   'AGAIN',62,34,73,15
  301   307   301   311   316
  062   034   073   015
013070                      0640   DC   'AIR',5,1,72
  301   311   322   005   001
  072
013076                      0642   DC   'ALL',75,43,30
  301   314   314   075   043
  030
013104                      0644   DC   'ALPHA',57,61,30,35,62
  301   314   320   310   301
  057   061   030   035   062

013116                      0646   DC   'AM',1,2,0,14,14
  301   315   001   002   000
  014   014
013125                      0648   DC   'AMERICA',61,14,1,1,53,0,31,62
  301   315   305   322   311
  303   301   061   014   001
  001   053   000   031   062

013144                      0650   DC   'AMOUNT',61,14,43,25,67,15,52
  301   315   317   325   316
  324   061   014   043   025
  067   015   052
013161                      0652   DC   'AMPS',1,2,0,14,45,37
  301   315   320   323   001
  002   000   014   045   037

013173                      0654   DC   'AN',57,0,11,15
  301   316   057   000   011
  015
013201                      0656   DC   'AND',57,0,11,15,36
  301   316   304   057   000
  011   015   036
013211                      0658   DC   'ANSWER',57,11,15,37,53,53
  301   316   323   327   305
  322   057   011   015   037
  053   053
013225                      0660   DC   'ANY',2,2,15,15,74,74
  301   316   331   002   002
  015   015   074   074
013236                      0662   DC   'APPLICATION',57,45,30,43,31,6,42,21,43,15
  301   320   320   314   311
  303   301   324   311   317
  316   057   045   030   043
  031   006   042   021   043
  015
013263                      0664   DC   'APPROVE',61,45,53,50,17
  301   320   320   322   317
  326   305   061   045   053
  050   017
013277                      0666   DC   'APRIL',6,41,45,53,43,30
  301   320   322   311   314
  006   041   045   053   043
  030
013312                      0668   DC   'ARE',25,43,72
  301   322   305   025   043
  072
013320                      0670   DC   'ASSIGN',61,37,25,74,15
  301   323   323   311   307
  316   061   037   025   074
  015
013333                      0672   DC   'ASSIST',61,37,47,37,52
  301   323   323   311   323
  324   061   037   047   037
  052
013346                      0674   DC   'AT',57,0,52
  301   324   057   000   052

013353                      0676   DC   'ATLANTIC',1,52,30,57,15,52,11,31
  301   324   314   301   316
  324   311   303   001   052
  030   057   015   052   011
  031
013373                      0678   DC   'AUGUST',75,34,1,37,52
  301   325   307   325   323
  324   075   034   001   037
  052
014006                      0680   DC   'AVAILABLE',61,17,6,41,30,43,16,43,30
  301   326   301   311   314
  301   302   314   305   061
  017   006   041   030   043
  016   043   030
014030                      0682 *
214030                      0684   DC   'AVAILABLE',61,17,6,41,30,43,16,43,30
  301   326   301   311   314
  301   302   314   305   061
  017   006   041   030   043
  016   043   030
014052                      0686   DC   'AVERAGE',57,11,17,53,12,36,32
  301   326   305   322   301
  307   305   057   011   017
  053   012   036   032
214070                      0688   DC   'AWAY',61,55,6,41,41
  301   327   301   331   061
  055   006   041   041
214101                      0690   DC   'BACK',16,57,0,31
  302   301   303   313   016
  057   000   031
014111                      0692   DC   'BAD',16,56,36
  302   301   304   016   056
  036
014117                      0694   DC   'BE',16,74,74
  302   305   016   074   074

214124                      0696   DC   'BECAUSE',16,42,31,62,61,22
  302   305   303   301   325
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  323   305   016   042   031
  062   061   022
014141                      0698        DC   'BEEN',16,0,2,15
  302   305   305   316   016
  000   002   015
014151                      0700        DC   'BEFORE',16,74,35,46,53
  302   305   306   317   322
  305   016   074   035   046
  053
014164                      0702        DC   'BEGIN',16,74,34,11,13,15
  302   305   307   311   316
  016   074   034   011   013
  015
014177                      0704        DC   'BENEFIT',16,2,15,0,35,11,52
  302   305   316   305   306
  311   324   016   002   015
  000   035   011   052
014215                      0706        DC   'BETWEEN',16,12,52,55,74,74,15
  302   305   324   327   305
  305   316   016   012   052
  055   074   074   015
014233                      0708        DC   'BRAVO',16,53,61,25,17,61,65
  302   322   301   326   317
  016   053   061   025   017
  061   065
014247                      0710        DC   'BUDDY',16,62,36,54
  302   325   304   304   331
  016   062   036   054
014260                      0712        DC   'BUT',16,62,43,52
  302   325   324   016   062
  043   052
014267                      0714        DC   'BUY',16,25,74
  302   325   331   016   025
  074
014275                      0716        DC   'BY',16,25,74
  302   331   016   025   074

014302                      0718        DC   'CALL',31,75,30
  303   301   314   314   031
  075   030
014311                      0720        DC   'CAN',31,56,0,0,15
  303   301   316   031   056
  000   000   015
014321                      0722        DC   'CAR',31,44,53
  303   301   322   031   044
  053
014327                      0724        DC   'CARE',31,5,1,53
  303   301   322   305   031
  005   001   053
014337                      0726        DC   'CAREFUL',31,5,1,53,35,43,30
  303   301   322   305   306
  325   314   031   005   001
  053   035   043   030
014355                      0728        DC   'CASE',31,6,41,42,37
  303   301   323   305   031
  006   041   042   037
014366                      0730        DC   'CAUTION',31,75,21,43,15
  303   301   325   324   311
  317   316   031   075   021
  043   015
015002                      0732        DC   'CENTS',37,0,2,15,37
  303   305   316   324   323
  037   000   002   015   037
015014                      0734        DC   'CHANGE',52,20,0,6,51,15,36,32
  303   310   301   316   307
  305   052   020   000   006
  051   015   036   032
015032                      0736        DC   'CHARGE',52,20,44,53,36,32
  303   310   301   322   307
  305   052   020   044   053
  036   032
015046                      0738        DC   'CHARLIE',20,61,25,53,30,51
  303   310   301   322   314
  311   305   020   061   025
  053   030   051
015063                      0740        DC   'CHECK',52,20,73,31
  303   310   305   303   313
  052   020   073   031
015074                      0742        DC   'CITY',37,13,4,74
  303   311   324   331   037
  013   004   074
015104                      0744        DC   'CLASS',31,30,56,43,37
  303   314   301   323   323
  031   030   056   043   037

015116                      0746        DC   'CLASSIFICATION',31,30,57,37,11,35,11,31
  303   314   301   323   323
  311   306   311   303   301
  324   311   317   316   031
  030   057   037   011   035
  011   031   006
015145                      0748        DC   42,21,43,15
  042   021   043   015
015151                      0750        DC   'CLEAR',31,30,11,13,53
  303   314   305   301   322
  031   030   011   013   053

015163                      0752        DC   'CLEARANCE',31,30,11,12,53,0,15,37
  303   314   305   301   322
  301   316   303   305   031
  030   011   012   053   000
  015   037
015204                      0754        DC   'CLOCK',31,30,25,43,31
  303   314   317   303   313
  031   030   025   043   031

015216                      0756        DC   'CLOSE',31,30,43,65,67,22
  303   314   317   323   305
  031   030   043   065   067
  022
015231                      0758        DC   'CODE',31,64,65,67,36
  303   317   304   305   031
  064   065   067   036
015242                      0760        DC   'COLLECT',31,61,31,43,1,1,31,3,52
  303   317   314   314   305
  303   324   031   061   031
  043   001   001   031   003
  052
015262                      0762        DC   'COMPLETE',31,43,14,45,30,54,52
  303   317   315   320   314
  305   324   305   031   043
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  014   045   030   054   052
015301                      0764      DC    'COMPUTE',31,43,14,45,51,4,52
  303   317   315   320   325
  324   305   031   043   014
  045   051   004   052
015317                      0766      DC    'COMPUTER',31,43,14,45,51,4,52,72
  303   317   315   320   325
  324   305   322   031   043
  014   045   051   004   052
  072
015337                      0768      DC    'CONDENSER',31,43,15,36,2,12,15,37,72
  303   317   316   304   305
  316   323   305   322   031
  043   015   036   002   012
  015   037   072
015361                      0770      DC    'CONDITION',31,43,15,36,12,21,43,15
  303   317   316   304   311
  324   311   317   316   031
  043   015   036   012   021
  043   015
016002                      0772      DC    'CONFIRM',31,43,15,35,53,53,14
  303   317   316   306   311
  322   315   031   043   015
  035   053   053   014
016020                      0774      DC    'CONTACT',31,25,15,52,57,0,31,3,52
  303   317   316   324   301
  303   324   031   025   015
  052   057   000   031   003
  052
016040                      0776      DC    'CORRECT',31,53,53,2,31,3,52
  303   317   322   322   305
  303   324   031   053   053
  002   031   003   052
016056                      0778      DC    'COST',31,75,37,52
  303   317   323   324   031
  075   037   052
016066                      0780      DC    'CUSTOMER',31,61,37,52,43,14,53
  303   325   323   324   317
  315   305   322   031   061
  037   052   043   014   053

016105                      0782      DC    'CW',37,74,74,3,31,41,50
  303   321   037   074   074
  003   231   041   050
016116                      0784      DC    'DAILY',36,6,51,30,51
  304   301   311   314   331
  036   006   051   030   051

016130                      0786      DC    'DASH',14,25,11,15,43,37
  304   301   323   310   014
  025   011   015   043   037

016142                      0788      DC    'DATA',36,6,41,4,61
  304   301   324   301   036
  006   041   004   061
016153                      0790      DC    'DATE',36,6,41,42,52
  304   301   324   305   036
  006   041   042   052
016164                      0792      DC    'DAY',36,2,6,41
  304   301   331   036   002
  006   041
016173                      0794      DC    'DECEMBER',36,42,37,1,1,14,16,53
  304   305   303   305   315
  302   305   322   036   042
  037   001   001   014   016
  053
016213                      0796      DC    'DEDUCT',36,11,36,61,61,31,3,52
  304   305   304   325   303
  324   036   011   036   061
  061   031   003   052
016231                      0798      DC    'DEFER',36,42,35,72,53
  304   305   306   305   322
  036   042   035   072   053

016243                      0800      DC    'DELIVER',36,43,30,12,17,53
  304   305   314   311   326
  305   322   036   043   030
  012   017   053
016260                      0802      DC    'DELTA',32,2,61,30,52,62
  304   305   314   324   301
  032   002   061   030   052
  062
016273                      0804      DC    'DEMAND',36,0,14,57,57,15,15,36
  304   305   315   301   316
  304   036   000   014   057
  057   015   015   036
016311                      0806      DC    'DEPARTURE',36,11,45,25,53,52,20,53
  304   305   320   301   322
  324   325   322   305   036
  011   045   025   053   052
  020   053
016332                      0808      DC    'DEPOSIT',36,11,45,25,43,22,12,52
  304   305   320   317   323
  311   324   036   011   045
  025   043   022   012   052

016351                      0810      DC    'DETERMINE',36,12,52,53,53,14,11,15
  304   305   324   305   322
  315   311   316   305   036
  012   052   053   053   014
  011   015
016372                      0812      DC    'DID',36,47,36
  304   311   304   036   047
  036
017000                      0814      DC    'DIFFERENCE',36,12,35,53,0,15,37
  304   311   306   306   325
  322   305   316   303   305
  036   012   035   053   000
  015   037
017021                      0816      DC    'DIGITAL',36,13,32,13,36,43,30
  304   311   307   311   324
  301   314   036   013   032
  013   036   043   030
017037                      0818      DC    'DIRECT',36,72,2,31,3,52
  304   311   322   305   303
  324   036   072   002   031
  003   052
017053                      0820      DC    'DIRECTION',36,72,2,31,21,43,15
  304   311   322   305   303
  324   311   317   316   036
  072   002   031   021   043
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  015
017073                        0822      DC   'DISTANCE',36,13,37,52,1,15,37
  304   311   323   324   301
  316   303   305   036   013
  037   052   001   015   037
017112                        0824      DC   'DIVIDE',36,11,17,25,43,74,36
  304   311   326   311   304
  305   036   011   017   025
  043   074   036
017127                        0826      DC   'DO',36,66,50
  304   317   036   066   050
017134                        0828      DC   'DOES',36,43,22
  304   317   305   323   036
  043   022
017143                        0830      DC   'DOLLAR',36,43,25,30,43,53
  304   317   314   314   301
  322   036   043   025   030
  043   053
017157                        0832      DC   'DOLLARS',36,43,25,30,43,53,37
  304   317   314   314   301
  322   323   036   043   025
  030   043   053   037
017175                        0834      DC   'DOWN',36,43,25,67,15
  304   317   327   316   036
  043   025   067   015
017206                        0836      DC   'EAST',54,42,37,52
  305   301   323   324   054
  042   037   052
017216                        0838      DC   'EASY',74,74,22,74,54
  305   301   323   331   074
  074   022   074   054
017227                        0840      DC   'ECHO',73,31,61,65
  305   303   310   317   073
  031   061   065
017237                        0842      DC   'ECONOMIC',1,31,43,15,25,14,12,31
  305   303   317   316   317
  315   311   303   001   031
  043   015   025   014   012
  031
017257                        0844      DC   'EFFECTIVE',61,35,2,31,3,52,11,17
  305   306   306   305   303
  324   311   326   305   061
  035   002   031   003   052
  011   017
017300                        0846      DC   'EIGHT',6,41,42,52
  305   311   307   310   324
  006   041   042   052
017311                        0848      DC   'EIGHTEEN',6,41,42,52,3,74,74,15
  305   311   307   310   324
  305   305   316   006   041
  042   052   003   074   074
  015
017331                        0850      DC   'EIGHTY',6,41,42,36,51
  305   311   307   310   324
  331   006   041   042   036
  051
017344                        0852      DC   'ELECTRIC',43,30,2,31,3,52,53,11,31
  305   314   305   303   324
  322   311   303   043   030
  002   031   003   052   053
  011   031
017365                        0854      DC   'ELEVEN',43,30,2,17,0,15
  305   314   305   326   305
  316   043   030   002   017
  000   015
020001                        0856      DC   'EMPLOYEE',1,14,45,30,65,11,74,74
  305   315   320   314   317
  331   305   305   001   014
  045   030   065   011   074
  074
020021                        0858      DC   'EMPTY',12,14,14,45,52,74,54
  305   315   320   324   331
  012   014   014   045   052
  074   054
020035                        0860      DC   'ENJOY',0,0,15,36,32,46,61,74,42
  305   316   312   317   331
  000   000   015   036   032
  046   061   074   042
020053                        0862      DC   'ENTER',2,15,52,72
  305   316   324   305   322
  002   015   052   072
020064                        0864      DC   'EVEN',54,17,1,15
  305   326   305   316   054
  017   001   015
020074                        0866      DC   'EXCEPT',1,31,37,2,45,3,52
  305   330   303   305   320
  324   001   031   037   002
  045   003   052
020111                        0868      DC   'EXCEPTION',1,31,37,2,45,21,43,15
  305   330   303   305   320
  324   311   317   316   001
  031   037   002   045   021
  043   015
020132                        0870      DC   'EXCHANGE',0,31,37,52,20,6,41,42,15,36,
  305   330   303   310   301
  316   307   305   000   031
  037   052   020   006   041
  042   015   036   032
020155                        0872      DC   'EXCUSE',1,31,37,31,42,66,67,22
  305   330   303   325   323
  305   001   031   037   031
  042   066   067   022
020173                        0874      DC   'EXPAND',0,31,37,45,57,0,15,36
  305   330   320   301   316
  304   000   031   037   045
  057   000   015   036
020211                        0876      DC   'EXPENSE',0,31,37,45,73,15,37
  305   330   320   305   316
  323   305   000   031   037
  045   073   015   037
020227                        0878      DC   'EXPERIENCE',0,31,37,45,13,53,42,43,15,
  305   330   320   305   322
  311   305   316   303   305
  000   031   037   045   013
  053   042   043   015   037
020253                        0880      DC   'EXPRESS',1,31,37,45,53,2,37
  305   330   320   322   305
  323   323   001   031   037
  045   053   002   037
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020271                          0882    DC  'EXTEND',1,31,37,52,2,11,15,36
  305   330   324   305   316
  304   001   031   037   052
  002   011   015   036
020307                          0884    DC  'EXTENSIVE',1,31,37,52,2,15,37,12,17
  305   330   324   305   316
  323   311   326   305   001
  031   037   052   002   015
  037   012   017
020331                          0886    DC  'FACE',35,6,41,42,37
  306   301   303   305   035
  006   041   042   037
020342                          0888    DC  'FAR',35,25,43,53
  306   301   322   035   025
  043   053
020351                          0890    DC  'FAST',35,56,0,37,52
  306   301   323   324   035
  056   000   037   052
020362                          0892    DC  'FEBRUARY',35,2,16,42,67,0,11,53,74
  306   305   302   322   325
  301   322   331   035   002
  016   042   067   000   011
  053   074
021003                          0894    DC  'FEET',35,54,52
  306   305   305   324   035
  054   052
021012                          0896    DC  'FEW',35,51,66,67
  306   305   327   035   051
  066   067
021021                          0898    DC  'FIFTEEN',35,13,35,52,74,74,15
  306   311   306   324   305
  305   316   035   013   035
  052   074   074   015
021037                          0900    DC  'FIFTY',35,13,35,52,51
  306   311   306   324   331
  035   013   035   052   051

021051                          0902    DC  'FIGHT',35,43,10,74,52
  306   311   307   310   324
  035   043   010   074   052

021063                          0904    DC  'FILE',35,25,74,43,30
  306   311   314   305   035
  025   074   043   030
021074                          0906    DC  'FILL',35,13,43,30
  306   311   314   314   035
  013   043   030
021104                          0908    DC  'FIND',35,25,11,74,15,36
  306   311   316   304   035
  025   011   074   015   036

021116                          0910    DC  'FINAL',35,25,11,15,61,30
  306   311   316   301   314
  035   025   011   015   061
  030
021131                          0912    DC  'FINE',35,44,74,15
  306   311   316   305   035
  044   074   015
021141                          0914    DC  'FIVE',35,43,25,74,17
  306   311   326   305   035
  043   025   074   017
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021152                          0916    DC  'FOR',35,46,57
  306   317   322   035   046
  053
021160                          0918    DC  'FORCE',35,46,53,37
  306   317   322   303   305
  035   046   053   037
021171                          0920    DC  'FORM',35,46,14
  306   317   322   315   035
  046   014
021200                          0922    DC  'FORTY',35,65,53,4,51
  306   317   322   324   331
  035   065   053   004   051

021212                          0924    DC  'FORWARD',35,65,53,55,72,36
  306   317   322   327   301
  322   304   035   065   053
  055   072   036
021227                          0926    DC  'FOUR',35,65,65,53
  306   317   325   322   035
  065   065   053
021237                          0928    DC  'FOURTEEN',35,46,53,52,3,74,74,15
  306   317   325   322   324
  305   305   316   035   046
  053   052   003   074   074
  015
021257                          0930    DC  'FOURTH',35,46,53,71
  306   317   325   322   324
  310   035   046   053   071

021271                          0932    DC  'FOXTROT',35,43,25,31,37,52,53,43,25,5
  306   317   330   324   322
  317   324   035   043   025
  031   037   052   053   043
  025   052
021312                          0934    DC  'FREQUENCY',35,53,74,31,55,2,15,37,74
  306   322   305   321   325
  305   316   303   331   035
  053   074   031   055   002
  015   037   074
021334                          0936    DC  'FRIDAY',35,53,25,74,36,6,41
  306   322   311   304   301
  331   035   053   025   074
  036   006   041
021351                          0938    DC  'FROM',35,53,62,14
  306   322   317   315   035
  053   062   014
021361                          0940    DC  'FRONT',35,53,62,15,52
  306   322   317   316   324
  035   053   062   015   052

021373                          0942    DC  'FUTURE',35,42,67,52,20,72
  306   325   324   322   322
  305   035   042   067   052
  020   072
022007                          0944    DC  'GASOLINE',34,57,37,43,30,54,15
  307   301   323   317   314
  311   316   305   234   057
  037   043   030   054   015
022026                          0946    DC  'GLIDE',34,30,25,74,36
  307   314   311   304   305
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  034   030   025   074   036
022040                      0948        DC    'GOING',34,64,64,55,12,24
  307   317   311   316   307
  034   064   064   055   012
  024
022053                      0950        DC    'GOLF',34,61,23,30,25
  307   317   314   306   034
  061   023   030   025
022064                      0952        DC    'GOOD',34,46,66,36
  307   317   317   304   034
  046   066   036
022074                      0954        DC    'GOODBYE',34,46,66,36,3,16,25,74
  307   317   317   304   302
  331   305   034   046   066
  036   003   016   025   074
022113                      0956        DC    'GOVERNMENT',34,62,17,53,14,0,15,52
  307   317   326   305   322
  316   315   305   316   324
  034   062   017   053   014
  000   015   052
022135                      0958        DC    'GRADE',34,53,6,41,42,36
  307   322   301   304   305
  034   053   006   041   042
  036
022150                      0960        DC    'GREAT',34,53,6,74,52
  307   322   305   301   324
  034   053   006   074   052
022162                      0962        DC    'GROUND',34,53,25,67,15,36
  307   322   317   325   316
  304   034   053   025   067
  015   036
022176                      0964        DC    'GROUP',34,53,66,50,45
  307   322   317   325   320
  034   053   066   050   045
022210                      0966        DC    'GUARANTEE',34,0,53,43,15,52,54,74
  307   325   301   322   301
  316   324   305   305   034
  000   053   043   015   052
  054   074
022231                      0968        DC    'GUARD',34,25,43,53,36
  307   325   301   322   304
  034   025   043   053   036
022243                      0970        DC    'GUESS',34,73,37
  307   325   305   323   323
  034   073   037
022253                      0972        DC    'GUIDE',34,25,74,36
  307   325   311   304   305
  034   025   074   036
022264                      0974        DC    'HA',33,44
  310   301   033   044
022270                      0976        DC    'HAHA',33,44,33,44
  310   301   310   301   033
  044   033   044
022300                      0978        DC    'HAD',33,56,0,36
  310   301   304   033   056
  000   036
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022307                      0980        DC    'HAIR',33,51,53
  310   301   311   322   122
  005   001   053
022317                      0982        DC    'HAM',33,56,14,3
  310   301   315   033   056
  014   003
022326                      0984        DC    'HAND',33,56,0,15,36
  310   301   316   304   033
  056   000   015   036
022337                      0986        DC    'HANDLE',33,57,0,15,36,43,30
  310   301   316   304   314
  305   033   057   000   015
  036   043   030
022354                      0988        DC    'HAPPEN',33,57,0,45,11,15
  310   301   320   320   305
  316   033   057   000   045
  011   015
022370                      0990        DC    'HAPPY',33,57,45,54
  310   301   320   320   331
  033   057   045   054
023001                      0992        DC    'HARDWARE',33,25,53,36,55,1,53
  310   301   322   304   327
  301   322   305   033   025
  053   036   055   001   053
023020                      0994        DC    'HAS',33,56,11,22
  310   301   323   033   056
  011   022
023027                      0996        DC    'HAVE',33,56,43,17
  310   301   326   305   033
  056   043   017
023037                      0998        DC    'HE',33,54
  310   305   033   054
023043                      1000        DC    'HEADLIGHT',33,22,36,30,43,10,42,52
  310   305   301   324   314
  311   307   310   324   033
  022   036   030   043   010
  042   052
023064                      1002        DC    'HEAR',33,54,52
  310   305   301   310   033
  054   052
023073                      1004        DC    'HEAR',33,54,53
  310   305   301   322   033
  054   053
023102                      1006        DC    'HEARD',33,72,53,36
  310   305   301   322   324
  033   072   053   036
023113                      1008        DC    'HEART',33,25,53,52
  310   305   301   322   324
  033   025   053   052
023124                      1010        DC    'HELLO',33,2,43,30,43,64,67
  310   305   314   314   317
  033   002   043   030   043
  064   067
023140                      1012        DC    'HELP',33,2,43,30,45
  310   305   314   320   033
  002   043   030   045
023151                      1014        DC    'HER',33,72,53
  310   305   322   033   072
  053
023157                      1016        DC    'HERE',33,72,53,52,22
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  310   305   322   324   332
  033   072   053   052   022

023171                      1018   DC   'HIGH',25,74
  310   311   307   310   033
  025   074
023200                      1020   DC   'HI',25,0
  310   311   033   025   025
  000
023206                      1022   DC   'HIM',13,14
  310   311   315   033   013
  014
023214                      1024   DC   'HIRE',25,42,72
  310   311   322   305   033
  025   042   072
023224                      1026   DC   'HIS',23,47,22
  310   311   323   033   047
  022
023232                      1028   DC   'HOPE',26,64,45,3
  310   317   320   305   033
  026   064   045   003
023243                      1030   DC   'HOTEL',33,61,54,52,2,61,30
  310   317   324   305   314
  033   061   064   052   002
  061   030
023257                      1032   DC   'HOW',33,25,64,67
  310   317   327   033   025
  064   067
023266                      1034   DC   'HOWEVER',33,25,67,2,17,53,53
  310   317   327   305   326
  305   322   033   025   067
  002   017   053   053
023304                      1036   DC   'HUNDRED',33,62,15,36,53,1,36
  310   325   316   304   322
  305   304   033   062   015
  036   053   001   036
023322                      1038   DC   'HURRY',33,72,53,51
  310   325   322   322   331
  033   072   053   051
023333                      1040   DC   'I',25,0,74
  311   025   000   074
023337                      1042   DC   'IF',47,35
  311   306   047   035
023343                      1044   DC   'IMPATIENT',13,14,45,6,41,21,0,15,52
  311   315   320   301   324
  311   305   316   324   013
  014   045   006   041   021
  000   015   052
023365                      1046   DC   'IMPERATIVE',76,12,14,45,2,53,0,52,11,17
  311   315   320   305   322
  301   324   311   326   305
  076   012   014   045   002
  053   000   052   011   017

024011                      1048   DC   'IMPLY',13,14,45,30,25,51
  311   315   320   314   331
  013   014   045   030   025
  051
024024                      1050   DC   'IMPOSSIBLE',12,14,45,25,37,43,15,30
  311   315   320   317   323
  323   311   302   314   305
  012   014   045   025   037
  043   016   030
024046                      1052   DC   'IMPRESS',12,14,45,53,2,37
  311   315   320   322   305
  323   323   012   014   045
  053   002   037
024063                      1054   DC   'IMPROVEMENT',11,14,45,53,67,17,14,0,15,52
  311   315   320   322   317
  326   305   315   305   316
  324   011   014   045   053
  067   017   014   000   015
  052
024110                      1056   DC   'IN',47,15
  311   316   047   015
024114                      1058   DC   'INCH',13,15,53,20
  311   316   303   310   013
  015   052   020
024124                      1060   DC   'INCLUDE',11,15,31,30,66,67,36
  311   316   303   314   325
  304   305   011   015   031
  030   066   067   036
024142                      1062   DC   'INCONSISTENT',76,13,15,31,43,15,37,52,0,15,
  311   316   303   317   316
  323   311   323   324   305
  316   324   076   013   015
  031   043   015   037   052
  000   015   052
024171                      1064   DC   'INCONVENIENCE',76,13,15,31,43,15,17,74,15
  311   316   303   317   316
  326   305   316   311   305
  316   303   305   076   013
  015   031   043   015   017
  074   015
024217                      1066   DC   42,43,15,37
  042   043   015   037
024223                      1068   DC   'INCREASE',12,15,31,53,54,37
  311   316   303   322   305
  301   323   305   012   015
  031   053   054   037
024241                      1070   DC   'INDEPENDENT',12,15,36,42,45,2,15,36,11,15,5
  311   316   304   305   320
  305   316   304   305   316
  324   012   015   036   042
  045   002   015   036   011
  015   052
024267                      1072   DC   'INDIA',12,15,36,54,62
  311   316   304   311   301
  047   015   036   054   062
024301                      1074   DC   'INDICATE',12,15,36,11,31,6,41,52
  311   316   304   311   303
  301   324   305   012   015
  036   011   031   006   041
  052
024321                      1076   DC   'INFERIOR',12,15,36,74,53,51,72
  311   316   306   305   322
  311   317   322   012   015
  035   074   053   051   072
024340                      1078   DC   'INFLUENCE',13,15,35,30,67,11,15,37
  311   316   306   314   325
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  305   316   303   305   013
  015   035   030   067   011
  015   037
024361                        1080  DC   'INFORM',12,15,35,46,53,14
  311   316   306   317   322
  315   012   015   035   046
  053   014
024375                        1082  DC   'INFORMATION',12,15,35,53,14,6,41,21,43,15
  311   316   306   317   322
  315   301   324   311   317
  316   012   015   035   053
  014   006   041   021   043
  015
025022                        1084  DC   'INITIAL',12,15,13,21,43,30
  311   316   311   324   311
  301   314   012   015   013
  021   043   030
025037                        1086  DC   'INQUIRE',11,15,31,55,10,74,53
  311   316   321   325   311
  322   305   011   015   031
  055   010   074   053
025055                        1088  DC   'INSERT',12,15,37,72,53,52
  311   316   323   305   322
  324   012   015   037   072
  053   052
025071                        1090  DC   'INSIDE',11,15,37,25,74,36
  311   316   323   311   304
  305   011   015   037   025
  074   036
025105                        1092  DC   'INSTEAD',12,15,37,52,73,36
  311   316   323   324   305
  301   304   012   015   037
  052   073   036
025122                        1094  DC   'INSTRUCT',12,15,37,52,53,62,31,52
  311   316   323   324   322
  325   303   324   012   015
  037   052   053   062   031
  052
025142                        1096  DC   'INSUFFICIENT',12,15,37,43,35,12,21,0,15,52
  311   316   323   325   306
  306   311   303   311   305
  316   324   012   015   037
  043   035   012   021   000
  015   052
025170                        1098  DC   'INSURANCE',13,15,21,53,53,0,15,37
  311   316   323   325   322
  301   316   303   305   013
  015   021   053   053   000
  015   037
025211                        1100  DC   'INTELLIGIBILITY',12,15,52,0,30,43,36,32,43
  311   316   324   305   314
  314   311   307   311   302
  311   314   311   324   331
  012   015   052   000   030
  043   036   032   043
025241                        1102  DC   16,12,30,11,52,51
  016   012   030   011   052
  051
025247                        1104  DC   'INTEND',12,15,52,2,11,15,36
  311   316   324   305   316
  304   012   015   052   002
  011   015   036
025264                        1106  DC   'INTEREST',12,15,52,53,1,37,52
  311   316   324   305   322
  305   323   324   012   015
  052   053   001   037   052
025303                        1108  DC   'INTERRUPT',12,15,52,72,62,45,52
  311   316   324   305   322
  322   325   320   324   012
  015   052   072   062   045
  052
025323                        1110  DC   'INTO',13,15,52,50
  311   316   324   317   013
  015   052   050
025333                        1112  DC   'INTRODUCED',12,15,52,53,43,36,66,67,37,52
  311   316   324   322   317
  304   325   303   305   304
  012   015   052   053   043
  036   066   067   037   052
025357                        1114  DC   'INVESTIGATE',12,15,17,2,37,52,11,34,5,42,52
  311   316   326   305   323
  324   311   307   301   324
  305   012   015   017   002
  037   052   011   034   005
  042   052
026005                        1116  DC   'IS',47,22
  311   323   047   022
026011                        1118  DC   'IT',13,52
  311   324   013   052
026015                        1120  DC   'JACKET',36,32,57,0,31,0,52
  312   301   303   313   305
  324   036   032   057   000
  031   000   052
026032                        1122  DC   'JANUARY',36,32,57,11,15,42,67,0,11,74
  312   301   316   325   321
  322   331   036   032   057
  011   015   042   067   000
  011   074
026053                        1124  DC   'JOINT',36,32,65,11,41,15,52
  312   317   311   316   324
  036   032   065   011   041
  015   052
026067                        1126  DC   'JULIET',36,32,66,67,30,51,2,52
  312   325   314   311   325
  324   036   032   066   067
  030   051   002   052
026105                        1128  DC   'JULY',35,32,66,34,25,74
  312   325   314   331   036
  032   066   030   025   074
026117                        1130  DC   'JUNE',36,32,66,50,15
  312   325   316   305   036
  032   066   050   015
026130                        1132  DC   'JUSTICE',36,32,62,37,52,11,37
  312   325   323   324   311
  303   305   036   032   062
  037   052   011   037
026146                        1134  DC   'KEEP',31,74,51,45
  313   305   305   320   031
  074   051   045
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026156                                  1136  DC    'KEY',31,74,74
  313   305   331   031   074
  074
026164                                  1138  DC    'KILO',31,74,54,30,62,65
  313   311   314   317   031
  074   054   030   062   065
026176                                  1140  DC    'KILOHERTZ',31,74,30,62,65,33,72,53,52,22
  313   311   314   317   310
  305   322   324   332   031
  074   030   062   065   033
  072   053   052   022
026221                                  1142  DC    'KILOWATTS',31,74,30,62,65,55,25,52,37
  313   311   314   317   327
  301   324   324   323   031
  074   030   062   065   055
  025   052   037
026243                                  1144  DC    'KIND',31,25,74,15,36
  313   311   316   304   031
  025   074   015   036
026254                                  1146  DC    'KNEW',15,66,50
  313   316   305   327   015
  066   050
026263                                  1148  DC    'KNOW',15,43,65,67
  313   316   317   327   015
  043   065   067
026273                                  1150  DC    'KNOWLEDGE',15,25,30,0,36,32
  313   316   317   327   314
  305   304   307   305   015
  025   030   000   036   032

026312                                  1152  DC    'LATER',30,43,6,41,4,72
  314   301   324   305   322
  030   043   006   041   004
  072
026325                                  1154  DC    'LEAD',30,2,11,36
  314   305   301   304   030
  002   011   036
026335                                  1156  DC    'LEAST',30,74,51,37,52
  314   305   301   323   324
  030   074   051   037   052

026347                                  1158  DC    'LEAVE',30,74,42,17
  314   305   301   326   305
  030   074   042   017
026360                                  1160  DC    'LEFT',30,1,43,35,52
  314   305   306   324   030
  001   043   035   052
026371                                  1162  DC    'LIFE',30,25,74,035
  314   311   306   305   030
  025   074   035
027001                                  1164  DC    'LIGHT',30,43,10,42,52
  314   311   307   310   324
  030   043   010   042   052

027013                                  1166  DC    'LIMA',30,74,54,14,62
  314   311   315   301   030
  074   054   014   062
027024                                  1168  DC    'LIMIT',30,12,14,11,52
  314   311   315   311   324
  030   012   014   011   052
027036                                  1170  DC    'LIST',30,13,37,52
  314   311   323   324   030
  013   037   052
027046                                  1172  DC    'LIVE',30,13,17
  314   311   326   305   030
  013   017
027055                                  1174  DC    'LOCATION',30,43,64,31,5,42,21,43,15
  314   317   303   301   324
  311   317   316   030   043
  064   031   005   042   021
  043   015
027076                                  1176  DC    'MADE',14,6,41,42,36
  315   301   304   305   014
  006   041   042   036
027107                                  1178  DC    'MANAGE',14,57,0,15,11,36
  315   301   316   301   307
  305   014   057   000   015
  011   036
027123                                  1180  DC    'MARCH',14,25,43,53,52,20
  315   301   322   303   310
  014   025   043   053   052
  020
027136                                  1182  DC    'MARK',14,25,43,53,31
  315   301   322   313   014
  025   043   053   031
027147                                  1184  DC    'MATERIAL',14,0,52,13,53,74,43,30
  315   301   324   305   322
  311   301   314   014   000
  052   013   053   074   043
  030
027167                                  1186  DC    'MAXIMUM',14,57,31,37,0,14,43,14
  315   301   330   311   315
  325   315   014   057   031
  037   000   014   043   014

027206                                  1188  DC    'MAY',14,0,6,41
  315   301   331   014   000
  006   041
027215                                  1190  DC    'ME',14,11,74,74
  315   305   014   011   074
  074
027223                                  1192  DC    'MEASUREMENT',14,2,7,53,14,0,15,52
  315   305   301   327   325
  322   305   315   305   315
  324   014   002   007   052
  014   000   015   052
027246                                  1194  DC    'MECHANIC',14,1,31,57,0,15,11,31
  315   305   303   310   301
  316   311   303   014   001
  031   057   000   015   011
  031
027266                                  1196  DC    'MEDIUM',14,74,36,74,61,14
  315   325   304   311   325
  315   014   074   036   074
  061   014
027322                                  1198  DC    'MEGAHERTZ',14,40,7,34,43,33,72,53,52,2
  315   305   307   301   310
  305   322   324   332   014
  240   007   034   043   033
  072   053   052   022
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027325                          1200  DC    'MEGOHMS',14,42,7,62,65,14,37
  315  305  307  317  310
  315  323  014  040  007
  062  065  014  037
027343                          1202  DC    'MEMBER',14,2,14,16,72
  315  305  315  302  305
  322  014  002  014  016
  072
027356                          1204  DC    'MEN',14,2,11,15
  315  305  316  014  002
  011  015
027365                          1206  DC    'MERGE',14,72,53,36,32
  315  305  322  307  305
  014  072  053  036  032

027377                          1208  DC    'MICROAMPS',14,25,11,31,53,62,65
  315  311  303  322  317
  301  315  320  323  014
  025  011  031  053  062
  065
030017                          1210  DC    1,2,0,14,45,37
  001  002  000  014  045
  037
030025                          1212  DC    'MIKE',14,25,11,31
  315  311  313  305  014
  025  011  031
030035                          1214  DC    'MILE',14,25,11,43,30
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  025  011  043  030
030046                          1216  DC    'MILLIAMPS',14,13,30,74,1,2,0,14,45,37
  315  311  314  314  311
  301  315  320  323  014
  013  030  074  001  002
  000  014  045  037
030071                          1218  DC    'MILLION',14,13,30,42,43,15
  315  311  314  314  311
  317  316  014  013  030
  042  043  015
030106                          1220  DC    'MIND',14,25,74,15,36
  315  311  316  304  014
  025  074  015  036
030117                          1222  DC    'MINUS',14,25,11,15,43,37
  315  311  316  325  323
  014  025  011  015  043
  037
030132                          1224  DC    'MINUTES',14,13,15,11,52,37
  315  311  316  325  324
  305  323  014  013  015
  011  052  037
030147                          1226  DC    'MISTAKE',14,11,37,52,6,41,42,31
  315  311  323  324  301
  313  305  014  011  037
  052  006  041  042  031

030166                          1228  DC    'MONDAY',14,62,15,36,6,41
  315  317  316  304  301
  331  014  062  015  036
  006  041
030202                          1230  DC    'MONTH',14,62,15,71
  315  317  316  324  310
  014  062  015  071
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030213                          1232  DC    'MORE',14,65,65,53
  315  317  322  305  014
  065  065  053
030223                          1234  DC    'MR',14,12,37,52,72
  315  322  014  012  037
  052  072
030232                          1236  DC    'MRS',14,13,37,12,22
  315  322  323  014  013
  037  012  022
030242                          1238  DC    'MUCH',14,62,52,20
  315  325  303  310  014
  062  052  020
030252                          1240  DC    'MUST',14,62,37,52
  315  325  323  324  014
  062  037  052
030262                          1242  DC    'MY',14,25,11,74
  315  331  014  025  011
  074
030270                          1244  DC    'NAME',15,6,41,41,14
  316  301  315  305  015
  006  041  041  014
030301                          1246  DC    'NATION',15,6,41,21,1,15
  316  301  324  311  317
  316  015  006  041  021
  001  015
030315                          1248  DC    'NECESSITATE',15,0,37,2,37,11,52,6,41,52
  316  305  303  305  323
  323  311  324  301  324
  305  015  000  037  002
  037  011  052  006  041
  052
030342                          1250  DC    'NEVER',15,2,17,72
  316  305  326  305  322
  015  002  017  072
030353                          1252  DC    'NEWSPAPER',15,66,67,22,45,6,41,45,53
  316  305  327  323  320
  301  320  305  322  015
  066  067  022  045  006
  041  045  053
030375                          1254  DC    'NINE',15,25,11,51,15
  316  311  316  305  015
  025  011  051  015
031006                          1256  DC    'NO',15,62,65
  316  317  015  062  065

031013                          1258  DC    'NOBODY',15,65,16,62,36,51
  316  317  302  317  324
  331  015  065  016  062
  036  051
031027                          1260  DC    'NORTH',15,46,53,71
  316  317  322  324  310
  015  046  053  071
031040                          1262  DC    'NOT',15,25,52
  316  317  324  015  025
  052
031046                          1264  DC    'NOVEMBER',15,65,17,1,0,14,16,72
  316  317  326  305  315
  302  305  322  015  065
  017  001  000  014  016
  072
031066                          1266  DC    'NOW',15,43,25,64,67
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  025   064   067
031076                      1268        DC    'NUMBER',15,62,14,16,72
  316   325   315   302   305
  322   015   062   014   016
  072
031111                      1270        DC    'OBSERVE',61,16,22,72,53,17
  317   302   323   305   322
  326   305   061   016   022
  072   053   017
031126                      1272        DC    'OCLOCK',65,31,30,25,31
  317   303   314   317   303
  313   065   031   030   025
  031
031141                      1274        DC    'OCTOBER',25,31,3,52,64,67,16,53
  317   303   324   317   302
  305   322   025   031   003
  052   064   067   016   053

031160                      1276        DC    'OF',63,17
  317   306   063   017
031164                      1278        DC    'OHMS',62,65,14,37
  317   310   315   323   062
  065   014   037
031174                      1280        DC    'ON',44,43,15,15
  317   316   044   043   015
  015
031202                      1282        DC    'ONCE',55,62,43,15,52,37
  317   316   303   305   055
  062   043   015   052   037

031214                      1284        DC    'ONE',55,63,15
  317   316   305   055   063
  015
031222                      1286        DC    'OPERATE',25,45,72,6,41,52
  317   320   305   322   301
  324   305   025   045   072
  006   041   052
031237                      1288        DC    'OSCAR',61,25,37,31,72
  317   323   303   301   322
  061   025   037   031   072

031251                      1290        DC    'OUR',25,67,72
  317   325   322   025   067
  072
031257                      1292        DC    'OURS',25,67,72,22
  317   325   322   323   025
  067   072   022
031267                      1294        DC    'OVER',66,67,17,72
  317   326   305   322   065
  067   017   072
031277                      1296        DC    'OWE',26,04,65,50
  317   327   305   026   064
  065   050
031306                      1298        DC    'PACIFIC',45,1,37,13,35,11,31
  320   301   303   311   306
  311   303   045   001   037
  013   035   011   031
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  320   301   307   305   045
  006   041   041   036   032
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031336                      1302        DC    'PAPA',45,61,25,45,61,25
  320   301   320   301   045
  061   025   045   061   025
031350                      1304        DC    'PAPER',45,6,41,45,72
  320   301   320   305   322
  045   006   041   045   072
031362                      1306        DC    'PARALLEL',45,2,53,43,30,0,43,30
  320   301   322   301   314
  314   305   314   045   002
  053   043   030   000   043
  030
032002                      1308        DC    'PART',45,25,53,52
  320   301   322   324   045
  025   053   052
032012                      1310        DC    'PARTS',45,25,53,52,37
  320   301   322   324   324
  045   025   053   052   037
032024                      1312        DC    'PASS',45,55,0,37
  320   301   323   323   045
  056   000   037
032034                      1314        DC    'PATTERN',45,57,0,4,72,15
  320   301   324   324   305
  322   316   045   057   000
  004   072   015
032051                      1316        DC    'PAVEMENT',45,6,41,17,14,0,15,52
  320   301   326   305   315
  305   316   324   045   006
  041   017   014   000   015
  052
032071                      1318        DC    'PAY',45,0,6,41
  320   301   331   045   000
  006   041
032100                      1320        DC    'PERCENT',45,53,37,2,15,52
  320   305   322   303   305
  316   324   045   053   037
  002   015   052
032115                      1322        DC    'PERCENTAGE',45,53,37,2,15,52,11,36,3
  320   305   322   303   305
  316   324   301   307   305
  045   053   037   002   015
  052   011   036   032
032140                      1324        DC    'PERFORMANCE',45,53,35,64,53,14,0,15,
  320   305   322   306   317
  322   315   301   316   303
  305   045   053   035   064
  053   014   000   015   037

032164                      1326        DC    'PERIOD',45,12,53,74,43,36
  320   305   322   311   317
  304   045   012   053   074
  043   036
032200                      1328        DC    'PERTAIN',45,72,52,6,41,42,15
  320   305   322   324   301
  311   316   045   072   052
  000   041   042   015
032216                      1330        DC    'PEST',45,46,67,15
  320   317   317   316   305
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032227                        1332  DC    'PHRASE',35,53,6,41,42,22
  320   310   322   301   323
  305   035   053   006   041
  042   022
032243                        1334  DC    'PLACE',45,30,6,41,42,37
  320   314   301   303   305
  045   030   006   041   042
  037
032256                        1336  DC    'PLACEMENT',45,30,5,41,37,14,0,15,52
  320   314   301   303   305
  315   305   316   324   045
  030   005   041   037   014
  000   015   052
032300                        1338  DC    'PLAN',45,30,57,0,15
  320   314   301   316   045
  030   057   000   015
032311                        1340  DC    'PLEASE',45,30,74,74,22
  320   314   305   301   323
  305   045   030   074   074
  022
032324                        1342  DC    'PLUS',45,33,30,62,37
  320   314   325   323   045
  033   030   062   037
032335                        1344  DC    'PM',45,74,74,3,2,0,43,14
  320   315   045   074   074
  003   002   000   043   014

032347                        1346  DC    'POINT',45,65,0,74,15,52
  320   317   311   316   324
  045   065   000   074   015
  052
032362                        1348  DC    'POLICY',45,25,30,11,37,57
  320   317   314   311   303
  331   045   025   030   011
  037   057
032376                        1350  DC    'POSITION',45,43,22,13,21,43,15
  320   317   323   311   324
  311   317   316   045   043
  022   013   021   043   015

033015                        1352  DC    'POSSIBLE',45,25,37,43,16,30
  320   317   323   323   311
  302   314   305   045   025
  037   043   016   030
033033                        1354  DC    'POSTAGE',45,65,37,52,11,36,32
  320   317   323   324   301
  307   305   045   065   037
  052   011   036   032
033051                        1356  DC    'POTENTIAL',45,64,52,2,15,21,43,30
  320   317   324   305   316
  324   311   301   314   045
  064   052   002   015   021
  043   030
033072                        1358  DC    'POTENTIOMETER',45,64,52,2,15,21,74
  320   317   324   305   316
  324   311   317   315   305
  324   305   322   045   064
  052   002   015   021   074

033116                        1360  DC    25,14,2,52,72
  025   014   002   052   072
033123                        1362  DC    'POWER',45,44,55,67,72
  320   317   327   305   322
  045   044   055   067   072
033135                        1364  DC    'PRACTICE',45,53,57,31,3,52,11,37
  320   322   301   303   324
  311   303   305   045   053
  057   031   003   052   011
  037
033155                        1366  DC    'PREFERENCE',45,53,1,17,53,0,15,37
  320   322   305   306   305
  322   305   316   303   305
  045   053   001   017   053
  000   015   037
033177                        1368  DC    'PREPARATION',45,53,0,45,72,6,41,21,43,15
  320   322   305   320   301
  322   301   324   311   317
  316   045   053   000   045
  072   006   041   021   043
  015
033224                        1370  DC    'PREPARE',45,53,0,45,0,6,53
  320   322   305   320   301
  322   305   045   053   000
  045   000   006   053
033242                        1372  DC    'PRESENT',45,53,11,22,1,1,15,52
  320   322   305   323   305
  316   324   045   053   011
  022   001   001   015   052

033261                        1374  DC    'PRESSURE',45,53,2,21,72
  320   322   305   323   323
  325   322   305   045   053
  002   021   072
033276                        1376  DC    'PRICE',45,53,43,10,74,37
  320   322   311   303   305
  045   053   043   010   074
  037
033311                        1378  DC    'PRINT',45,53,13,15,52
  320   322   311   316   324
  045   053   013   015   052

033323                        1380  DC    'PROBLEM',45,53,25,16,30,0,14,22
  320   322   317   302   314
  305   315   045   053   025
  016   030   000   014   022
033342                        1382  DC    'PROBLEMS',45,53,25,16,30,0,14,22
  320   322   317   302   314
  305   315   323   045   053
  025   016   030   000   014
  022
033362                        1384  DC    'PRODUCE',45,53,43,36,66,67,37
  320   322   317   324   325
  303   305   045   053   043
  036   066   067   037
034000                        1386  DC    'PROGRAM',45,53,65,34,53,57,0,14
  320   322   317   307   322
  301   315   045   053   065
  034   053   057   000   014
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034017                          1388    DC   'PROGRESS',45,53,25,34,53,2,37
  320   322   317   307   322
  305   323   323   045   053
  025   034   053   002   037

034036                          1390    DC   'PUBLIC',45,62,16,30,11,31
  320   325   302   314   311
  303   045   062   016   030
  011   031
034052                          1392    DC   'PUPIL',45,42,67,42,43,30
  320   325   320   311   314
  045   042   067   042   043
  030
034065                          1394    DC   'QUANITY',31,55,10,0,15,4,12,4,51
  321   325   301   316   311
  324   331   031   055   010
  000   015   004   012   004
  051
034105                          1396    DC   'QUART',31,55,64,53,52
  321   325   301   322   324
  031   055   064   053   052

034117                          1398    DC   'QUEBEC',31,55,54,16,73,31
  321   325   305   302   305
  303   031   055   054   016
  073   031
034133                          1400    DC   'QUESTION',31,55,2,37,52,20,43,15
  321   325   305   323   324
  311   317   316   031   055
  002   037   052   020   043
  015
034153                          1402    DC   'QUICK',31,55,13,31
  321   325   311   303   313
  031   055   013   031
034164                          1404    DC   'QUIET',31,55,25,51,0,52
  321   325   311   305   324
  031   055   025   051   000
  052
034177                          1406    DC   'QUITE',31,55,62,51,52
  321   325   311   324   305
  031   055   062   051   052

034211                          1408    DC   'QUOTATION',31,55,65,52,5,51,21,43,15
  321   325   317   324   301
  324   311   317   316   031
  055   065   052   005   051
  021   043   015
034233                          1410    DC   'QUOTE',31,55,65,67,52
  321   325   317   324   305
  031   055   065   067   052

034245                          1412    DC   'RADIO',53,6,41,36,74,64,76
  322   301   304   311   317
  053   006   041   036   074
  064   076
034261                          1414    DC   'RANGE',53,6,41,11,15,36,32
  322   301   316   307   305
  053   006   041   011   015
  036   032
034275                          1416    DC   'RAPID',53,57,45,11,36
  322   301   320   311   304
  053   057   045   011   036

034307                          1418    DC   'REACTION',53,74,57,0,31,21,43,15
  322   305   301   303   324
  311   317   316   053   074
  057   000   031   021   043
  015
034327                          1420    DC   'READ',53,0,11,36
  322   305   301   304   053
  000   011   036
034337                          1422    DC   'RECEIVE',53,74,37,54,74,17
  322   305   303   305   311
  326   305   053   074   037
  054   074   017
034354                          1424    DC   'RECOGNITION',53,0,31,12,37,15,12,21,43,15
  322   305   303   317   307
  316   311   324   311   317
  316   053   000   031   012
  037   015   012   021   043
  015
035001                          1426    DC   'RECOMMEND',53,0,31,43,14,73,15,36
  322   305   303   317   315
  315   305   316   304   053
  000   031   043   014   073
  015   036
035022                          1428    DC   'RECOMMENDATION',53,0,31,1,14,1,15,36,6,41
  322   305   303   317   315
  315   305   316   304   301
  324   311   317   316   053
  000   031   001   014   001
  015   036   006   041
035052                          1430    DC   21,43,15
  021   043   015
035055                          1432    DC   'REFUND',53,74,35,43,62,15
  322   305   306   325   316
  304   053   074   035   043
  062   015
035071                          1434    DC   'REGISTER',53,1,36,32,11,37,52,53
  322   305   307   311   323
  324   305   322   053   001
  036   032   011   037   052
  053
035111                          1436    DC   'RELEASE',53,74,30,74,42,37,52
  322   305   314   305   301
  323   305   053   074   030
  074   042   037   052
035127                          1438    DC   'REMARK',53,74,14,25,53,31
  322   305   315   301   322
  313   053   074   014   025
  053   031
035143                          1440    DC   'REMEMBER',53,74,14,0,43,14,16,53
  322   305   315   305   315
  302   305   322   053   074
  014   000   043   014   016
  053
035163                          1442    DC   'REMIND',53,74,14,25,74,15,36
  322   305   315   311   316
  304   053   074   014   025
  074   015   036
035200                          1444    DC   'REORGANIZE',53,74,65,53,34,43,15,25,42,22
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  322   305   317   322   307
  301   316   311   332   305
  053   074   065   053   034
  043   015   025   042   022

035224                        1446    DC    'REPEAT',53,74,45,74,42,52
  322   305   320   305   301
  324   053   074   045   074
  042   052
035240                        1448    DC    'REPLACE',53,74,45,30,6,41,37
  322   305   320   314   301
  303   305   053   074   045
  030   006   041   037
035256                        1450    DC    'REPLACEMENT',53,74,45,30,6,42,37,14,0,15,52
  322   305   320   314   301
  303   305   315   305   316
  324   053   074   045   030
  006   042   037   014   000
  015   052
035304                        1452    DC    'REPORT',53,74,45,65,53,52
  322   305   320   317   322
  324   053   074   045   065
  053   052
035320                        1454    DC    'REPRESENT',53,0,45,53,11,22,15,52
  322   305   320   322   305
  323   305   316   324   053
  000   045   053   011   022
  015   052
035341                        1456    DC    'REQUEST',53,11,13,55,2,37,52
  322   305   321   325   305
  323   324   053   011   013
  055   002   037   052
035357                        1458    DC    'RESISTOR',53,74,22,47,37,52,72
  322   305   323   311   323
  324   317   322   053   074
  022   047   037   052   072

035376                        1460    DC    'RETURN',53,74,52,72,53,15
  322   305   324   325   322
  316   053   074   052   072
  053   015
036012                        1462    DC    'RIGHT',53,10,43,74,52
  322   311   307   310   324
  053   010   043   074   052

036024                        1464    DC    'ROBERT',53,25,16,72,52
  322   317   302   305   322
  324   053   025   016   072
  052
036037                        1466    DC    'ROBERTS',53,25,16,72,52,37
  322   317   302   305   322
  324   323   053   025   016
  072   052   037
036054                        1468    DC    'ROGER',53,10,10,36,32,72
  322   317   307   305   322
  053   010   010   036   032
  072
036067                        1470    DC    'ROMEO',53,61,64,14,54,61,65
  322   317   315   305   317
  053   061   064   014   054
  061   065

036103                        1472    DC    'ROTATION',53,64,52,6,41,21,43,15
  322   317   324   301   324
  311   317   316   053   064
  052   006   041   021   043
  015
036123                        1474    DC    'RUNAWAY',76,35,62,15,55,6,41
  322   325   316   301   327
  301   331   076   035   062
  015   055   006   041
036141                        1476    DC    'SAD',37,56,36
  323   301   304   037   056
  036
036147                        1478    DC    'SAID',37,2,11,36
  323   301   311   304   037
  002   011   036
036157                        1480    DC    'SAME',37,0,6,41,42,14
  323   301   315   305   037
  000   006   041   042   014

036171                        1482    DC    'SATURDAY',37,57,0,4,53,36,6,41
  323   301   324   325   322
  304   301   331   037   057
  000   004   053   036   006
  041
036211                        1484    DC    'SAVE',37,0,6,41,42,17
  323   301   326   305   037
  000   006   041   042   017

036223                        1486    DC    'SAY',37,0,6,41
  323   301   331   037   000
  006   041
036232                        1488    DC    'SCHOOL',37,31,67,67,30
  323   303   310   317   317
  314   037   031   067   067
  030
036245                        1490    DC    'SCREEN',37,31,53,74,74,15
  323   303   322   305   305
  316   037   031   053   074
  074   015
036261                        1492    DC    'SEARCH',37,72,53,52,20
  323   305   301   322   303
  310   037   072   053   052
  020
036274                        1494    DC    'SEASON',37,54,22,1,15
  323   305   301   323   317
  316   037   054   022   001
  015
036307                        1496    DC    'SECOND',37,2,31,61,15,52
  323   305   303   317   316
  304   037   002   031   061
  015   052
036323                        1498    DC    'SECONDS',37,2,31,61,15,52,37
  323   305   303   317   316
  304   323   037   002   031
  061   015   052   037
036341                        1500    DC    'SECTION',37,2,31,21,43,15
  323   305   303   324   311
  317   315   037   002   031
  021   043   015
036356                        1502    DC    'SECURE',37,11,31,42,72,53
  323   305   303   325   322
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  305   037   011   031   042
  072   053
036372                        1504  DC   'SEE',37,74,74
  323   305   305   037   074
  074
037000                        1506  DC   'SEEN',37,74,74,15
  323   305   305   316   037
  074   074   015
037010                        1508  DC   'SELECT',37,43,30,43,2,31,52
  323   305   314   305   303
  324   037   043   030   043
  002   031   052
037025                        1510  DC   'SELF',37,2,43,30,35
  323   305   314   306   037
  002   043   030   035
037036                        1512  DC   'SELL',37,2,43,30
  323   305   314   314   037
  002   043   030
037046                        1514  DC   'SEND',37,2,11,15,36
  323   305   316   304   037
  002   011   015   036
037057                        1516  DC   'SENT',37,0,2,15,52
  323   305   316   324   037
  000   002   015   052
037070                        1518  DC   'SEPARATE',37,2,45,53,0,52
  323   305   320   301   322
  301   324   305   037   002
  045   053   000   052
037106                        1520  DC   'SEPARATION',37,2,45,72,6,41,21,43,15
  323   305   320   301   322
  301   324   311   317   316
  037   002   045   072   006
  041   021   043   015
037131                        1522  DC   'SEPTEMBER',37,1,45,52,2,14,16,53
  323   305   320   324   305
  315   302   305   322   037
  001   045   052   002   014
  016   053
037152                        1524  DC   'SERVE',37,72,53,17
  323   305   322   326   305
  037   072   053   017
037163                        1526  DC   'SEVEN',37,2,17,0,15
  323   305   326   305   316
  037   002   017   000   015

037175                        1528  DC   'SEVENTEEN',37,2,17,0,15,52,74,74,15
  323   305   326   305   316
  324   305   305   316   037
  002   017   000   015   052
  074   074   015
037217                        1530  DC   'SEVENTY',37,2,17,0,15,36,51
  323   305   326   305   316
  324   331   037   002   017
  000   015   036   051
037235                        1532  DC   'SEVERAL',37,2,17,53,43,30
  323   305   326   305   322
  301   314   037   002   017
  053   043   030
037252                        1534  DC   'SHE',21,74,74
  323   310   305   021   074
  074
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037260                        1536  DC   'SHIPMENT',21,12,45,14,0,15,52
  323   310   311   320   315
  305   316   324   021   012
  045   014   000   015   052

037277                        1538  DC   'SHORT',21,65,53,52
  323   310   317   322   324
  021   065   053   052
037310                        1540  DC   'SHORTAGE',21,64,53,52,12,36,32
  323   310   317   322   324
  301   307   305   021   064
  053   052   012   036   032

037327                        1542  DC   'SHOULD',21,66,66,66,36
  323   310   317   325   314
  304   021   066   066   066
  036
037342                        1544  DC   'SIDE',37,25,74,36
  323   311   304   305   037
  025   074   036
037352                        1546  DC   'SIERRA',37,74,54,2,53,43,43
  323   311   305   322   322
  301   037   074   054   002
  053   043   043
037367                        1548  DC   'SIGN',37,25,11,74,15
  323   311   307   316   037
  025   011   074   015
040000                        1550  DC   'SIGNAL',37,13,34,15,43,30
  323   311   307   316   301
  314   037   013   034   015
  043   030
040014                        1552  DC   'SIGNATURE',37,13,34,15,11,52,20,72
  323   311   307   316   301
  324   325   322   305   037
  013   034   015   011   052
  020   072
040035                        1554  DC   'SIGNIFICANT',37,12,34,15,12,35,11,31,0,15,5
  323   311   307   316   311
  306   311   303   301   316
  324   037   012   034   015
  012   035   011   031   000
  015   052
040063                        1556  DC   'SINCE',37,47,15,37
  323   311   316   303   305
  037   047   015   037
040074                        1558  DC   'SINGLE',37,13,24,34,30
  323   311   316   307   314
  305   037   013   024   034
  030
040107                        1560  DC   'SITUATION',37,12,52,20,66,67,5,41,21,43,15
  323   311   324   325   301
  324   311   317   316   037
  012   052   020   066   067
  005   041   021   043   015
040133                        1562  DC   'SIX',37,13,31,37
  323   311   330   037   013
  031   037
040142                        1564  DC   'SIXTEEN',37,13,31,37,52,74,74,15
  323   311   330   324   305
  305   316   037   013   031
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  037   052   074   074   015

040161                        1566   DC   'SIXTY',37,13,31,37,52,51
  323   311   330   324   331
  037   013   031   037   052
  051
040174                        1568   DC   'SIZE',37,25,11,74,22
  323   311   332   305   037
  025   011   074   022
040205                        1570   DC   'SKETCH',37,31,2,11,52,20
  323   313   305   324   303
  310   037   031   002   011
  052   020
040221                        1572   DC   'SLOW',37,30,43,65,67
  323   314   317   327   037
  030   043   065   067
040232                        1574   DC   'SO',37,65,65
  323   317   037   065   065

040237                        1576   DC   'SORRY',37,25,43,72,51,42
  323   317   322   322   331
  037   025   043   072   051
  042
040252                        1578   DC   'SORT',37,46,53,52
  323   317   322   324   037
  046   053   052
040262                        1580   DC   'SOUND',37,25,43,67,15,36
  323   317   325   316   304
  037   025   043   067   015
  036
040275                        1582   DC   'SOUTH',37,25,64,67,71
  323   317   325   324   310
  037   025   064   067   071

040307                        1584   DC   'SPEAKER',37,45,54,31,72
  323   320   305   301   313
  305   322   037   045   054
  031   072
040323                        1586   DC   'SPECIFIC',37,1,37,13,35,11,31
  323   320   305   303   311
  306   311   303   037   001
  037   013   035   011   031

040342                        1588   DC   'SPEED',37,45,74,74,36
  323   320   305   305   304
  037   045   074   074   036

040354                        1590   DC   'SPEND',37,45,2,11,15,36
  323   320   305   316   304
  037   045   002   011   015
  036
040367                        1592   DC   'SPRING',37,45,53,13,24
  323   320   322   311   316
  307   037   045   053   013
  024
041002                        1594   DC   'SQUARE',37,31,55,0,11,53
  323   321   325   301   322
  305   037   031   055   000
  011   053
041016                        1596   DC   'STAMP',37,52,57,0,14,45
  323   324   301   315   320

  037   052   057   000   014
  045
041031                        1598   DC   'STANDARD',37,52,57,0,15,36,72,36
  323   324   301   316   304
  301   322   304   037   052
  057   000   015   036   072
  036
041051                        1600   DC   'START',37,52,25,43,53,52
  323   324   301   322   324
  037   052   025   043   053
  052
041064                        1602   DC   'STATE',37,52,6,41,42
  323   324   301   324   305
  037   052   006   041   042

041076                        1604   DC   'STATES',37,52,6,41,42,37
  323   324   301   324   305
  323   037   052   006   041
  042   037
041112                        1606   DC   'STATEMENT',37,52,6,41,52,14,0,15,52
  323   324   301   324   305
  315   305   316   324   037
  052   006   041   052   014
  000   015   052
041134                        1608   DC   'STATISTICS',37,52,1,52,13,37,52,11,31,37
  323   324   301   324   311
  323   324   311   303   323
  037   052   001   052   013
  037   052   011   031   037

041160                        1610   DC   'STOCK',37,52,25,60,31
  323   324   317   303   313
  037   052   025   060   031

041172                        1612   DC   'STOP',37,52,44,43,45
  323   324   317   320   037
  052   044   043   045
041203                        1614   DC   'STORE',37,52,46,53
  323   324   317   322   305
  037   052   046   053
041214                        1616   DC   'SUBJECT',37,62,16,36,32,2,31,52
  323   325   302   312   305
  303   324   037   062   016
  036   032   002   031   052

041233                        1618   DC   'SUBJECTIVE',37,61,16,36,32,2,31,52,11,17
  323   325   302   312   305
  323   324   311   326   305
  037   061   016   036   032
  002   031   052   011   017

041257                        1620   DC   'SUBSTITUTE',37,62,16,37,52,0,52,66,67,52
  323   325   302   323   324
  311   324   325   324   305
  037   062   016   037   052
  000   052   066   067   052

041303                        1622   DC   'SUCCESS',37,61,31,37,2,37
  323   325   303   303   305
  323   323   037   061   031
  037   002   037
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041320                          1624    DC  'SUCH',37,63,52,20
  323   325   303   310   037
  063   052   020
041330                          1626    DC  'SUFFICIENT',37,61,35,13,21,0,15,52
  323   325   306   306   311
  303   311   305   316   324
  037   061   035   013   021
  000   015   052
041352                          1628    DC  'SUGGEST',37,61,34,36,32,73,37,52
  323   325   307   307   305
  323   324   037   061   034
  036   032   073   037   052

041371                          1630    DC  'SUNDAY',37,62,15,15,36,5,41
  323   325   316   304   301
  331   037   062   015   015
  036   005   041
042006                          1632    DC  'SUPPLY',37,61,45,30,25,74
  323   325   320   320   314
  331   037   061   045   030
  025   074
042022                          1634    DC  'SUPPORT',37,61,45,53,52
  323   325   320   320   317
  322   324   037   061   045
  053   052
042036                          1636    DC  'SURPLUS',37,72,45,30,61,37
  323   325   322   320   314
  325   323   037   072   045
  030   061   037
042053                          1638    DC  'SYNTHESIZER',37,47,15,70,2,37,25
  323   331   316   324   310
  305   323   311   332   305
  322   037   047   015   070
  002   037   025
042075                          1640    DC  11,74,22,72
  011   074   022   072
042101                          1642    DC  'TALKING',52,23,31,13,24
  324   301   314   313   311
  316   307   052   023   031
  013   024
042115                          1644    DC  'TANGO',52,57,41,24,34,61,64
  324   301   316   307   317
  052   057   041   024   034
  061   064
042131                          1646    DC  'TAUGHT',52,75,52
  324   301   325   307   310
  324   052   075   052
042142                          1648    DC  'TEACHER',52,74,52,20,72
  324   305   301   303   310
  305   322   052   074   052
  020   072
042156                          1650    DC  'TECHNICAL',52,2,31,15,11,31,43,30
  324   305   303   310   316
  311   303   301   314   052
  002   031   015   011   031
  043   030
042177                          1652    DC  'TECHNIQUE',52,2,31,15,54,31
  324   305   303   310   316
  311   321   325   305   052
  002   031   015   054   031
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042216                          1654    DC  'TELEPHONE',52,2,30,43,35,65,67,15
  324   305   314   305   320
  310   317   316   305   052
  002   030   043   035   065
  067   015
042237                          1656    DC  'TELEVISION',52,2,30,43,17,12,7,43,15
  324   305   314   305   326
  311   323   311   317   316
  052   002   030   043   017
  012   007   043   015
042262                          1658    DC  'TEN',52,0,2,15
  324   305   316   052   000
  002   015
042271                          1660    DC  'TERMINATE',52,72,14,13,15,5,42,52
  324   305   322   315   311
  316   301   324   305   052
  072   014   013   015   005
  042   052
042312                          1662    DC  'TEST',52,73,37,52
  324   305   323   324   052
  073   037   052
042322                          1664    DC  'THAT',70,57,0,52
  324   310   301   324   070
  057   000   052
042332                          1666    DC  'THE',70,43,43,43
  324   310   305   070   043
  043   043
042341                          1668    DC  'THEM',70,2,0,14
  324   310   305   315   070
  002   000   014
042351                          1670    DC  'THEN',70,2,0,15
  324   310   305   316   070
  002   000   015
042361                          1672    DC  'THERE',70,1,5,53
  324   310   305   322   305
  070   001   005   053
042372                          1674    DC  'THESE',70,74,74,22
  324   310   305   323   305
  070   074   074   022
043003                          1676    DC  'THIRD',71,72,53,36
  324   310   311   322   304
  071   072   053   036
043014                          1678    DC  'THIRTEEN',71,53,72,52,3,74,74,15
  324   310   311   322   324
  325   305   316   071   053
  072   052   003   074   074
  015
043034                          1680    DC  'THIS',70,47,37
  324   310   311   323   070
  047   037
043043                          1682    DC  'THREE',71,53,74,51
  324   310   322   305   305
  071   053   074   051
043054                          1684    DC  'THURSDAY',71,71,72,53,22,36,6,41
  324   310   325   322   323
  304   301   331   071   071
  072   053   022   036   006
  041
043074                          1686    DC  'TIME',52,25,2,14
  324   311   315   305   052
  025   022   014
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043104                      1688    DC    'TO',52,66,50
  324  317  052  066  050
043111                      1690    DC    'TODAY',52,50,36,6,41,41
  324  317  304  301  331
  052  050  036  006  041
  041
043124                      1692    DC    'TOPIC',52,25,45,11,31
  324  317  320  311  303
  052  025  045  011  031
043136                      1694    DC    'TOUCH',52,63,52,20
  324  317  325  303  310
  052  063  052  020
043147                      1696    DC    'TRAFFIC',52,53,57,0,35,11,31
  324  322  301  306  306
  311  303  052  053  057
  000  035  011  031
043165                      1698    DC    'TRANSACTION',52,53,57,15,22,57,0,31
  324  322  301  316  323
  301  303  324  311  317
  316  052  053  057  015
  022  057  000  031
043210                      1700    DC    21,43,15
  021  043  015
043213                      1702    DC    'TRANSFER',52,53,57,11,15,37,35,72
  324  322  301  316  323
  306  305  322  052  053
  057  011  015  037  035
  072
043233                      1704    DC    'TUESDAY',52,66,67,67,22,36,6,41
  324  325  305  323  304
  301  331  052  066  067
  067  022  036  006  041
043252                      1706    DC    'TUNE',52,66,50,15
  324  325  316  305  052
  066  050  015
043262                      1708    DC    'TURN',52,53,53,15
  324  325  322  316  052
  053  053  015
043272                      1710    DC    'TWO',52,66,66,67,67
  324  327  317  052  066
  066  067  067
043302                      1712    DC    'TYPE',52,61,10,74,45
  324  331  320  305  052
  061  010  074  045
043313                      1714    DC    'UNCONSCIOUS',61,15,31,25,15,21,43,37
  325  316  303  317  316
  323  303  311  317  325
  323  061  015  031  025
  015  021  043  037
043336                      1716    DC    'UNDERSTAND',61,15,36,53,37,52,57,0,15,36
  325  316  304  305  322
  323  324  301  316  304
  061  015  036  053  037
  052  057  000  015  035
043362                      1718    DC    'UNDERSTOOD',61,15,36,53,37,52,66,66,36
  325  316  304  305  322
  323  324  317  317  304
  061  015  036  053  037
  052  066  066  036
044005                      1720    DC    'UNIFORM',51,66,67,15,43,35,65,53,14
  325  316  311  306  317
  322  315  051  066  067
  015  043  035  065  053
  014
044025                      1722    DC    'UNITE',42,66,67,15,25,42,52
  325  316  311  324  305
  042  066  067  015  025
  042  052
044041                      1724    DC    'UNKNOWN',61,15,15,43,65,67,15
  325  316  313  316  317
  327  316  061  015  015
  043  065  067  015
044057                      1726    DC    'UNLIMITED',61,15,30,12,14,11,52,11,36
  325  316  314  311  315
  311  324  305  304  061
  015  030  012  014  011
  052  011  036
044101                      1728    DC    'UNTIL',61,15,52,13,43,30
  325  316  324  311  314
  061  015  052  013  043
  030
044114                      1730    DC    'UNUSUAL',61,15,42,66,67,7,66,67,43,30
  325  316  325  323  325
  301  314  061  015  042
  066  067  007  066  067
  043  030
044135                      1732    DC    'UP',43,43,45
  325  320  043  043  045
044142                      1734    DC    'UPON',62,45,25,43,15
  325  320  317  316  062
  045  025  043  015
044153                      1736    DC    'URGENT',53,53,36,32,1,15,52
  325  322  307  305  316
  324  053  053  036  032
  001  015  052
044170                      1738    DC    'USE',42,66,50,37
  325  323  305  042  066
  050  037
044177                      1740    DC    'VACANCY',17,6,41,31,0,15,37,51
  326  301  303  301  316
  303  331  017  006  041
  031  000  015  037  051
044216                      1742    DC    'VALID',17,57,43,30,43,36
  326  301  314  311  304
  017  057  043  030  043
  036
044231                      1744    DC    'VERIFY',17,2,53,0,35,25,74
  326  305  322  311  306
  331  017  002  053  000
  035  025  074
044246                      1746    DC    'VERY',17,73,53,51
  326  305  322  331  017
  073  053  051
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  326  311  303  324  317
  322  017  012  033  031
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  003   052   046   053
044274                      1750        DC    'VOICE',17,65,43,74,37
  326   317   311   303   305
  017   065   043   074   037

044306                      1752        DC    'VOLTS',17,65,30,52,37
  326   317   314   324   323
  017   065   030   052   037

044320                      1754        DC    'VOLUME',17,25,30,42,67,14
  326   317   314   325   315
  305   017   025   030   042
  067   014
044334                      1756        DC    'VOTRAX',17,46,52,53,56,31,3,37
  326   317   324   322   301
  330   017   046   052   053
  056   031   003   037
044352                      1758        DC    'WALK',55,75,31
  327   301   314   313   055
  075   031
044361                      1760        DC    'WANT',55,25,43,15,52
  327   301   316   324   055
  025   043   015   052
044372                      1762        DC    'WAREHOUSE',55,2,53,33,43,10,67,37
  327   301   322   305   310
  317   325   323   305   055
  002   053   033   043   010
  067   037
045013                      1764        DC    'WATCH',55,60,25,52,20
  327   301   324   303   310
  055   060   025   052   020

045025                      1766        DC    'WATTS',55,25,52,37
  327   301   324   324   323
  055   025   052   037
045036                      1768        DC    'WEDNESDAY',55,2,15,22,36,6,41
  327   305   304   316   305
  323   304   301   331   055
  002   015   022   036   006
  041
045056                      1770        DC    'WEIGH',55,0,5,41,42,52
  327   305   311   307   310
  055   000   005   041   042
  052
045071                      1772        DC    'WELCOME',55,2,30,31,62,14
  327   305   314   303   317
  315   305   055   002   030
  031   062   014
045106                      1774        DC    'WELL',55,2,43,30
  327   305   314   314   055
  002   043   030
045116                      1776        DC    'WENT',55,2,15,52
  327   305   316   324   055
  002   015   052
045126                      1778        DC    'WERE',55,72,53
  327   305   322   305   055
  072   053
045135                      1780        DC    'WEST',55,2,37,52
  327   305   323   324   055
  002   037   052
045145                      1782        DC    'WHAT',55,62,52
  327   310   301   324   055
  062   052
045154                      1784        DC    'WHEN',55,2,15
  327   310   305   316   055
  002   015
045163                      1786        DC    'WHERE',55,1.5,53
  327   310   305   322   305
  055   001   005   053
045174                      1788        DC    'WHICH',55,13,52,20
  327   310   311   303   310
  055   013   052   020
045205                      1790        DC    'WHISKEY',33,55,13,33,37,31,51
  327   310   311   323   313
  305   331   033   055   013
  033   037   031   051
045223                      1792        DC    'WHITE',55,43,10,74,52
  327   310   311   324   305
  055   043   010   074   052

045235                      1794        DC    'WHY',55,43,25,74
  327   310   331   055   043
  025   074
045244                      1796        DC    'WILL',55,12,43,30
  327   311   314   314   055
  012   043   030
045254                      1798        DC    'WIND',55,25,74,15,36
  327   311   316   304   055
  025   074   015   036
045265                      1800        DC    'WITH',55,12,71
  327   311   324   310   055
  012   071
045274                      1802        DC    'WITHIN',55,12,71,12,11,15
  327   311   324   310   311
  316   055   012   071   012
  011   015
045310                      1804        DC    'WITHOUT',55,12,71,43,10,67,52
  327   311   324   310   317
  325   324   055   012   071
  043   010   067   052
045326                      1806        DC    'WON',55,43,61,61,15
  327   317   316   055   043
  061   061   015
045336                      1808        DC    'WORK',55,72,53,31
  327   317   322   313   055
  072   053   031
045346                      1810        DC    'WOULD',55,67,66,66,36
  327   317   325   314   304
  055   067   066   066   036

045360                      1812        DC    'WOUND',55,43,25,67,15,36
  327   317   325   316   304
  055   043   025   067   015
  036
045373                      1814        DC    'WRAP',53,57,0,45
  327   322   301   320   051
  057   000   045
045403                      1816        DC    'WRITE',53,12,43,74,52
  327   322   311   324   305
  053   012   043   074   052

046015                      1818        DC    'GRAY',0,31,37,53,41,41
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  330   322   301   331   000
  031   037   053   041   041

046027                      1820          DC    'YALL',51,75,43,30
  331   301   314   314   051
  075   043   030
046037                      1822          DC    'YES',51,2,0,37
  331   305   323   051   002
  000   037
046046                      1824          DC    'YESTERDAY',51,2,37,52,53,36,6,41
  331   305   323   324   305
  322   304   301   331   051
  002   037   052   053   036
  006   041
046067                      1826          DC    'YOU',51,66,50
  331   317   325   051   066
  050
046075                      1828          DC    'ZERO',22,41,11,53,43,64,67
  332   305   322   317   022
  041   011   053   043   064
  067
046110                      1830          DC    'ZONE',22,43,65,67,15
  332   317   316   305   022
  043   065   067   015
046121                      1832 ZZZZZ    DC    377
  377

NO ERRORS FOUND

FILE  060000  233055
READY
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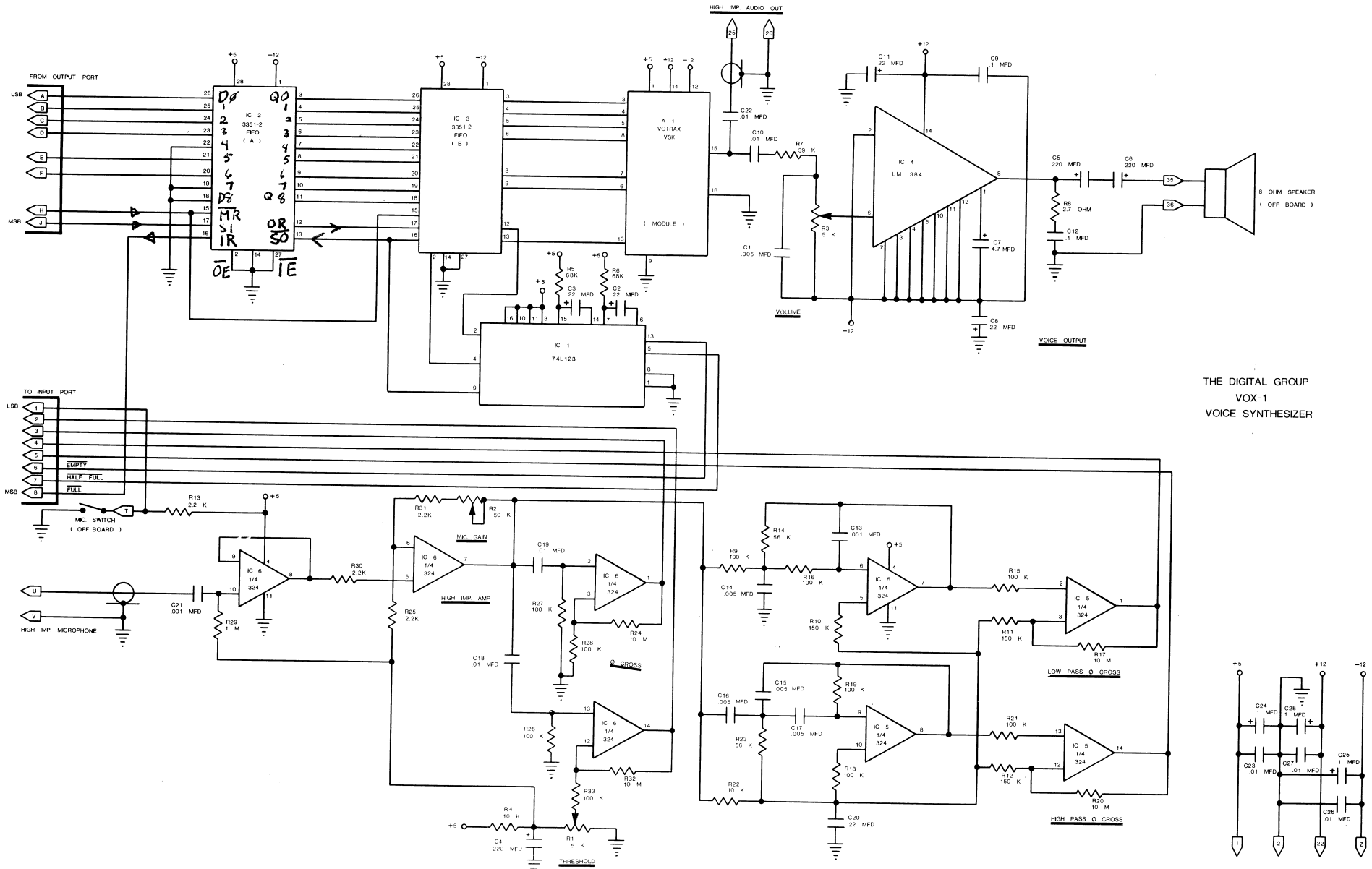
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MSB
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3351-2
FIFO
(A)
IC 3
3351-2
FIFO
(B)
A 1
VOTRAX
VSK
(MODULE)
HIGH IMP. AUDIO OUT
IC 4
LM 384
8 OHM SPEAKER
(OFF BOARD)
VOLUME
VOICE OUTPUT
IC 1
74L123
TO INPUT PORT
EMPTY
HALF FULL
FULL
MIC. SWITCH
(OFF BOARD)
HIGH IMP. MICROPHONE
MIC. GAIN
HIGH IMP. AMP
Ø CROSS
LOW PASS Ø CROSS
HIGH PASS Ø CROSS
THRESHOLD
THE DIGITAL GROUP
VOX-1
VOICE SYNTHESIZER

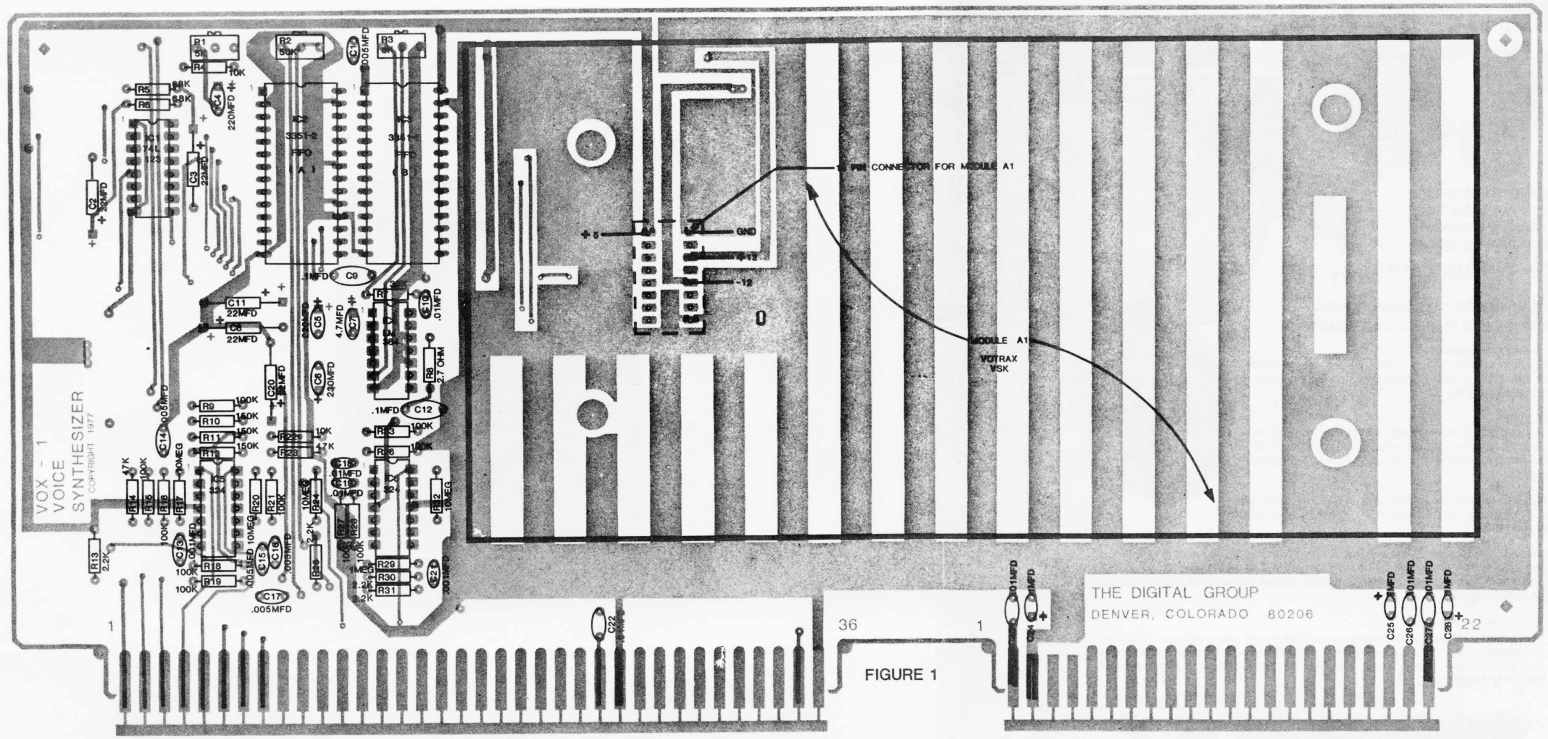

FIGURE 1

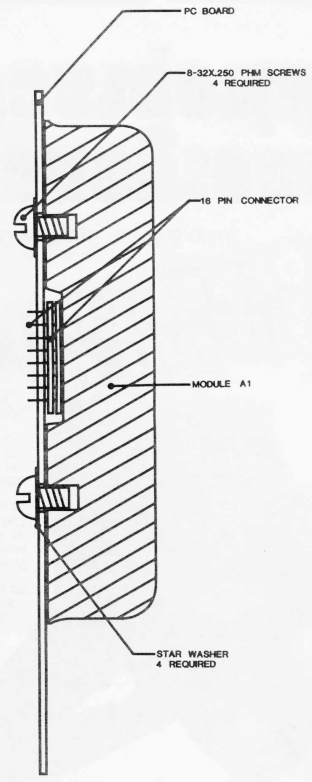

FIGURE 2
(CROSS SECTION)