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The Votrax(TM) Voice Synthesizer introduces a subtechnology into the field of man-machine communications. It can best be described as an electronic analog of the human vocal system. Its audio output can be transmitted over standard speaker systems or common carrier telephone lines with remarkably intelligible quality.

Several versions of the Voice Synthesizer are available for use either as a computer peripheral or a stand alone unit. As a peripheral, the device can bridge the man-machine gap by providing direct audio interaction with a computer system. Hence the touch-tone telephone now becomes a responsive computer terminal, or, as a stand alone unit, with a self-contained memory of variable size (50 to 2000 word vocabulary), the Votrax(TM) Voice Synthesizer can readily be integrated into any system where audio response is desired.

The compact design of this solid state device, and its minimal power requirements, make it well suited for aircraft and surface vehicles. Potential applications for the Voice Synthesizer cover the full spectrum of Business, Industry and Government.

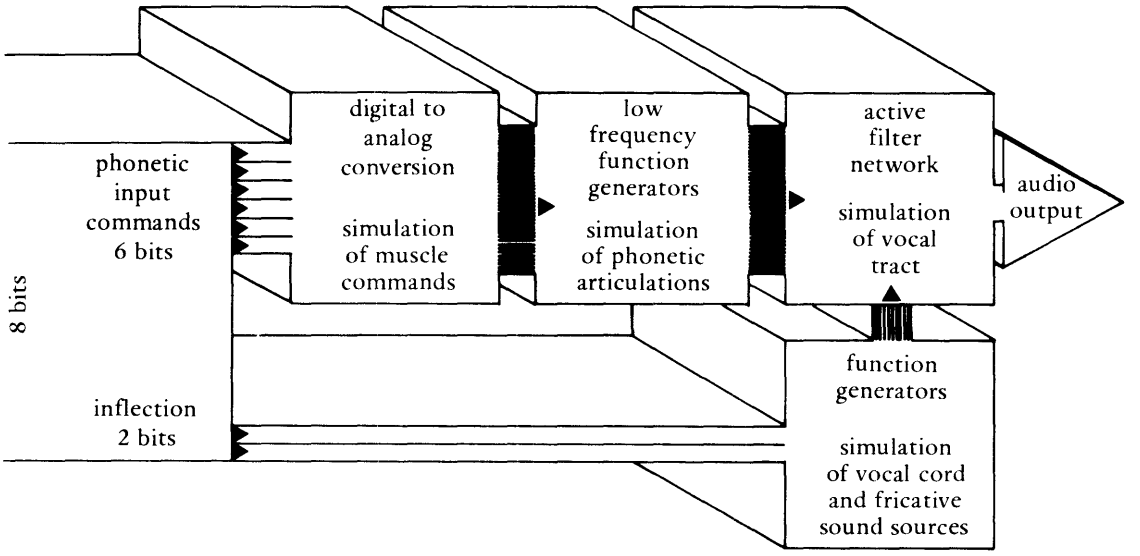
The Votrax(TM) Voice Synthesizer is a small, inexpensive system capable of synthesizing human speech with an *unlimited* vocabulary. The unit consists of three circuit cards. It accepts sequences of digital phoneme commands (a phoneme is a basic unit of speech) and converts these commands into corresponding phonetic audio signals. All spoken words consist of these basic building block units called phonemes. The human brain and articulatory system are capable of uttering phonemes in nearly any desired sequence. The Votrax(TM) Voice Synthesizer is an electronic simulation of the human brain-vocal system. Thus, any word in the language may be synthesized by a corresponding appropriate sequence of phoneme commands.

Each phoneme command consists of a parallel 8-bit binary word. Typically, there are roughly as many phonemes in a word as there are letters. For example, the word *hello* written phonetically becomes heluo. There are five phonemes in this word, each phoneme command requiring 8 binary bits. Thus, the word "hello" requires 40 command bits of input information to the synthesizer. Six of the eight bits, in each individual phoneme command determine which one of some 60 phonemes is uttered; the other two bits determine the inflection of the synthesized voice for each phoneme. The average word contains six phonemes, requiring six times eight or 48 digital bits. Thus, a 75 word vocabulary will require the storage of 48 x 75 or 3600 bits.

A 128 word vacabulary would require 6144 bits. It is economical to store such small vocabularies in read-only-memory for many applications. Thus, the addition of one more circuit card to its system, containing read-only-memory integrated circuits, will give the Votrax(TM) synthesizer a built-in vocabulary of up to 2000 words.

The Votrax(TM) Voice Synthesizer utilizes analog circuitry to simulate electronically the human vocal system. A short series of appropriate 8 bit digital commands based on the phonetic alphabet will call forth any word in the English language. A series of active filters synthesizes the resonance in the vocal and nasal tracts. Special forcing function generators provide the filter excitation, synthesizing the vocal cords and fricative sound sources. The articulations or dynamics of the vocal tract parameters when transitioning from one phonetic sound to another are generated by specially designed low frequency function generators. All parameters for proper pronunciation and articulation of each phoneme are specified by a read-only-memory matrix.

The flexibility of the Votrax(TM) Voice Synthesizer allows it to operate with its own self-contained vocabulary, or with a vocabulary stored in an external memory, retrieved and transmitted by a computer or other instrumentation. The cost of the unit, with or without built-in vocabulary, will be in an area to justify large volume uses in the field of man-machine communications.



PHYSICAL CHARACTERISTICS

	Outside Dimensions	Net Weight	Shipping Weight
Basic Synthesizer			
Stand-Alone	11 7/8"w x 11 1/4"d x 3 1/8"h	11 lb.	14 lb.
19" Rack Mount	19"w x 10 1/4"d x 3 1/2"h	11 lb.	14 lb.
Portable Case	18"w x 22 1/2"d x 6"h	11 lb.	14 lb.
Keyboard (Free-Standing)	15 3/4"w x 8.0"d x 3 1/2"h	6 lb.	9 lb.
Speaker (Free-Standing)	15 1/8"w x 6 3/4"d x 8 1/8"h	10 lb.	11 lb.

ELECTRICAL CHARACTERISTICS

Input Power Requirements 115 VAC ± 10%, 47-420 Hz, 0.25 AMPS.

Input Power Fuse: 3 AG-1/2 AMP, 125 Volts.

Audio Output 100 - 5,000 Hz, .825 Watts (Continuous), 6 Volts (Peak)

FEATURES

Temperature Range 0^{o} - 70^{o} C

Solid State Circuitry, Basic Printed Circuit Card System

64 Phoneme Alphabet, with Inflection

8 Bit Phonetic Command

Unlimited Vocabulary

Variable Word Length (Standard Buffer Length, 80 Phonemes)

Unpackage synthesizer and inspect for possible damage in shipment. If there are signs of damage, notify carrier before using synthesizer. If no damage is detected, remove Avi-Pak printed circuit board retaining straps.

With the power cord provided, connect the synthesizer to an appropriate power source (see specifications).

Wire the speaker to the audio output jack on the rear of the synthesizer using the phone plug provided.

Systems with a keyboard interface can be checked-out by plugging the keyboard into the 25 pin "keyboard" connector on the rear of the synthesizer and following the operating instructions in Bulletin ETB-5-0330-ME or ETB-5-0628-ME.

Systems with a TTL parallel interface are connected to the computer interface using the same 25 pin "keyboard" connector. Refer to Bulletins ETB-5-0405-ME, ETB-5-0302-MD, and ETB-5-0419-ME for details.

Systems with an RS-232C (serial) interface are connected to the Bell 403E6 Modem by means of the data set cable included with the system. Plug one end into the 25 pin connector of the Modem and the other into the 25 pin male connector on the back panel of the synthesizer marked "Data Phone". Connect the serial interface of the business machine to the 25 pin female connector (labeled "Business Machine") also on the back panel. Refer to Bulletins ETB-5-0410-MD and ETB-5-0409-ME for details.

Notify Vocal Interface Division, Federal Screw Works, 500 Stephenson Hwy., Troy, Michigan 48084 (Phone: 313-588-2050) of any defects.

SECTION I PACKAGING INSTRUCTIONS	BULLETIN # ETB 5.1-1024-LB

PACKAGING VS-5.1 STAND-ALONE & RACK MODELS FOR SHIPMENT

ORIGINAL SHIPPING CONTAINER

1. Place two packing straps behind P.C. boards and around front panel, as shown in Figure 1. Tighten hand tight.

2. Fold shipping container internal side panels and insert in shipping container. NOTE: Internal side inserts are reversible to accomodate either rack mount or stand-alone units.

3. Install bottom insert.

4. Fill sides with packing material.

5. Place a layer of plastic packing material in bottom of shipping container. Fill cavity of bottom insert.

6. Insert synthesizer (stand-alone unit is packed with controls down).

7. Place top insert over synthesizer.

8. Fill to top of carton with plastic packing material.

9. Seal top with shipping tape. Banding across the flaps is recommended.

CUSTOMER'S PACKAGE

1. Select a carton that afford 3 inches or more of space around synthesizer. See Figure 1.

2. Place two packing straps behind P.C. Boards and around front panel, as shown in Figure 1. Tighten hand tight.

3. Place a 3 inch layer of packing material in the bottom of the container.

4. Place synthesizer in container and fill with plastic packing material.

5. Seal carton with shipping tape. Banding across the flaps is recommended.

KEYBOARDS

1. A cardboard retainer should be taped in place over the key caps to prevent dislodging during shipment.

2. Place keyboard in container with sufficient packing material on all sides as shown in Figure 1.

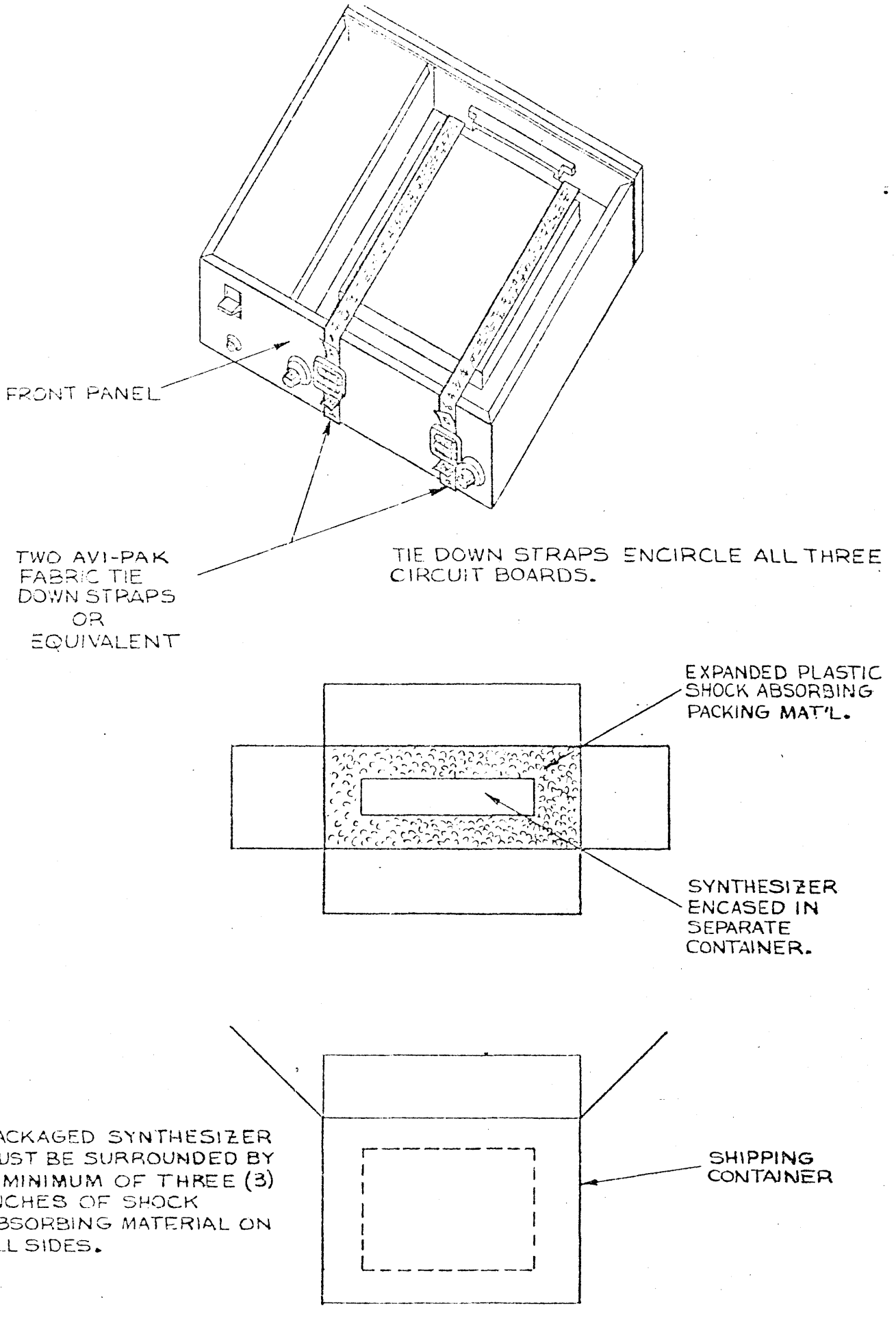
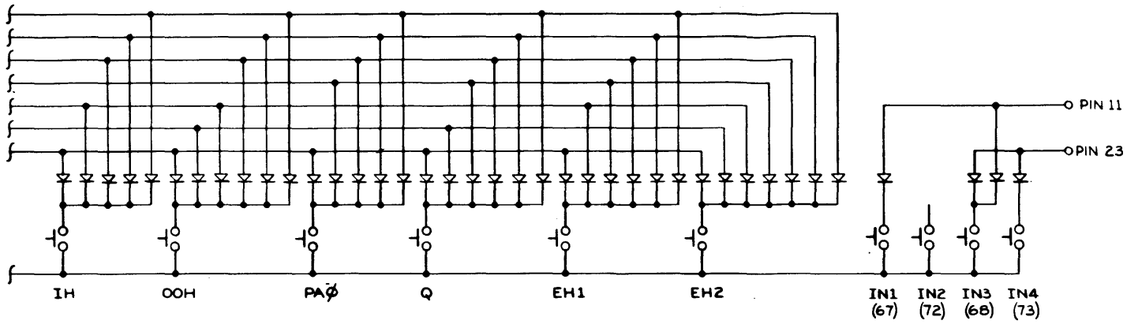
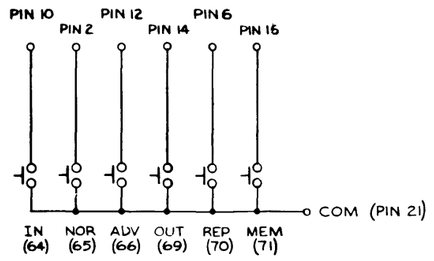
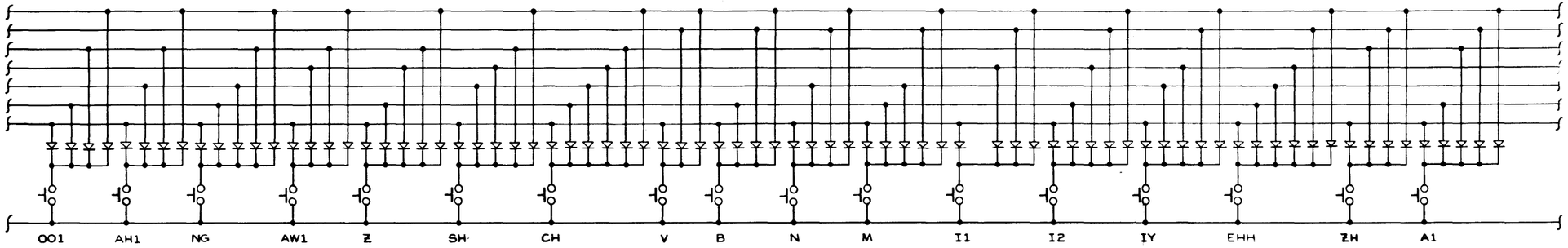
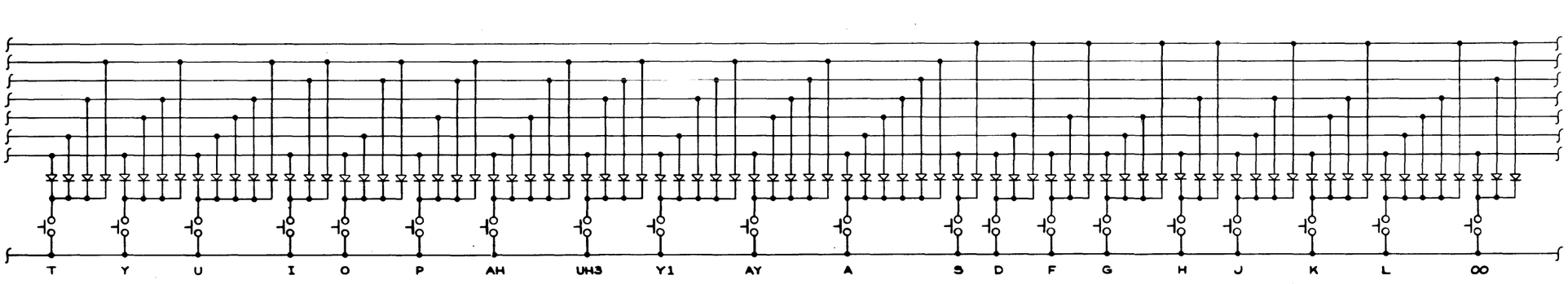

FRONT PANEL
TWO AVI-PAK FABRIC TIE DOWN STRAPS OR EQUIVALENT
TIE DOWN STRAPS ENCIRCLE ALL THREE CIRCUIT BOARDS.
EXPANDED PLASTIC SHOCK ABSORBING PACKING MAT'L.
SYNTHESIZER ENCASED IN SEPARATE CONTAINER.
PACKAGED SYNTHESIZER MUST BE SURROUNDED BY A MINIMUM OF THREE (3) INCHES OF SHOCK ABSORBING MATERIAL ON ALL SIDES.
SHIPPING CONTAINER

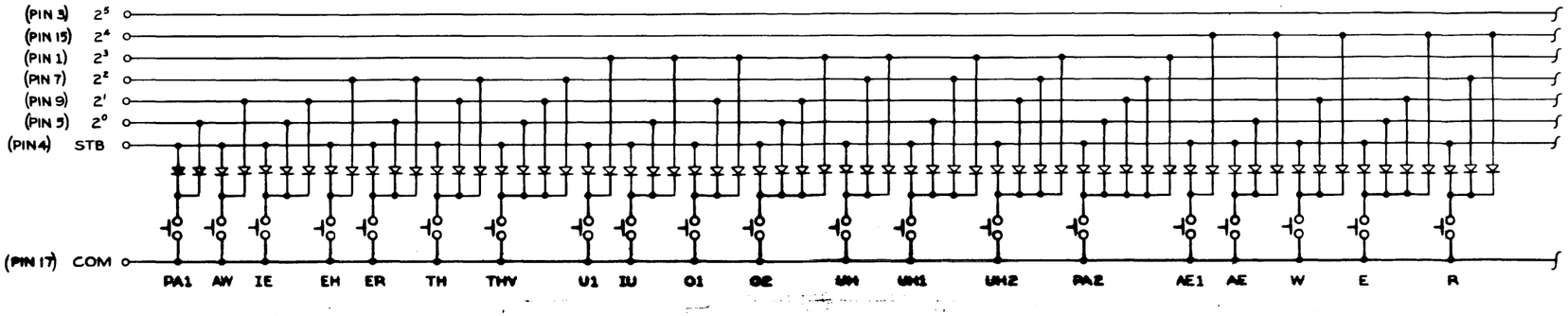
FIGURE 1











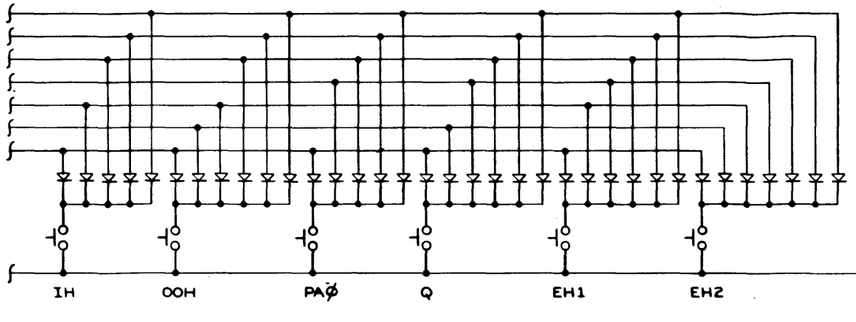
NO	REMARKS	DATE	DR	REL

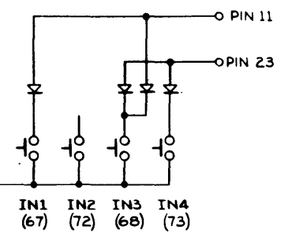
REVISIONS

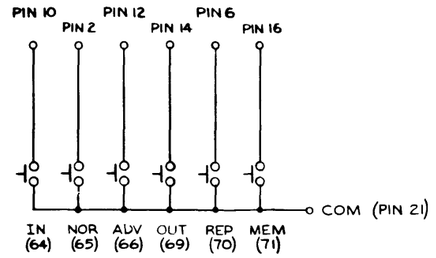
VOCAL INTERFACE DIVISION
FEDERAL SCREW WORKS

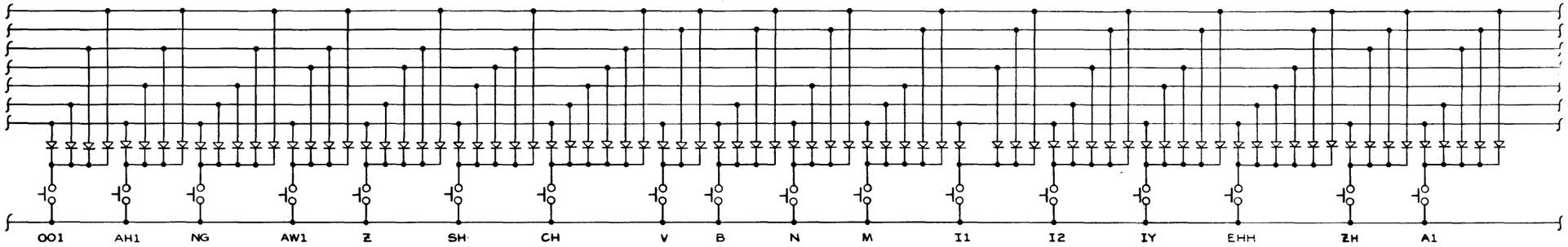
SYNTHESIZER KEYBOARD
— SCHEMATIC —

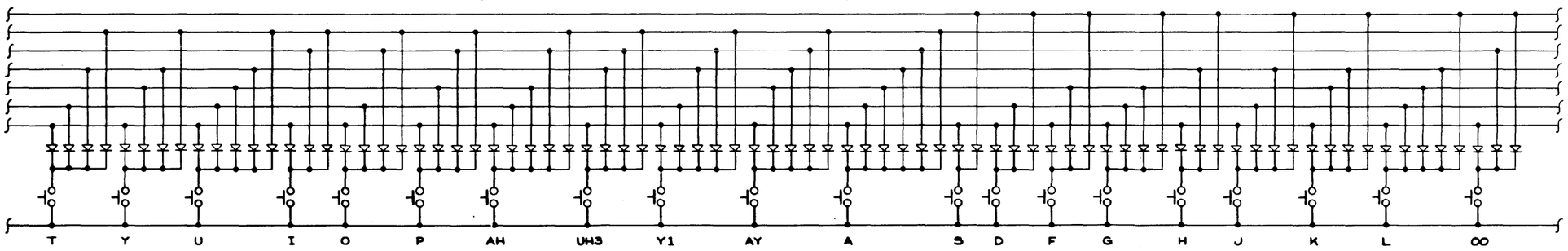
SCALE:	DATE	FINAL ASS'Y	VS 5.1
DR M. KLEIST	9/29/83	NEXT ASS'Y	905
CK	9/30/83		D501SC
REL	9/30/83		

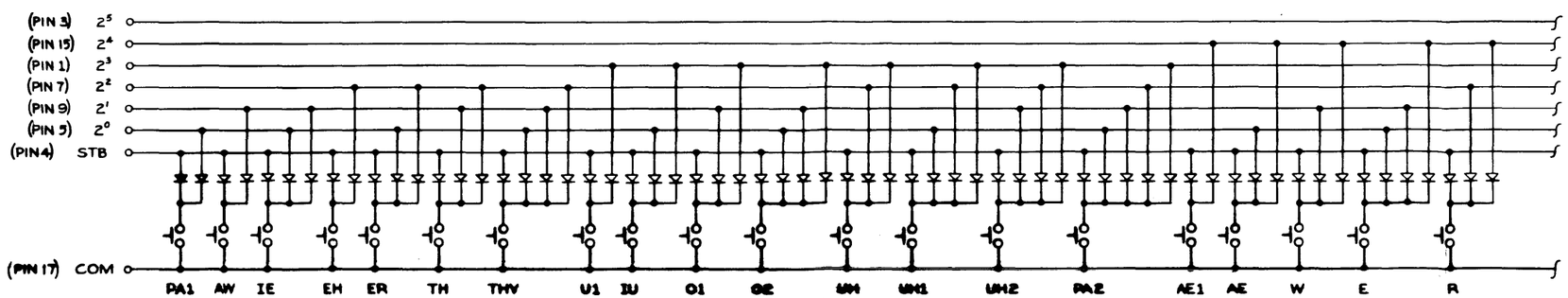












NO	REMARKS	DATE	DR	REL
	REVISIONS			

VOCAL INTERFACE DIVISION
FEDERAL SCREW WORKS

SYNTHESIZER KEYBOARD
— SCHEMATIC —

SCALE:	DATE	FINAL ASS'Y	VS 5.1
DR M. KLEIST	9/28/83	NEXT ASS'Y	905
CK	9/28/83		D501SC
REL	9/28/83		

VOCAL INTERFACE DIVISION
Federal Screw Works

Reference Parts List

STAND ALONE KEYBOARD ASSEMBLY, Part No. 905 — October 23, 1973

Part No.	Description
718	Cabinet Top, Keyboard
501	Keyboard Sub Assembly (Includes Keycaps, Reed Switches and Bus Wires)
717	Bushing, Strain Relief
701	Spacer
810	P.C. Board, Blank, Keyboard
300	Diode, IN4148
520	Cable Assembly (Includes Cable, Connector and Connector Hood)
719	Cabinet Bottom, Keyboard
709	Rubber Foot
---	Phillips Head Screw, 6-32 x 1/4 in.
---	Machine Screw, 6-32 x 3/8 in., Round Head

DESCRIPTION OF INPUT/OUTPUT CHARACTERISTICS
REF. MODELS #5-2219-301-01 and #5-2219-301-02

INTRODUCTION

The VOTRAX voice synthesizer with RS-232C interface option is designed for installation between the asynchronous serial data port of a computer and a modem such as the Bell 403E6. VOTRAX emulates the functions of the Bell 103 or 113 dataset to the computer.

When the VOTRAX unit is installed with option RS-232, it becomes a voice response input/output terminal. A remote user, using a telephone can interrogate a computerized data base and receive a verbal reply. In addition, the RS-232 option can also be used to implement asynchronous serial transmission of voice output for a local site. This configuration is activated by applying a permanent Data Set Ready signal to the data set connector. In this form, the VOTRAX voice response system could be used as a vocal output device at the computer site.

There are many advantages to voice response computer communications. The availability of a fast, inexpensive, and world-wide communications network is certainly foremost among these. There are presently 120 million telephones installed; each of these represents one of the simplest and cheapest computer terminals ever produced. The privacy of the system response is another asset. Only the person requiring information receives the information. The "humanizing" influence of the voice answer back is another attribute. In addition, there is the benefit of being able to dynamically update data files (through telephone key entry) and receive an immediate voice response of timely, accurate information that is critical to decision making.

INTERFACE SIGNALS

The VOTRAX asynchronous serial interface meets E.I.A. specifications RS-232C with respect to all electrical characteristics. The following circuits are implemented in the VOTRAX/computer interface:

AA	Protective Ground	CB	Clear to Send
AB	Signal Ground	CC	Data Set Ready
BA	Transmitted Data	CD	Data Terminal Ready
BB	Received Data	CE	Ring Indicator
CA	Request to Send	CF	Carrier Detect (same as CC)

The VOTRAX/dataset interface is designed to connect directly to a Bell 403E6 or equivalent modem.

See Bulletin ETB-5-0410-MD for signals implemented and connector pin assignments for the business machine, data set and keyboard connectors.

OPERATION

This commentary describes the data flow and control operations encountered in using the VOTRAX synthesizer in a telephone inquiry-voice response system. The same commentary, without reference to answering calls and inputting data, would apply to the unit when it is interfaced for local use (P. A. systems) of the voice output.

Figure 1 is an illustration of the components and signals encountered in this description.

When used to answer and respond to calls, the computer may either wait for signal CE (Ring Indicator) and then turn on signal CD (Data Terminal Ready), which tells the data set to answer the call and respond with signal CC (Data Set Ready); or the computer may turn on CD initally, in which case the data set will automatically answer the incoming call and turn on CC. The presence of both CC and CD enables the interface circuitry. This phase is commonly referred to as the ENABLE operation performed by the computer. The interface may now pass decoded touch-tone data to the computer and will pass these codes as long as the computer does not go into output mode when the break option is installed (refer to Table 1 for a complete list of these codes).

These codes are sent to the computer as asynchronous serial characters with parameters as assigned by the customer. These parameters are: length of the data character, parity of the data character, and rate (baud) of the serial transfer. These codes will be passed to the computer at all times except when the computer enters output mode, and the break option has been installed.

When the computer is ready to send output data to the VOTRAX voice synthesizer, it must turn on signal CA (Request to Send). When VOTRAX can accept data, signal CB (Clear to Send) is asserted. The computer may now send data to the VOTRAX synthesizer. The codes for the phonemes may be found in Bulletin ETB-5-0406-ME. While in the output mode (signal CA on) with the break option, the depression of a touch-tone key will cause a BREAK or ATTENTION signal to be sent to the computer. This signal will tell the computer to terminate its current output, and typically the computer will enter an input mode. The receipt of a touch-tone input during output will always clear any phonemes currently buffered, even if the BREAK option is not installed.

Since Request to Send must be raised before output and dropped after output, the computer port must have a half-duplex protocol to the VOTRAX synthesizer. The port itself may be full-duplex, as long as control over the Request to Send, Clear to Send, interlock is maintained. If the port is full-duplex, the BREAK feature is, in most cases, undesirable. On true half-duplex ports, the BREAK will be desired as long as the port has a BREAK recognition capability. If the BREAK option is not installed, the computer will receive the touch-tone codes even as it is outputting phonemes. This mode requires a full duplex asynchronous computer port to operate. If a full duplex port is not available, and the port does not have BREAK recognition, the effect of input while outputting will be dependent upon the port and computer characteristics. To avoid any undesirable action, the 403 can be made half-duplex avoiding the input while outputting problem. This will cause the output from the computer to be uninterruptable and, therefore, all output operations will proceed to completion before the computer will enter an input mode.

If the data characters sent from the computer contain less than eight bits of intelligence, they will be assembled two at a time to form VOTRAX phoneme codes. In this mode, the phoneme codes are broken up into two characters, in which the low four bits of the two characters are combined to create the eight bit phoneme code. The first character contains the low order four bits of the phoneme and the second character contains the high order four bits of the phoneme (including the inflection). Also, in this mode, the two high order bits next to the parity bit will be used as CONTROL/DATA bits. Using this option, control codes sent by the computer software or hardware will be ignored by the synthesizer, and only the users data will be accepted and stored into the synthesizer buffer (See Table 2 for a list of valid data codes). It is recommended that data be sent in blocks of 64 VOTRAX codes or less. If this is done and the user checks Clear to Send between transfers, the interface will prevent buffer overrun and subsequent loss of data.

Voice output will begin as soon as a null code (all ones) is encountered in the output data stream. It is recommended that a null character be transmitted at the end of every word. This allows output to be enabled on a word basis, and if the computer for any reason cannot keep up with speech rates, the vocal output will stop and wait for data only at the end of words. The system can produce continuous speech at 150 baud for eight bit non-parity codes, and 300 baud for codes with lesser numbers of intelligence bits.

If at any time signal CD is dropped, the 403 dataset will be put ON HOOK, thereby disconnecting the current user. This phase is commonly referred to as the DISABLE operation performed by computers. If the user hangs up, the computer is immediately notified by signal CC dropping.

ORDER INFORMATION

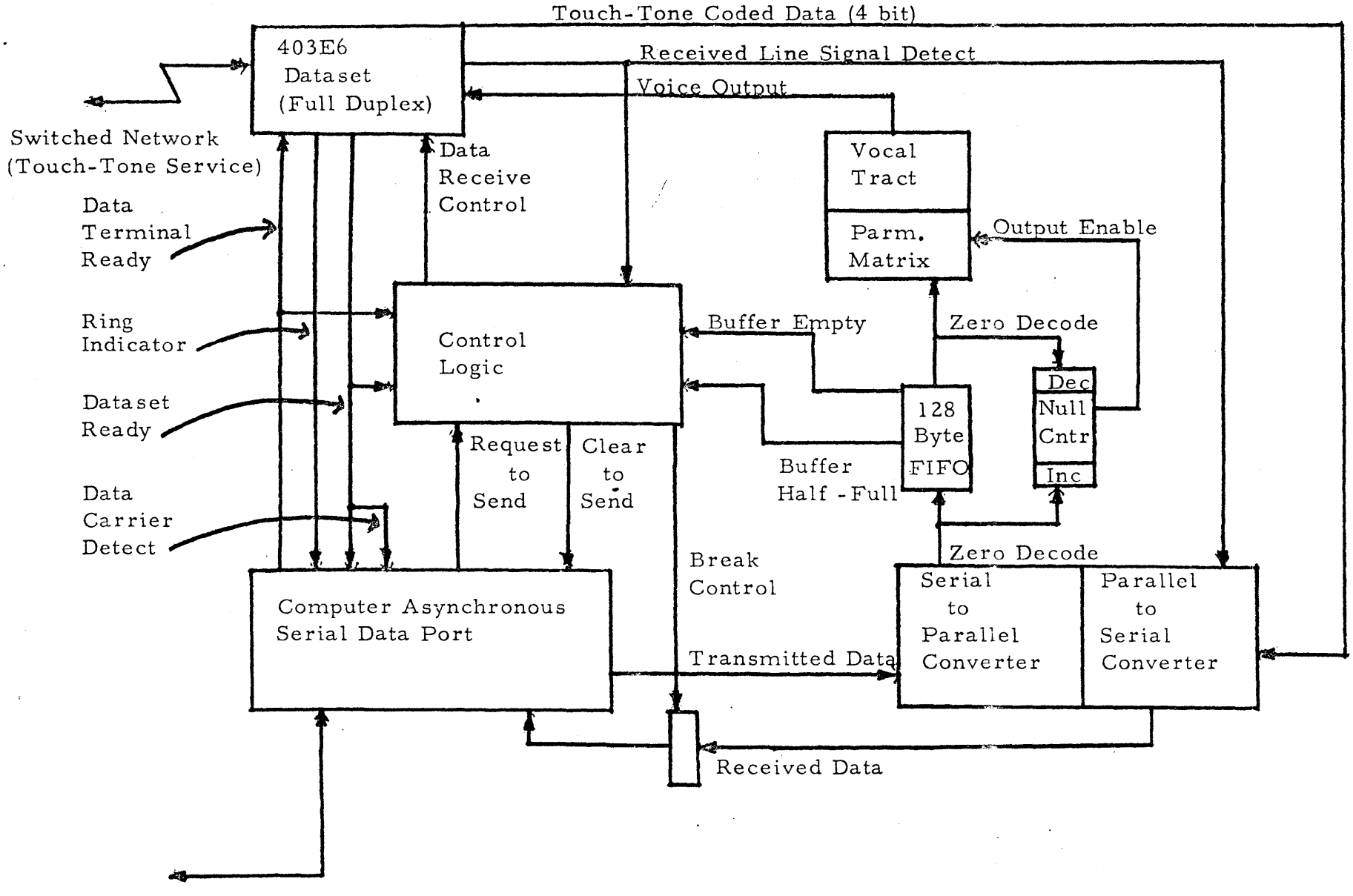
The VOTRAX voice synthesizer with RS-232C interface is designed to cover a wide range of user interfacing requirements. The user can specify data rates of 110, 150, 300, 600 or 1200 baud. The code level may be specified as 5, 6, 7 or 8 bits with 1 or 2 stop bits. A selectable parity option provides for odd, even or no parity at the user interface.

Break or normal operation upon receipt of input while outputting must be selected. Definition of these parameters is required at the time of order; in addition, please specify the computer system and interface being used.

BUTTON	CODE SENT TO COMPUTER	ASC II
1	0 1 0 0 1 0 1 0	'J'
2	0 1 0 0 1 0 0 1	'I'
3	0 1 0 0 1 0 1 1	'K'
4	0 1 0 0 0 1 1 0	'F'
5	0 1 0 0 0 1 0 1	'E'
6	0 1 0 0 0 1 1 1	'G'
7	0 1 0 0 1 1 1 0	'N'
8	0 1 0 0 1 1 0 1	'M'
9	0 1 0 0 1 1 1 1	'O'
0	0 1 0 0 0 0 0 1	'A'
*	0 1 0 0 0 0 1 0	'B'
#	0 1 0 0 0 0 1 1	'C'
Column 4 Row 1	0 1 0 0 1 0 0 0	'H'
Column 4 Row 2	0 1 0 0 0 1 0 0	'D'
Column 4 Row 3	0 1 0 0 1 1 0 0	'L'
Column 4 Row 4	0 1 0 0 0 0 0 0	'@'

THE FOUR HIGH ORDER BITS MAY BE ALTERED BY CHANGING JUMPERS ON THE CIRCUIT CARD. IN ADDITION, THE CHARACTER SIZE MAY BE CHANGED TO 5, 6 OR 7 DATA BITS, AND THE HIGH BIT MAY BE EVEN OR ODD PARITY. THE FOUR LOWER ORDER BITS ARE THE CODES GENERATED BY THE 403E6 DATA SET.

TABLE 1
TOUCH-TONE DECODE CHART



VOTRAX RS-232 Interface
Block Diagram

Figure 1

4/16/73

BINARY CODE	HEX	OCTAL	ASC II
X 1 0 X 0 0 0 0	40 or 50	100 or 120	@ or P
X 1 0 X 0 0 0 1	41 or 51	101 or 121	A or Q
X 1 0 X 0 0 1 0	42 or 52	102 or 122	B or R
X 1 0 X 0 0 1 1	43 or 53	103 or 123	C or S
X 1 0 X 0 1 0 0	44 or 54	104 or 124	D or T
X 1 0 X 0 1 0 1	45 or 55	105 or 125	E or U
X 1 0 X 0 1 1 0	46 or 56	106 or 126	F or V
X 1 0 X 0 1 1 1	47 or 57	107 or 127	G or W
X 1 0 X 1 0 0 0	48 or 58	110 or 130	H or X
X 1 0 X 1 0 0 1	49 or 59	111 or 131	I or Y
X 1 0 X 1 0 1 0	4A or 5A	112 or 132	J or Z
X 1 0 X 1 0 1 1	4B or 5B	113 or 133	K or [
X 1 0 X 1 1 0 0	4C or 5C	114 or 134	L or \
X 1 0 X 1 1 0 1	4D or 5D	115 or 135	M or]
X 1 0 X 1 1 1 0	4E or 5E	116 or 136	N or ^
X 1 0 X 1 1 1 1	4F or 5F	117 or 137	O or _

X = 0 or 1

THE ABOVE CODES ARE THE ONLY CODES ACCEPTED AS DATA BY VOTRAX WHEN OPERATING WITH LESS THAN EIGHT DATA BITS PER CHARACTER.

NOTE THAT ONLY THE LOW ORDER FOUR BITS ARE STORED BY VOTRAX, AND THAT TWO CONSECUTIVE CHARACTERS ARE ASSEMBLED TO CREATE A VOTRAX COMMAND. (See Bulletin #ETB-5-0406-ME for the codes to use to create the commands).

TABLE 2
VALID DATA CODES

REF.: MODELS #5-2219-301-01 and #5-2219-301-02

RS-232 Interface Pin Assignments

Business Equipment Connector

Pin #	Signal	Pin #	Signal
1 *	Protective Ground	6	Data Set Ready
2	Transmitted Data	7	Signal Ground
3	Received Data	8	Received Line Sig. Det.
4	Request to Send	20	Data Terminal Ready
5	Clear to Send	22 **	Ring Indicator

Data Set Connector ***

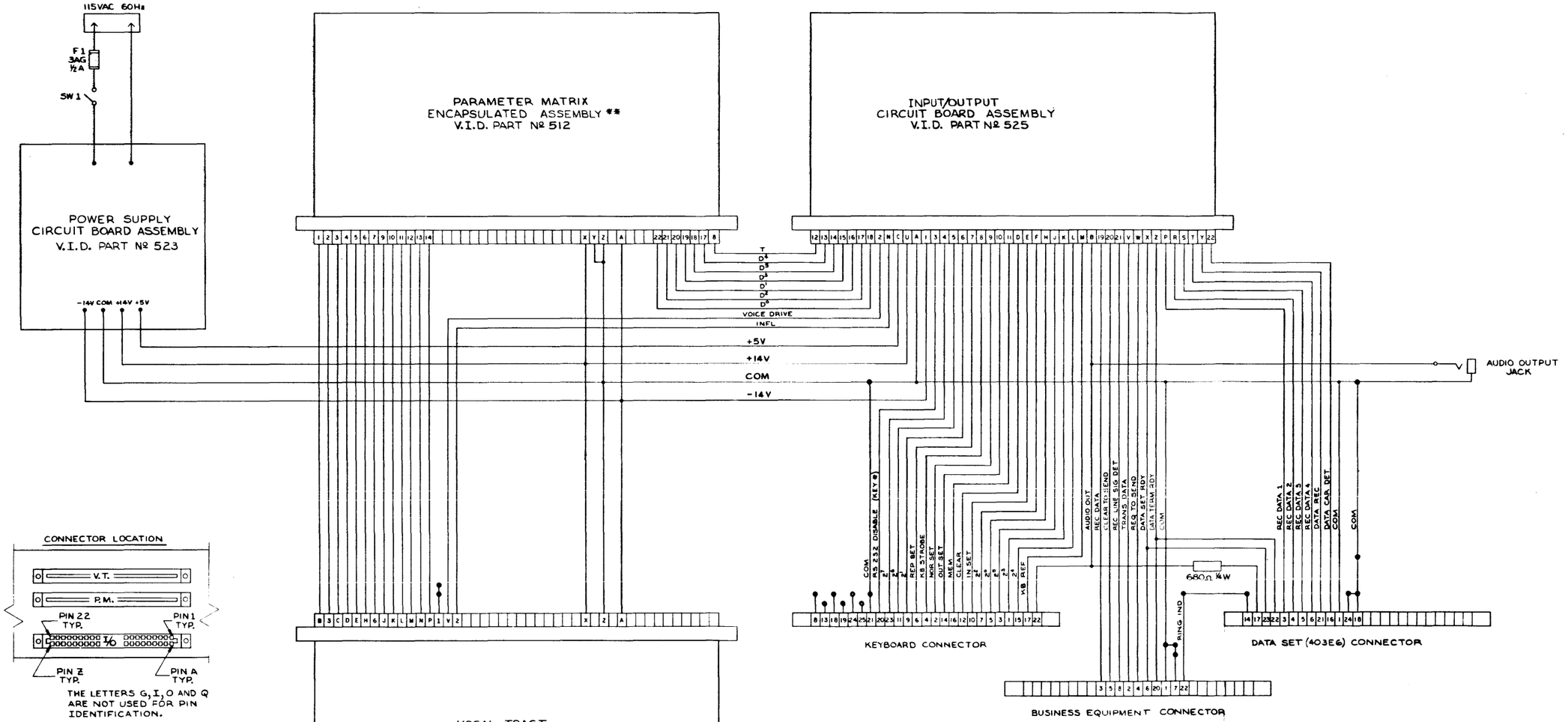
Pin #	Signal	Pin #	Signal
1*	Protective Ground	18	Audio Grnd. (Voice Ans'Bk)
3	Received Data 1	21	Data Receive
4	Received Data 2	22	Data Terminal Ready
5	Received Data 3	23	Data Set Ready
6	Received Data 4	24	Signal Ground
14 **	Ring Indicator		
16	Data Carrier Detect		
17 ****	Audio Out (Voice Ans'Bk)		

* Ground to VOTRAX Chassis
** Jumper from Data Set Connector to Business Equip. Conn.
*** Connects to Bell 403E6 or compatible
**** Audio Out is also available at Mini-phone Jack

Keyboard Connector (Applies only to Model 5-2219-301-02)

Pin #	Signal	Pin #	Signal
21	Ground	23	2^7 - Data In (Infl. MSB)
5	2^0 - Data In	10	Input Set
9	2^1 - Data In	14	Output Set
7	2^2 - Data In	2	Normal Set
1	2^3 - Data In	6	Repeat Set
15	2^4 - Data In	12	Advance (clear)
3	2^5 - Data In	16	Mem. (Alter Phoneme)
4	Keyboard Strobe	17	Keyboard Reference Volt.
11	2^6 - Data In (Infl. LSB)	20	RS-232 Disable
		22 ****	Audio Out

NOTE: Pin 20, RS-232 Disable, should be bussed to ground if this connector is used.
**** Audio out is also available at Mini-phone Jack



** PARAMETER MATRIX AND VOCAL TRACT ENCAPSULATED ASSEMBLIES ARE NOT USER SERVICEABLE. DIAGNOSIS AND REPAIR OF MALFUNCTIONS CAN BE EFFECTED BY DIRECT SUBSTITUTION OR REPLACEMENT OF RESPECTIVE ASSEMBLIES.

Nº	REMARKS	DATE OR REL

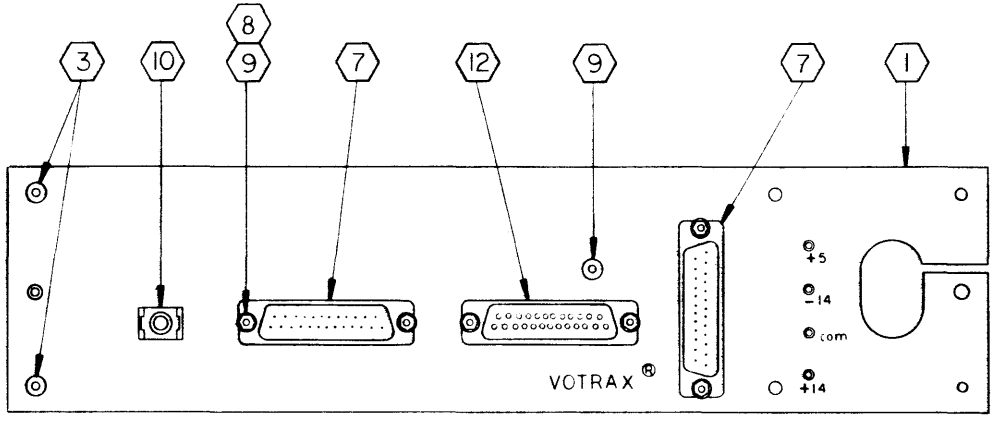
REVISIONS

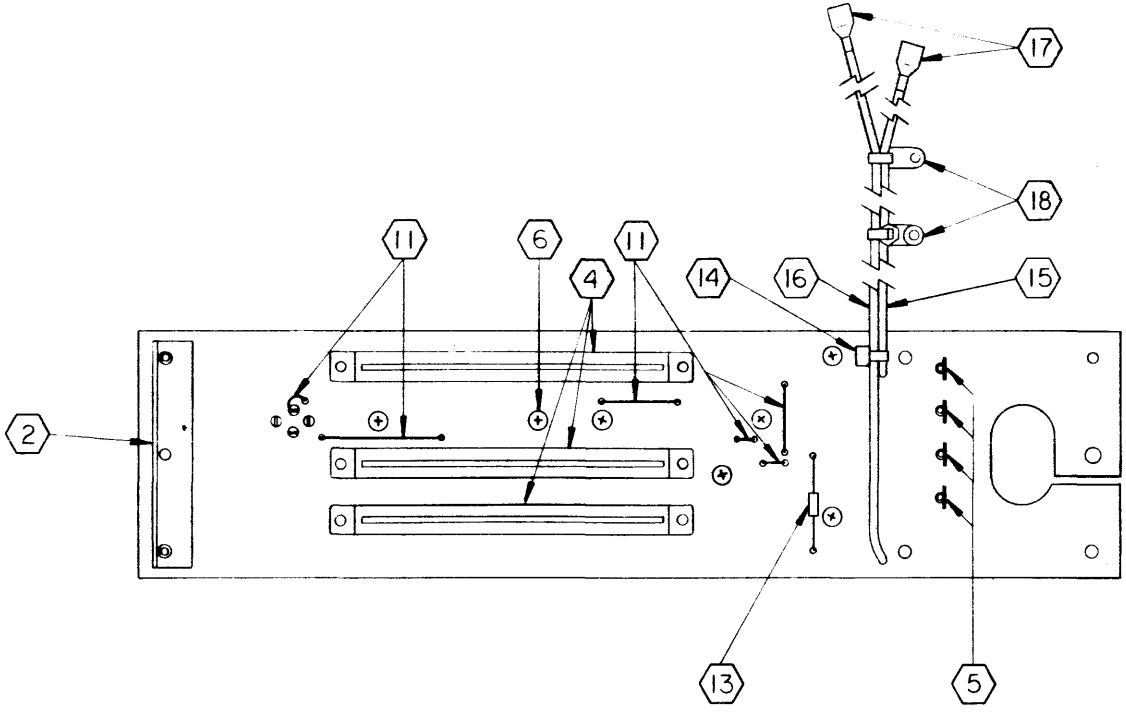
VOCAL INTERFACE DIVISION
FEDERAL SCREW WORKS

BASIC RS232 ASSEMBLY
— SCHEMATIC —

SCALE: N/A DATE FINAL ASS'Y VS 5.
DR M. KLEIST NEXT ASS'Y
CK
RE

901SC





Nº	REMARKS	DATE	DR	REL
	REVISIONS			

VOCAL INTERFACE DIVISION
FEDERAL SCREW WORKS

MOTHER BOARD ASS'Y-RS 232

SCALE: FULL	DATE	FINAL ASS'Y	VS 5.1
DR M. KLEIST	10/17/73	NEXT ASS'Y	VS 5.1
CK P.D. Bean	10/17/73		C508AD
REL P.D. Bean	10/17/73		

BULLETIN #
MTB-5-2002-MK

VOCAL INTERFACE DIVISION
Federal Screw Works

Reference Parts List

RS 232 MOTHER BOARD ASSY., Part No. 508 — October 17, 1973

Symbol or Detail No.	Part No.	Description
1	808	Blank P.C. Board, RS 232, Mother Bd.
2	614	Angle Bracket
3	---	Pop-Rivets
4	800	Connector, Card Edge
5	612	Spade Terminal, Male
6	---	Screws, #6-32 x 1/2" Oval Hd., Phillips
7	610	Connector, Wire-wrap, Male
8	609	Screw-loks
9	611	Stand-off
10	613	Speaker Jack
11	---	Jumper Wire
12	623	Connector, Wire-wrap, Female
13	209	Resistor, 680 OHM
14	622	Tie Wrap
15	---	Wire, 16 GA. Black
16	---	Wire, 16 GA. Orange
17	620	Terminal
18	621	Tie Wrap, Stud Mount

NOTE 1
OPTION PLUGS

JP1
LOCATION B41H
TO OPERATE IN EIGHT BIT MODE, INSTALL PLUG IN THIS LOCATION.
LOCATION B50H
TO OPERATE IN FOUR BIT MODE, INSTALL PLUG IN THIS LOCATION.

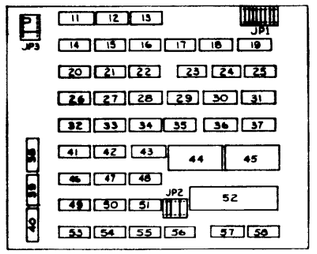
LOCATION A25C
JP2
PARITY SELECT
1 STOP BIT SELECT
5 OR 6 DATA BITS SELECT
EVEN PARITY SELECT
ODD PARITY SELECT

LOCATION B12
300 BAUD
JP3
600 BAUD
1200 BAUD
CONNECT FOR 5,6 AND 7 BIT SYSTEMS DROP CLEAR TO SEND- BUFFER FULL

CONNECT SYSTEM CLOCK TO 300 OR 600 OR 1200 AS REQUIRED. OPTIONAL CRYSTAL CAN BE INSTALLED FOR 110 BAUD.

11,12,18,19	SW 74193
13,14,15,16,17,25,46, 47,48,51,54,55,56,58	SW 7474 N
20, 23	DM 7402 N
21, 43	SW 7410 N
22, 29, 41, 50	N 7400 A
24, 26, 28, 27, 32, 42	SN 7408 N
28	SN 7413 N
30, 31, 36, 37	3341 DC
33, 34	SW 7426 N
35	N 7404 A
38, 39, 40	U6A9617
44, 45	N8263 N
48	SN 7432 N
52	UAR-T AY-5-1012
53	RC 1408
57	N 74121 A

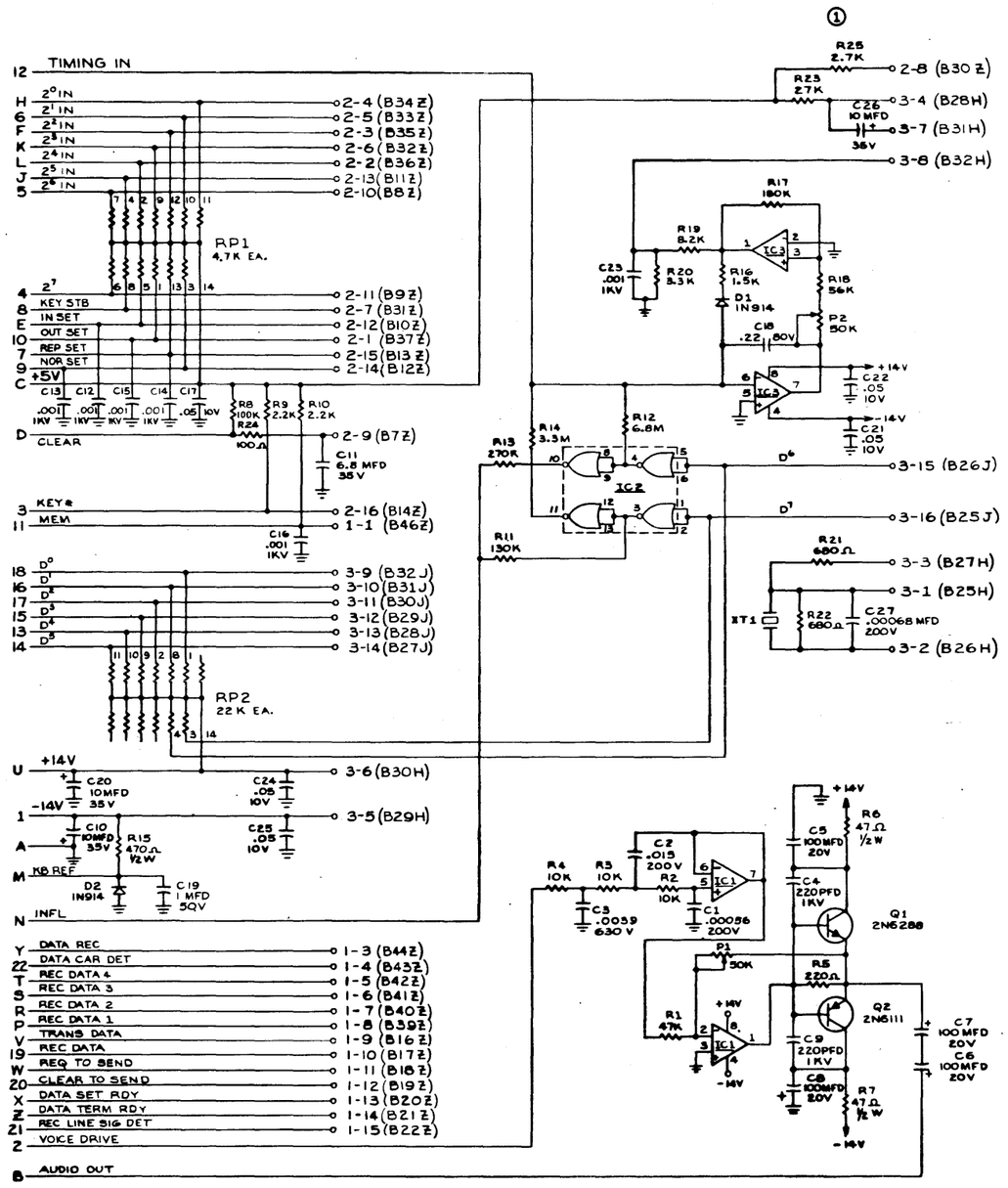
WHEN JUMPER PLUGS ARE WIRED AND INSTALLED AS SHOWN, OPERATION WILL BE: 4 BIT MODE, 7 DATA BITS, EVEN PARITY, 1 STOP BIT AND 300 BAUD.

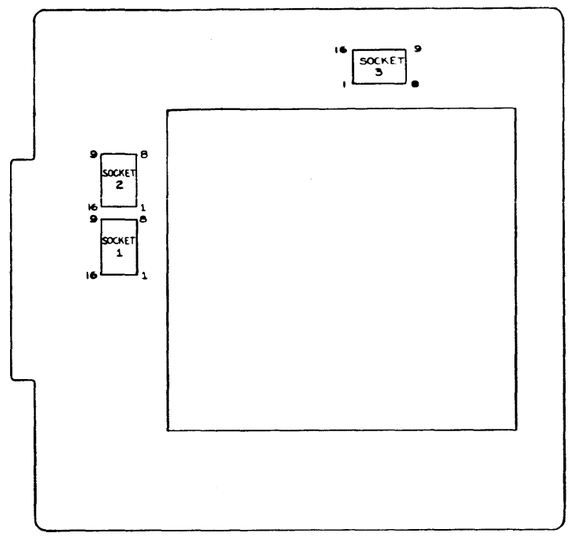


NOTE 2
PATH TO GROUND IS ESTABLISHED WHEN KEYBOARD IS CONNECTED.

UNUSED DEVICES

REVISIONS			
NO	REMARKS	DATE	DR APP
VOCAL INTERFACE DIVISION FEDERAL SCREW WORKS			
I/O BOARD-RS232 WIRE WRAP ASSY SCHEMATIC			
SCALE: N.A.	DATE FINAL ASS'Y		
DR M KLEIST	DWG NO. SHEET ASS'Y		
CH P.B.	7/14/72		
APP J.D.	7/14/72	E507SC	





TOP VIEW

NOTES:

1. ALL RESISTORS 1/4 WATT 5% UNLESS OTHERWISE NOTED.
2. ICs 1/3 ARE 8 PIN DIP. +14V PIN 8, -14V PIN 4.
3. IC 2 IS 14 PIN DIP. GROUND PIN 7, +14V PIN 14.
4. WIRE WRAP BOARD AND ASSOCIATED COMPONENTS ARE NOT PART OF THIS SUB-ASSEMBLY.

IC1/3 N5558V
IC2 CD4001A

Nº	REMARKS	DATE	DR	REL
1	ADD R25-2.7K 1/4 W	8/7/73	MK	TS

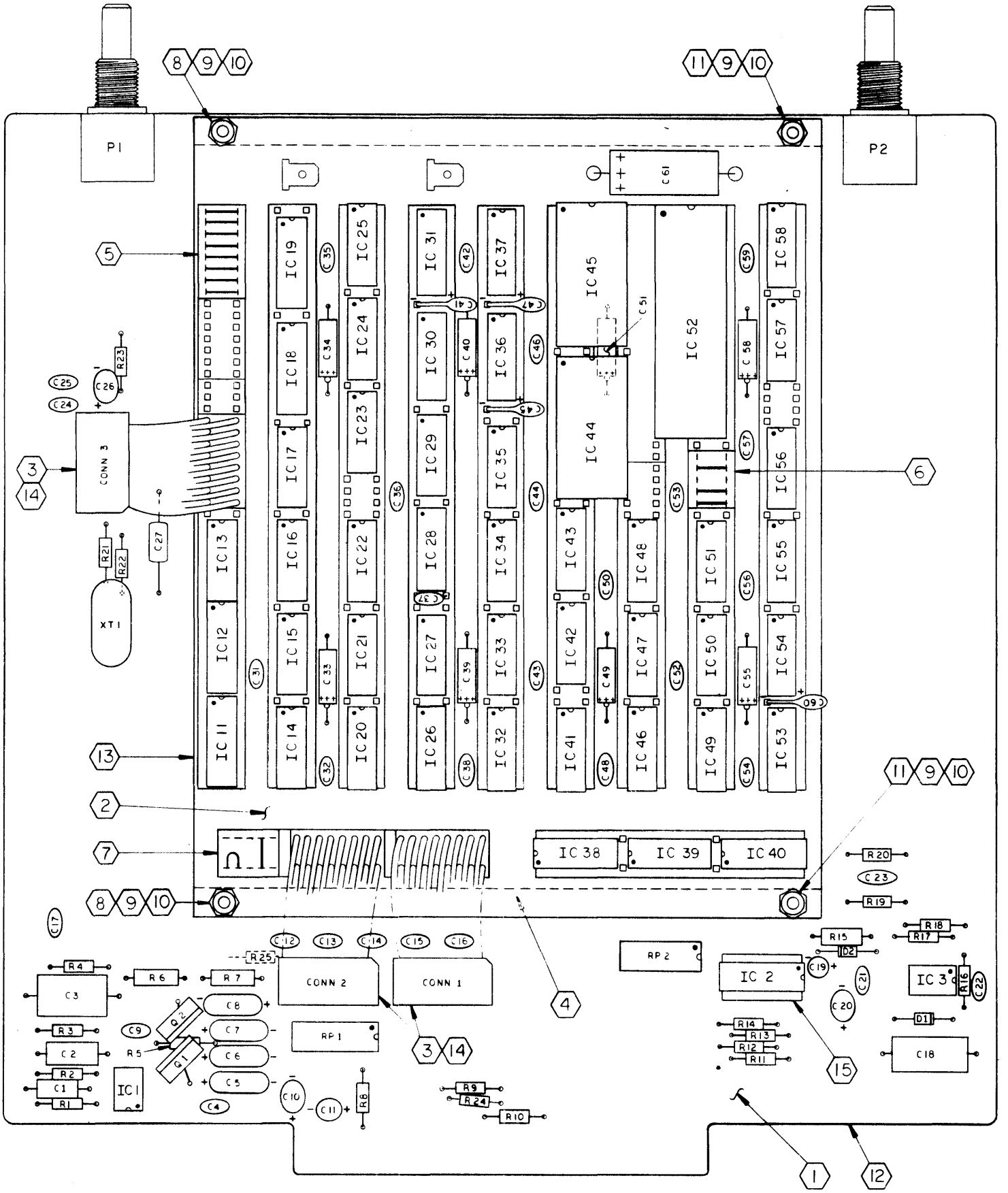
REVISIONS

VOCAL INTERFACE DIVISION
FEDERAL SCREW WORKS

I/O BOARD-RS 232
FRAME CARD SCHEMATIC

SCALE:	DATE	FINAL ASS'Y	VS 5.1
DR M. KLEIST	8/2/73	NEXT ASS'Y	525
CK	8/7/73		506SC
REL	9/10/73		

FORMERLY VSR 162-1



REVISIONS			
Nº	REMARKS	DATE	DR REL

VOCAL INTERFACE DIVISION
FEDERAL SCREW WORKS

I/O BOARD - RS 232 INTERFACE

SCALE: N/A	DATE	FINAL ASS'Y	VS 5.1
DR M. KLEIST	10/10/73	NEXT ASS'Y	VS 5.1
CK J.D Bam	10/11/73		C 525 AD
REL J.D. Bam	10/15/73		

BULLETIN #
MTB-5-2001-MK

VOCAL INTERFACE DIVISION

Federal Screw Works

Reference Parts List

P.C. BOARD ASSY., RS 232I/O, Part No. 525 — January 10, 1974

Symbol or Detail No.	Part No.	Description
1	506	P.C. Board, Frame Card Assembly
2	507	Wire Wrap Assembly
3	510	Ribbon Connector
4	721	Spacer
5	629	Option Selector Plug, JP1
6	630	Option Selector Plug, JP2
7	630	Option Selector Plug, JP3
8		Machine Screw, 4-40 x 1/2 in.
9		Hex Nut, 4-40
10		Lockwasher, No. 4
11		Machine Screw, 4-40 x 3/4 in.
12	807	P.C. Board, Blank Frame Card
13	809	Wire Wrap Board, Blank
14	336	Socket, 16 Pin DIP
15	335	Socket, 14 Pin DIP
R1	236	Resistor, 47K ohm, 1/4 W, ±5%
R2, 3, 4	226	" 10K ohm, " "
R5	214	" 220 ohm, " "
R6, 7	278	" 47 ohm, 1/2 W, ±5%
R8	238	" 100K ohm, 1/4 W, ±5%
R9, 10	217	" 2.2K ohm, " "
R11	240	" 130K ohm, " "
R12	268	" 6.8M ohm, " "
R13	247	" 270K ohm, " "
R14	266	" 3.3M ohm, " "
R15	210	" 470 ohm, 1/2W, ±5%
R16	216	" 1.5K ohm, 1/4W, ±5%
R17	243	" 180K ohm, " "
R18	276	" 56K ohm, " "
R19	225	" 8.2K ohm, " "
R20	219	" 3.3K ohm, " "
R21, 22	209	" 680 ohm, " "
R23	232	" 27K ohm, " "
R24	277	" 100 ohm, " "
R25	218	Resistor, 2.7K ohm, 1/4W, ±5%

P.C. BOARD ASSY., RS 232 I/O, Part No. 525 (cont.) January 10, 1974

Symbol or Detail No.	Part No.	Description
C6, 7	141	Capacitor 350 Mfd, -10%+100% 15VDC
C1	102	Capacitor, 0.00056 Mfd, ±10%, 200VDC
C2	103	" 0.015 Mfd, " "
C3	112	" 0.0039 Mfd, ±5%, 600VDC
C4, 9	105	Capacitor, 220 pf, ±10% 1KV
C5, 8	130	" 100 Mfd, ±20% 20VDC
C10, 20, 26	122	" 10 Mfd, ±20% 35VDC
C11	125	" 6.8 Mfd, ±20% 35VDC
C12-16, 23, 37	110	" 0.001 Mfd, ±20% 1KV
43, 52	"	" " " " "
C17, 21, 22, 24	129	" 0.05 Mfd, ±20% 10VDC
25, 31, 32, 35,	"	" " " " "
36, 38, 42, 44	"	" " " " "
46, 48, 50, 53	"	" " " " "
54, 56, 57, 59	"	" " " " "
C18	108	" 0.22 Mfd, ±10% 80VDC
C19, 41, 45, 47, 60	121	" 1.0 Mfd, ±20% 35VDC
C27	100	" 680 pf, ±10% 200VDC
C33, 34, 39, 40	127	" 22 Mfd, ±10% 15VDC
49, 51, 55, 58	"	" " " " "
C61	109	Capacitor, 100 Mfd, -10% + 100% 15VDC
C62	115	" 0.01 " ±10% 200 VDC
P1	279	Potentiometer, 50K ohm, Audio
P2	275	Potentiometer, 50K ohm,
RP1	274	Resistor Pack, 4.7K ohm, 14 Pin DIP
RP2	273	Resistor Pack, 22K ohm, 14 Pin DIP
Q1	344	Transistor, 2N6288
Q2	343	Transistor, 2N6111
D1, 2	300	Diode, 1N914
XT1	334	Crystal Oscillator, FR307.4 ±2KC
IC1, 3	340	I.C., Dual Op. Amp., N4558
IC2	309	I.C., COS/MOS, Quad, NOR GATE, CD4001AE
IC11, 12, 18, 19	329	I.C., TTL, Sync. 4 Bit Up/Down Counter, 74193
IC13-17, 25, 46,	327	I.C., TTL, Dual "D" Flip Flops, 7474
47, 49, 51,	"	" " " " " " "
54-56, 58	"	" " " " " " "
IC20, 23	318	I.C., TTL, Quad, NOR Gate, 7402
IC21, 43	320	I.C., TTL, Triple, NAND Gate, 7410
IC22, 29, 41, 50	316	I.C., TTL, Quad, NAND Gate, 7400
IC24, 26, 27, 32,	321	I.C. TTL, Quad, AND Gate, 7408
42	"	" " " " " "
IC28	322	I.C., TTL. Dual NAND Scmitt Trigger, 7413

P.C. BOARD ASSY., RS 232I/O, Part No. 525 (cont.) January 10, 1974

Symbol or Detail No.	Part No.	Description
IC30, 31, 36, 37	331	I.C., MOS, FIFO, 3341
IC33, 34	325	I.C., TTL, Quad, NAND Gate, 7426
IC35	319	I.C., TTL, Hex Inverter, 7404
IC38-40	333	I.C., RS232 Triple Line RCVR, 9617
IC44, 45	332	I.C., Multiplexer, 8263N
IC48	323	I.C., TTL, Quad, OR Gate, 7432
IC52	315	I.C., VAR-T, AY-5-1012
IC53	330	I.C., RS232 Quad Line Driver, 1488
IC57	328	I.C., TTL, MONOSTABLE, 74121

VOCAL INTERFACE DIVISION

Federal Screw Works

Reference Parts List

P.C. BOARD ASSY., RS 232I/O, Part No. 525 — January 10, 1974

Symbol or Detail No.	Part No.	Description
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6	630	Option Selector Plug, JP2
7	630	Option Selector Plug, JP3
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R5	214	" 220 ohm, " "
R6, 7	278	" 47 ohm, 1/2 W, ±5%
R8	238	" 100K ohm, 1/4 W, ±5%
R9, 10	217	" 2.2K ohm, " "
R11	240	" 130K ohm, " "
R12	268	" 6.8M ohm, " "
R13	247	" 270K ohm, " "
R14	266	" 3.3M ohm, " "
R15	210	" 470 ohm, 1/2W, ±5%
R16	216	" 1.5K ohm, 1/4W, ±5%
R17	243	" 180K ohm, " "
R18	276	" 56K ohm, " "
R19	225	" 8.2K ohm, " "
R20	219	" 3.3K ohm, " "
R21, 22	209	" 680 ohm, " "
R23	232	" 27K ohm, " "
R24	277	" 100 ohm, " "
R25	218	Resistor, 2.7K ohm, 1/4W, ±5%

P.C. BOARD ASSY., RS 232 I/O, Part No. 525 (cont.) January 10, 1974

Symbol or Detail No.	Part No.	Description
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C4, 9	105	Capacitor, 220 pf, ±10% 1KV
C5, 8	130	" 100 Mfd, ±20% 20VDC
C10, 20, 26	122	" 10 Mfd, ±20% 35VDC
C11	125	" 6.8 Mfd, ±20% 35VDC
C12-16, 23, 37	110	" 0.001 Mfd, ±20% 1KV
43, 52	"	" " " " "
C17, 21, 22, 24	129	" 0.05 Mfd, ±20% 10VDC
25, 31, 32, 35,	"	" " " " "
36, 38, 42, 44	"	" " " " "
46, 48, 50, 53	"	" " " " "
54, 56, 57, 59	"	" " " " "
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C19, 41, 45, 47, 60	121	" 1.0 Mfd, ±20% 35VDC
C27	100	" 680 pf, ±10% 200VDC
C33, 34, 39, 40	127	" 22 Mfd, ±10% 15VDC
49, 51, 55, 58	"	" " " " "
C61	109	Capacitor, 100 Mfd, -10% + 100% 15VDC
C62	115	" 0.01 " ±10% 200 VDC
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Q2	343	Transistor, 2N6111
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IC13-17, 25, 46,	327	I.C., TTL, Dual "D" Flip Flops, 7474
47, 49, 51,	"	" " " " " " "
54-56, 58	"	" " " " " " "
IC20, 23	318	I.C., TTL, Quad, NOR Gate, 7402
IC21, 43	320	I.C., TTL, Triple, NAND Gate, 7410
IC22, 29, 41, 50	316	I.C., TTL, Quad, NAND Gate, 7400
IC24, 26, 27, 32,	321	I.C. TTL, Quad, AND Gate, 7408
42	"	" " " " " "
IC28	322	I.C., TTL. Dual NAND Scmitt Trigger, 7413

P.C. BOARD ASSY., RS 232I/O, Part No. 525 (cont.) January 10, 1974

Symbol or Detail No.	Part No.	Description
IC30, 31, 36, 37	331	I.C., MOS, FIFO, 3341
IC33, 34	325	I.C., TTL, Quad, NAND Gate, 7426
IC35	319	I.C., TTL, Hex Inverter, 7404
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IC52	315	I.C., VAR-T, AY-5-1012
IC53	330	I.C., RS232 Quad Line Driver, 1488
IC57	328	I.C., TTL, MONOSTABLE, 74121

VOTRAX PHONETIC CODES

PHONEME	HEX	OCTAL	* ASC II
PAØ	Ø3	ØØ3	'SP'
PA1	3E	Ø76	'NS'
PA2	3Ø	Ø6Ø	'PS'
A	2Ø	Ø4Ø	'PR'
A1	Ø6	ØØ6	'VP'
AE	2E	Ø56	'NR'
AE1	2F	Ø57	'OR'
AH	24	Ø44	'TR'
AH1	15	Ø25	'UQ'
AW	3D	Ø75	'MS'
AW1	13	Ø23	'SQ'
AY	21	Ø41	'QR'
B	ØE	Ø16	'NP'
CH	1Ø	Ø2Ø	'PQ'
D	1E	Ø36	'NQ'
E	2C	Ø54	'LR'
EH	3B	Ø73	'KS'
EH1	Ø1	ØØ1	'QP'
EH2	ØØ	ØØØ	'PP'
EHH	Ø8	Ø1Ø	'HP'
ER	3A	Ø72	'JS'
F	1D	Ø35	'MQ'

PHONEME	HEX	OCTAL	* ASC II
G	1C	Ø34	'LQ'
H	1B	Ø33	'KQ'
I	27	Ø47	'WR'
I1	ØB	Ø13	'KP'
I2	ØA	Ø12	'JP'
IE	3C	Ø74	'LS'
IH	Ø5	ØØ5	'UP'
IU	36	Ø66	'VS'
IY	Ø9	Ø11	'IP'
J	1A	Ø32	'JQ'
K	19	Ø31	'IQ'
L	18	Ø3Ø	'HQ'
M	ØC	Ø14	'LP'
N	ØD	Ø15	'MP'
NG	14	Ø24	'TQ'
Ø	26	Ø46	'VR'
Ø1	35	Ø65	'US'
Ø2	34	Ø64	'TS'
ØØ	17	Ø27	'WQ'
ØØ1	16	Ø26	'VQ'
ØØH	Ø4	ØØ4	'TP'
P	25	Ø45	'UR'

PHONEME	HEX	OCTAL	* ASC II
Q	Ø2	ØØ2	'RP'
R	2B	Ø53	'KR'
S	1F	Ø37	'OQ'
SH	11	Ø21	'QQ'
T	2A	Ø52	'JR'
TH	39	Ø71	'IS'
THV	38	Ø7Ø	'HS'
U	28	Ø5Ø	'HR'
U1	37	Ø67	'WS'
UH	33	Ø63	'SS'
UH1	32	Ø62	'RS'
UH2	31	Ø61	'QS'
UH3	23	Ø43	'SR'
V	ØF	Ø17	'OP'
W	2D	Ø55	'MR'
Y	29	Ø51	'IR'
Y1	22	Ø42	'RR'
Z	12	Ø22	'RQ'
ZH	Ø7	ØØ7	'WP'
*NULL CODE =	FF	377	'OO'

* For use with RS-232 Only

NOTE: The above table is assuming Inflection Code 3

INFLECTION LEVELS

To add inflection levels, add the selected level below to the phoneme value above.
(i.e., 1AH1 = Hex 95 Octal 225)

LEVEL	HEX	OCTAL	
1	8Ø	2ØØ	(lowest)
2	CØ	3ØØ	
3	ØØ	ØØØ	
4	4Ø	1ØØ	(highest)

To Add Inflection Code, Change Second Character

FROM	P	Q	R	S	* ASC II (Inflection Code)	3
TO	H	I	J	K	(Inflection Code)	1
TO	L	M	N	O	(Inflection Code)	2
TO	P	Q	R	S	(Inflection Code)	3
TO	T	U	V	W	(Inflection Code)	4

A	1/A1, 1/A1, 4/Y1
Abort	1/UH2, 2/B, 2/O1, 1/O1, 2/R, 1/T
About	2/UH3, 2/B, 1/AH1, 1/OO1, 1/U1, 1/T
Above	1/UH3, 2/B, 2/UH1, 1/UH3, 2/V, 1/V
Accelerator	1/AE1, 2/K, 2/S, 2/EH, 2/L, 1/UH3, 2/R, 1/A, 1/AY, 2/T, 1/ER
Accept	1/AE1, 2/K, 2/S, 1/EH, 2/P, 2/T
Accepted	1/AE1, 2/K, 2/S, 1/EH, 2/P, 2/T, 1/EH2, 2/D
Account	2/UH3, 2/K, 1/AH1, 1/O1, 1/U1, 2/N, 2/T
Acknowledge	1/EH1, 1/K, 1/PAØ, 2/N, 1/AH1, 1/AW1, 1/UH3, 1/L, 1/EH2, 1/D, 2/J
Actual	1/AE, 1/AE1, 2/K, 1/T, 1/CH, 1/IU, 1/U1, 1/OO1, 1/UH3, 2/L
Affirm	1/UH3, 2/F, 2/ER, 1/R, 1/M
Affirmative	1/UH3, 2/F, 2/ER, 1/R, 1/M, 1/UH3, 2/T, 1/I, 2/V
After	1/AE1, 2/F, 1/PAØ, 1/T, 2/ER
Alabama	2/AE, 1/UH3, 2/L, 1/UH2, 2/B, 2/AE1, 1/AE, 1/M, 1/UH2
Alarm	1/UH3, 2/L, 1/AH1, 1/AW1, 1/R, 1/M
Alaska	2/UH3, 1/L, 2/AE1, 1/AE, 2/S, 2/K, 1/UH2
Alpha	2/AE1, 1/UH2, 1/L, 1/F, 2/UH1
Altitude	2/AE1, 2/L, 2/T, 2/IH, 2/T, 1/IU, 2/U, 2/D
Am	1/AE1, 1/AE, 2/M
An	1/AE1, 1/AE, 2/N, 1/N

And	2/AE1, 1/AE1, 1/UH3, 2/N, 2/D
Approach	1/UH3, 2/P, 2/R, 1/O, 1/O1, 1/PAØ, 2/T, 2/CH
Approaching	1/UH3, 4/P, 2/R, 1/O, 1/PAØ, 2/T, 2/CH, 1/I, 2/NG
Arizona	1/AE1, 2/R, 1/IH, 2/Z, 1/O, 1/O1, 2/N, 1/UH2
Arkansas	1/AH1, 2/R, 2/K, 1/EH2, 2/N, 2/S, 1/AW1, 2/AW1
Artifact	2/AH1, 2/R, 2/T, 2/IH, 1/F, 1/AE, 2/AE1, 2/K, 2/T
Assistance	1/UH1, 2/S, 2/I, 2/S, 2/T, 1/EH2, 2/N, 2/S
Assume	1/UH3, 2/S, 2/S, 1/U1, 1/U1, 1/M
At	1/AE, 1/AE1, 2/T
Attention	1/UH3, 2/T, 1/EH1, 2/EH2, 1/N, 2/SH, 1/UH2, 2/N
Automobile	2/AW1, 2/T, 1/O1, 1/M, 1/O, 1/B, 1/IE, 1/E, 1/L
Available	1/UH3, 2/V, 2/A, 1/AY, 2/L, 1/UH2, 2/B, 1/UH3, 2/L

B	2/B, 2/IE, 1/E, 2/E
Bachelor	2/B, 2/AE1, 1/AE, 2/T, 1/CH, 2/L, 1/ER
Balance	2/B, 1/AE, 1/EH1, 2/L, 1/UH3, 2/N, 2/S
Bank	2/B, 1/AE1, 1/AE1, 1/IH, 2/NG, 2/K
Bat	2/B, 1/AE1, 1/AE1, 2/T
Be	2/B, 2/IE, 1/E, 2/E
Been	2/B, 1/EH, 1/EH1, 2/N, 1/N
Begin	1/B, 1/E, 1/PAØ, 2/G, 1/IE, 1/I, 1/I1, 1/N, 1/N
Below	1/B, 1/E, 1/PAØ, 2/L, 1/UH3, 1/O, 1/O1, 1/U1
Belt	2/B, 1/EH1, 2/L, 2/T
Billion	3/B, 2/I1, 2/UH3, 1/L, 1/Y, 2/EH2, 3/N
Bill-To	2/B, 1/I, 2/L, 1/PA1, 2/T, 2/IU, 1/U
Bird	2/B, 2/ER, 1/ER, 1/R, 2/D
Blind	2/B, 2/L, 1/AH, 1/Y1, 2/N, 2/D
Block	2/B, 2/L, 1/AH, 1/AH1, 2/K
Blocked	2/B, 2/L, 1/AH, 1/AH1, 2/K, 1/PAØ, 2/T
Brakes	2/B, 2/R, 1/A, 1/AY, 2/K, 2/S
Bravo	2/B, 2/R, 1/UH2, 1/AH1, 2/V, 1/UH2, 1/O1, 2/O2
Brought	2/B, 2/R, 1/AW, 1/AW1, 2/T
Bush	2/B, 2/OO1, 1/OO, 2/SH, 2/SH

But	2/B, 1/UH2, 1/UH3, 2/T
By	2/B, 1/UH3, 2/AH, 1/AH1, 1/IY

C	2/S, 1/IE, 1/E, 2/E
Cabin	2/K, 2/AE1, 1/AE, 2/B, 1/IH, 2/N
California	2/K, 1/AE, 2/L, 1/UH3, 2/F, 1/O, 1/R, 2/N, 1/Y1, 1/UH2
Call	2/K, 1/AW1, 1/AW1, 1/UH3, 2/L
Calling	2/K, 1/AW, 1/AW1, 2/L, 2/IH, 2/NG
Can	2/K, 1/AE, 1/AE1, 2/IH, 2/N
Caught	2/K, 1/AW, 1/UH3, 2/T
Caution	2/K, 1/AW1, 1/AW1, 2/SH, 1/UH2, 2/N
Center	2/S, 1/EH, 2/N, 2/T, 1/ER
Centerline	1/S, 2/EH, 1/N, 1/T, 2/ER, 1/PAØ, 1/L, 1/AH, 1/IY, 2/N, 1/N
Cents	2/S, 1/EH, 2/N, 1/T, 2/S
Chair	1/T, 2/CH, 1/EH, 1/R
Changed	2/T, 2/CH, 2/A, 1/AY, 2/N, 2/J, 2/D
Charlie	2/T, 2/CH, 1/UH3, 2/AH1, 2/R, 2/L, 2/IH, 1/E
Check	2/T, 2/CH, 1/EH, 2/K
Circuit	2/S, 2/ER, 2/R, 2/K, 2/IH, 2/T
Clear	2/K, 1/L, 1/E, 2/R
Cleared	2/K, 1/L, 1/IE, 1/IY, 2/R, 1/PAØ, 2/D
Climb	2/K, 2/L, 1/AH1, 1/IY, 2/M
Codes	2/K, 1/UH3, 1/O1, 1/U1, 2/D, 2/D, 2/S

Colorado	2/K, 1/AH1, 2/UH3, 2/L, 2/UH3, 1/R, 3/AE1, 2/EHH, 2/D, 2/UH2, 1/O
Come	2/K, 1/AH1, 1/UH, 1/M
Coming	2/K, 1/EHH, 1/UH, 1/M, 1/I, 2/NG
Complete	2/K, 1/UH2, 1/M, 2/P, 2/L, 2/E, 1/IE, 2/T
Confuse	2/K, 1/UH2, 2/N, 2/F, 1/Y1, 1/U, 2/U1, 2/Z
Connecticut	2/K, 1/UH2, 2/N, 1/EH, 2/T, 1/IH, 2/K, 1/UH2, 2/T
Contact	2/K, 2/AH1, 2/AH1, 2/N, 2/PAØ, 2/T, 2/AE1, 2/AE1, 2/K, 2/T
Continent	1/K, 1/UH2, 2/AH1, 2/N, 2/T, 2/IH, 2/N, 1/EH1, 2/N, 2/T
Control	2/K, 1/UH3, 2/N, 2/T, 2/R, 1/O, 1/O1, 2/L
Controller	2/K, 1/UH1, 2/N, 2/T, 2/R, 1/O1, 1/O, 1/L, 1/ER
Convenience	2/K, 1/UH2, 1/N, 2/V, 1/E, 2/N, 1/Y1, 1/UH3, 2/N, 2/S
Correcting	1/K, 1/UH3, 1/O2, 2/R, 1/EH, 1/EHH, 1/K, 1/PAØ, 1/T, 1/I, 1/NG
Cost	2/K, 1/AW1, 1/AW1, 1/UH3, 2/S, 2/T
Course	2/K, 1/UH3, 2/O2, 1/O, 1/ER, 1/S, 1/S
Cover	2/K, 1/UH, 2/V, 1/ER
Credit	2/K, 2/R, 1/EH1, 2/D, 1/IH, 2/T
Current	2/K, 1/ER, 1/R, 1/EH2, 2/N, 2/T

D	2/D, 2/IE, 1/E, 2/E
Danger	2/D, 1/A, 1/AY, 2/N, 1/D, 2/J, 1/ER
Decimal	2/D, 2/EHH, 1/EH1, 2/S, 1/S, (1/UH3), 1/M, 1/UH2, 2/L
Decision	1/D, 1/I, 1/PAØ, 2/S, 3/I2, 2/I2, 1/I2, 2/ZH, 1/UH3, 2/N, 1/N
Dedicated	2/D, 2/EH, 2/D, 1/IH, 2/K, 1/A, 1/AY, 2/T, 1/UH3, 2/D
Degrees	2/D, 1/IH, 2/G, 2/R, 2/E, 1/IE, 2/Z
Delaware	2/D, 1/EH, 2/L, 1/UH2, 2/W, 1/EH1, 1/A1, 2/R
Delayed	2/D, 1/EH1, 1/L, 1/A, 2/AY, 1/I2, 2/D
Delta	2/D, 1/EH, 2/L, 1/PAØ, 2/T, 1/UH2
Departure	2/D, 1/E, 2/P, 2/AH1, 2/R, 1/T, 2/CH, 1/ER
Depress	2/D, 1/IH, 2/P, 2/R, 1/EH, 2/S, 1/S
Descend	2/D, 2/E, 2/S, 2/EH, 2/N, 1/N, 2/D, 1/D
Descent	2/D, 1/I1, 2/S, 1/S, 1/EH, 2/N, 2/T
Desired	2/D, 1/IH, 2/Z, 1/AH1, 1/IY, 2/R, 2/D
Do	2/D, 1/OOH, 1/U, 1/U
Does	2/D, 1/UH2, 1/UH1, 1/Z, (2/Z)
Down	2/D, 1/AH, 1/AW1, 1/U1, 1/N, 2/N
Due	2/D, 1/OOH, 1/U, 1/U

E	1/E, 2/Y, 3/Y1
Earliest	2/ER, 1/R, 2/L, 1/E, 1/EH1, 2/S, 2/T
Echo	1/EH, 1/K, 2/UH2, 3/O1
Eight	1/A, 3/Y1, 3/T
Eighteen	1/A, 1/Y1, 1/T, 1/T, 1/IE, 2/Y, 2/N
Eighty	1/A, 1/Y1, 2/T, 1/E, 2/Y1
Electronic	1/IH, 2/L, 1/EH, 2/K, 2/T, 2/R, 1/AH, 1/N, 1/IH, 2/K
Elevator	1/EH1, 2/L, 1/UH3, 2/V, 1/EHH, 1/AY, 2/T, 1/ER
Eleven	2/AY, 1/L, 1/EH1, 2/V, 3/EH2, 4/N
Emergency	1/I, 1/M, 2/ER, 1/D, 2/J, 1/UH3, 1/N, 2/S, 1/E
Engage	1/EH1, 2/N, 2/G, 1/A, 1/AY, 1/D, 2/J
Engine	1/EH, 2/N, 2/J, 1/IH, 2/N
Enter	1/EH1, 2/N, 1/T, 1/ER
Entered	1/EH1, 2/N, 2/T, 1/ER, 2/D
Equals	1/E, 2/Q, 2/W, 1/UH3, 1/L, 2/Z
Error	1/EH1, 2/R, 1/R, 1/UH3, (1/02), 1/ER
Estimate	1/EH1, 2/S, 1/T, 2/UH2, 1/M, 1/A, 1/AY, 1/T (1/EH1, 2/S, 1/T, 1/UH2, 1/M, 1/I1, 1/T)
Evacuation	2/E, 2/V, 2/AE, 2/K, 2/Y1, 1/U, 1/A, 1/AY, 2/SH, 1/UH3, 2/N
Exceeds	1/EH1, 2/K, 2/S, 2/E, 1/IE, 2/D, 2/Z
Execute	1/EH1, 1/K, 1/PAØ, 2/S, 1/UH2, 2/K, 1/IY, 1/IU, 1/U1, 1/T
Executing	1/EH1, 1/K, 1/PAØ, 2/S, 1/UH2, 2/K, 1/IY, 1/IU, 1/T, 1/I, 1/NG

F	1/EH1, 2/EH2, 3/F
Fade	2/F, 1/A, 1/AY, 1/IY, 2/D
Failure	2/F, 2/A, 1/AY, 2/L, 1/Y1, 2/ER
Far	2/F, 1/AH, 1/AH1, 1/ER
Fasten	2/F, 2/AE1, 1/AE1, 2/S, 1/UH3, 1/N, 2/N
Faster	2/F, 2/AE1, 1/AE1, 2/S, 2/T, 1/ER, 2/R
Fear	2/F, 1/E, 2/IE, 2/R
Federal	2/F, 1/EH, 2/D, 1/ER, 1/UH3, 2/L
Fifteen	3/F, 2/I2, 1/IH, 1/F, 1/T, 1/IE, 2/Y, 2/N
Fifty	3/F, 1/I1, 1/F, 2/T, 3/Y
Final	2/F, 1/AH, 1/I2, 2/N, 1/UH2, 2/L
Fire	2/F, 1/AH1, 1/IY, 2/R
Five	2/F, 1/AH, 2/IY, 3/V
Flaps	2/F, 2/L, 1/AE, 1/EHH, 2/P, 2/S
Flight	2/F, 2/L, 1/AH1, 2/IY, 2/T
Florida	2/F, 2/L, 2/OO1, 2/O2, 2/R, 1/UH3, 2/D, 1/UH3, 2/UH3
Foot	2/F, 1/O2, 1/OO1, 2/T
For	2/F, 1/O2, 1/O2, 3/R
Forty	2/F, 1/O2, 2/O2, 2/R, 2/T, 2/Y1, 3/Y1
Found	2/F, 1/AH1, 1/AW1, 1/U1, 2/N, 2/D

Four	2/F, 1/O2, 1/O2, 3/R
Fourteen	3/F, 2/O1, 1/R, 1/T, 1/T, 1/IE, 2/Y, 3/N
Foxtrot	2/F, 2/AH, 2/K, 2/S, 2/T, 2/R, 1/AH, 2/T
Frame	2/F, 1/R, 1/A, 1/AY, 1/M
From	2/F, 1/R, 1/UH1, 1/OO1, 1/M
Fuel	2/F, 2/Y, 2/U1, 1/U1, 1/UH3, 1/L

G	2/D, 2/J/ 2/IE, 1/E, 2/E
Galley	2/G, 2/AE1, 1/AE1, 2/L, 1/Y
Georgia	2/D, 2/J, 1/UH2, 2/O1, 2/R, 2/D, 2/J, 1/UH2
Go	2/G, 1/UH3, 1/O2, 1/O1, 1/U1
Going	2/G, 1/UH3, 2/O, 2/W, 1/I, 1/NG, 2/NG
Graphic	2/G, 1/R, 1/AE, 2/F, 1/I, 2/K
Ground	2/G, 2/R, 1/AH1, 1/OO1, 1/U1, 2/N, 2/D

H	1/A, 2/AY, 1/T, 3/CH
Hand	2/H, 2/AE1, 1/AE, 2/N, 2/D
Has	2/H, 2/AE1, 1/AE, 1/I2, 2/Z
Have	2/H, 2/AE1, 1/AE, 1/UH3, 2/V
Hawaii	2/H, 1/UH2, 2/W, 1/AH, 1/IY, 1/E
Heading	2/H, 1/EH, 1/EH2, 2/D, 1/I, 2/NG
Height	1/H, 1/AH, 1/IY, 2/T
Hello	2/H, 2/EH, 1/L, 2/UH, 2/O
Here	2/H, 1/IE, 1/IE, 2/R
High	1/H, 1/AH, 1/AH1, 1/IY
Him	2/H, 1/I, 1/M
His	2/H, 1/I, 2/Z
Hold	2/H, 1/O, 1/O, 2/L, 2/D
Holding	2/H, 2/O1, 1/O, 2/L, 1/PAØ, 2/D, 1/I, 2/NG
Hotel	2/H, 1/O1, 1/O1, 2/T, 1/EH, 1/L, 1/L
Hours	1/AH1, 1/AW1, 2/U1, 3/W, 2/ER, 2/Z, 1/Z
How	2/H, 1/UH3, 1/AH, 1/O1, 1/U1
Hundred	3/H, 2/UH1, 1/N, 1/D, 1/R, 2/IH, 3/D
Hunt	2/H, 1/UH1, 2/N, 2/T

I	1/AH, 3/IY
Idaho	1/AH1, 1/AY, 2/D, 1/UH2, 1/PAØ, 2/H, 1/O, 1/O1
Identify	1/AH1, 1/IY, 2/D, 1/EH1, 2/N, 2/T, 1/UH3, 2/F, 1/AH1, 1/IY
If	1/I, 2/F, 1/F
Illinois	1/I, 1/L, 1/EH2, 2/N, 1/AW1, 1/O2, 1/I
Immediately	1/IH, 1/M, 1/M, 2/IE, 1/E, 2/D, 1/IH, 1/UH3, 2/T, 2/L, 1/E
In	2/I, 1/I1, 2/N, 1/N
Inch	1/I, 2/N, 2/T, 2/CH
India	2/I, 2/N, 1/N, 1/D, 1/IE, 1/E, 1/UH3, 2/UH3
Indiana	1/I, 2/N, 2/D, 1/IY, 2/AE, 1/AE1, 2/N, 2/UH3
Initiated	1/IH, 2/N, 2/I, 2/SH, 1/IY, 1/A, 1/I2, 2/T, 1/IH, 2/D
Input	1/I, 2/N, 2/P, 1/O2, 1/OO1, 2/T
Instrument	2/I, 3/N, 2/S, 2/T, 1/R, 1/UH3, 1/M, 1/EH, 1/N, 1/T
Interface	2/I, 2/N, 2/T, 1/ER, 2/F, 1/A, 1/AY, 2/S
Interference	1/I, 1/N, 1/T, 1/ER, 2/F, 1/IE, 1/IE, 1/ER, 1/EHH, 2/N, 1/T, 1/S
Iowa	1/AH, 2/IH, 1/UH3, 1/W, 1/UH3, 2/UH3
Is	1/I, 2/Z
It	1/I, 2/T

J	1/D, 1/J, 1/A, 1/AY, 2/IY
Job	2/D, 2/J, 1/AH, 1/AH1, 1/UH3, 2/B
Juliet	2/D, 1/J, 1/IU, 2/U, 2/L, 1/IY, 1/Y, 1/EH2, 2/EH2, 2/T
Just	1/D, 2/J, 1/I2, 2/UH3, 3UH3, 2/S, 2/T

K	1/K, 1/I2, 1/A, 2/AY
Kansas	2/K, 2/AE, 1/EH2, 2/N, 2/Z, 1/UH2, 2/S
Keeper	2/K, 1/I2, 1/E, 2/P, 1/ER
Kentucky	2/K, 1/EH2, 1/EHH, 2/N, 2/T, 2/UH1, 2/K, 1/Y
Kilo	2/K, 2/IE, 3/E, 2/L, 1/UH1, 3/O1
Known	2/N, 1/UH3, 2/O, 1/U1, 2/N

L	1/EH1, 1/UH2, 3/L
Land	1/L, 1/AE, 1/IH, 1/N, 2/N, 2/D
Landing	2/L, 1/AE, 2/IH, 1/N, 1/N, 1/D, 1/PAØ, 1/I1, 1/NG, 2/NG
Launch	2/L, 1/AW1, 1/AH1, 2/N, 1/T, 2/CH
Law	2/L, 1/AW1, 1/AW1
Leak	2/L, 1/IE, 1/E, 2/K
Left	1/L, 1/EH, 2/F, 1/T
Legal	2/L, 1/IE, 1/E, 2/G, 1/UH3, 2/L
Level	2/L, 1/EH, 2/V, 1/UH3, 2/L
Life	2/L, 1/AH1, 1/IY, 1/F, 2/F
Lift	2/L, 1/I, 2/F, 2/T
Light	2/L, 1/AH1, 1/IE, 1/Y1, 2/T
Lights	2/L, 1/AH1, 1/IE, 1/Y1, 2/T, 2/S
Lima	2/L, 1/IE, 1/E, 1/M, 1/AH1, 3/UH3
Limits	1/L, 2/I, 1/M, 1/IH, 2/T, 2/S
Liner	2/L, 1/AH1, 1/IY, 2/N, 1/ER
Little	2/L, 1/I, 2/T, 1/T, 3/L
Logged	2/L, 1/AW1, 1/AW1, 2/G, 2/D
Loss	2/L, 1/AW, 1/AW1, 1/S, 2/S
Lost	2/L, 1/AW1, 1/AW1, 2/S, 2/T
Louisiana	2/L, 1/EHH, 2/U, 1/E, 2/Z, 1/IY, 2/AE, 2/N, 1/UH2
Low	1/L, 1/UH3, 1/OO1, 1/O, 1/U1

M	1/EHH, 1/EH1, 2/M, 3/M
Maine	1/M, 2/A, 1/AY, 1/IY, 1/N, 1/N
Maintain	1/M, 2/A, 1/IY, 1/N, 2/T, 2/A, 1/AY, 1/IY, 1/N
Make	1/M, 2/A, 1/IY, 2/K
Man	1/M, 2/AE, 1/AE1, 1/PAØ, 1/N, 1/N
Many	1/M, 2/EH, 2/N, 1/Y
Maryland	1/M, 2/A, 3/R, 1/UH2, 2/L, 1/IH, 2/N, 2/D
Massachusetts	1/M, 1/AE, 2/S, 1/UH2, 1/T, 2/CH, 2/U1, 1/U1, 2/S, 1/EHH, 2/T 2/S
Match	1/M, 1/AE1, 1/AE1, 2/IH, 2/T, 2/CH
Mayday	1/M, 2/A, 1/IY, 2/D, 1/A, 1/AY, 2/IY
Me	1/M, 1/E, 1/E
Mechanic	1/M, 1/EH2, 2/K, 2/AE1, 1/AE, 2/N, 1/IH, 2/K
Mechanical	1/M, 1/EH2, 2/K, 2/AE1, 1/AE, 2/N, 1/IH, 2/K, 1/UH3, 1/L
Medium	1/M, 1/E, 2/D, 1/E, 1/UH3, 2/M
Merge	1/M, 1/ER, 1/ER, 1/D, 2/J
Message	1/M, 1/EH, 2/S, 1/I1, 1/IH, 1/D, 2/J
Michigan	1/M, 2/I, 3/SH, 1/IH, 2/G, 1/UH3, 2/N
Middle	1/M, 2/I, 2/D, 1/UH3, 2/L
Midnight	2/M, 3/I, 2/D, 2/N, 1/AH, 1/IY, 2/T
Might	2/M, 1/AH, 1/IY, 2/T
Miles	1/M, 2/AH1, 1/AH1, 1/IE, 1/UH3, 1/L, 1/Z

Million	2/M, 2/I1, 2/UH3, 1/L, 1/Y, 1/EH2, 1/N, 1/N
Minnesota	1/M, 1/I, 1/N, 1/EHH, 2/S, 2/O1, 1/O, 2/T, 1/UH2
Minus	1/M, 1/AH1, 1/AH1, 1/IY, 2/N, 1/UH3, 2/S
Missed	1/M, 2/I, 2/S, 2/S, 2/PAØ, 2/T
Mississippi	1/M, 2/I1, 2/S, 2/IH, 2/S, 2/I, 2/P, 1/Y
Missouri	1/M, 2/I1, 2/Z, 1/OO1, 1/ER, 1/R, 1/IE
Montana	1/M, 1/AH1, 1/AH1, 1/N, 2/T, 2/AE1, 1/AE1, 2/N, 1/UH2
Morning	1/M, 1/O, 2/R, 2/N, 1/I, 1/NG
Mountain	1/M, 1/AH1, 1/AW1, 1/U1, 1/N, 2/T, 2/UH2, 1/N
My	1/M, 2/AH1, 1/AH1, 1/IY

N	1/EHH, 1/EH1, 3/N, 4/N
Nation	2/N, 2/A, 1/IY, 1/SH, 1/SH, 1/UH2, 2/N
Navy	2/N, 2/A, 1/IY, 2/V, 1/IE, 1/Y
Nebraska	2/N, 1/UH2, 2/B, 2/R, 2/AE, 1/AE1, 2/S, 2/K, 1/UH2
Negative	2/N, 1/EH, 2/G, 1/UH3, 2/T, 1/IH, 2/V
Neutral	2/N, 2/IU, 1/U, PAØ, 2/T, 1/R, 1/UH2, 2/L
Nevada	2/N, 1/UH2, 2/V, 2/AH, 1/AH1, 1/D, 1/UH2
New	2/N, 2/I2, 1/IU, 1/U
New Hampshire	2/N, 1/IU, 1/U, 3/H, 3/H, 2/AE, 1/M, 2/P, 2/SH, 1/ER
New Jersey	2/N, 1/IU, 1/U, 1/D, 2/J, 2/ER, 2/R, 1/R, 1/Z, 1/E
New Mexico	2/N, 1/IU, 1/U, 2/M, 2/EH, 2/K, 2/S, 2/IH, 2/K, 2/O, 1/O1
New York	2/N, 1/IU, 1/U, 2/Y, 2/O2, 1/O, 1/R, 2/K
Next	2/N, 1/EH, 2/K, 2/S, 1/T
Night	2/N, 1/AH, 1/IY, 2/T
Nine	2/N, 1/AH, 1/IY, 2/N
Nineteen	2/N, 1/AH1, 1/IY, 2/N, 1/T, 1/IE, 1/E, 2/N
Ninety	2/N, 2/AH1, 1/IY, 1/N, 1/T, 1/Y
Normal	1/N, 1/UH3, 2/O2, 1/O, 1/R, 1/M, 1/UH3, 1/L, 1/L
North Carolina	1/N, 1/AW1, 2/R, 2/TH, 1/PAØ, 2/K, 2/AE1, 2/R, 1/UH3, 2/L 1/AH1, 1/IY, 2/N, 1/UH3
North Dakota	1/N, 1/AW1, 2/R, 2/TH, 2/PAØ, 2/D, 1/UH1, 2/K, 2/O, 2/T, 1/UH1

Not	1/N, 1/UH3, 2/AH1, 1/AH1, 1/T
November	2/N, 1/O1, 1/O1, 2/V, 2/EH2, 1/EH1, 1/M, 1/B, 1/ER
Now	2/N, 1/AH1, 1/AW1, 1/O1, 1/U1
Number	2/N, 2/UH3, 1/UH1, 1/M, 2/B, 2/ER, 2/R

O	2/O, 1/O1, 1/U1
Observe	1/UH2, 1/B, 1/S, 2/Z, 2/ER, 2/R, 1/R, 1/V
Of	2/UH, 2/V, 1/V
Off	1/AW1, 1/AW1, 2/F
Ohio	2/O, 2/H, 2/H, 2/AH1, 1/AH, 1/IY, 1/O, 1/O1
Okay	1/O1, 1/O1, 2/K, 2/A, 1/AY, 1/IY
Oklahoma	2/O, 2/K, 1/L, 1/UH2, 1/PAØ, 2/H, 1/O1, 2/O2, 1/M, 1/UH2
One	1/W, 2/UH, 1/EHH, 3/N
Only	1/O, 1/O1, 2/N, 2/L, 2/IH, 1/IY
Orange	2/O, 2/R, 1/I2, 1/I2, 1/N, 1/J, 1/CH
Orbit	1/O, 2/R, 2/B, 1/I, 2/T
Order	2/O, 1/ER, 1/D, 1/ER, 2/R
Orders	2/O, 1/ER, 1/D, 1/ER, 1/R, 1/Z
Oregon	1/O1, 1/OO1, 2/R, 1/IH, 1/G, 1/AH1, 1/AH1, 2/N, 1/N
Oscar	1/UH3, 1/AH1, 2/S, 2/K, 1/ER
Our	1/AH1, 1/OO1, 1/U1, 2/R
Out	1/AH1, 1/OO1, 1/U1, 1/T
Over	1/O1, 2/O, 1/V, 1/ER

P	2/P, 1/E, 1/IY
Pan	2/P, 1/AE1, 1/AE1, 1/EHH, 2/N, 1/N
Pancake	2/P, 1/AE1, 1/AE1, 1/EHH, 1/N, 2/K, 1/A, 1/IY, 2/K
Partner	2/P, 1/UH3, 1/AH, 1/R, 1/T, 1/PAØ, 1/N, 1/ER, 1/ER
Password	2/P, 2/AE1, 1/AE , 2/S, 2/W, 1/ER, 2/R, 2/D
Pat	2/P, 2/AE1, 1/AE, 1/EHH, 1/T
Patient	2/P, 2/A, 1/IY, 1/SH, (1/SH), 1/UH2, 2/N, 2/T
Pennsylvania	2/P, 1/EH, 2/N, 2/S, 1/IH, 2/L, 2/V, 1/A, 1/IY, 2/N, 1/Y1, 1/UH2
Pilot	2/P, 1/UH3, 1/AH, 1/IY, 2/L, 1/UH3, 2/T
Pin	2/P, 1/H, 1/I, 1/EHH, 2/N, 1/N
Pit	2/P, 1/H, 1/I, 1/IH, 2/T
Place	2/P, 2/L, 1/A, 1/IY, 1/S, 2/S
Planned	2/P, 1/L, 1/AE1, 1/AE1, 1/EHH, 2/N, 1/N, 1/D
Playboy	2/P, 1/L, 1/A, 1/IY, 2/B, 1/O, 1/OO1, 1/Y1
Please	2/P, 1/L, 1/E, 1/IY, 2/Z
Plus	2/P, 1/H, 2/L, 1/UH1, 2/S
Point	2/P, 1/O, 1/O1, 1/IY, 2/N, 2/T
Position	2/P, 1/UH3, 2/Z, 1/I1, 1/I2, 2/SH, 1/UH3, 2/N
Positive	2/P, 1/AH1, 1/AH1, 2/Z, 1/IH, 2/T, 1/I1, 2/V
Port	2/P, 1/O, 2/R, 2/T

Pressure	2/P, 2/R, 1/EH, 1/S, 2/SH, 1/ER, 1/ER
Previous	2/P, 1/R, 1/E, 2/V, 1/IY, 1/UH3, 2/S
Probably	2/P, 1/R, 1/AH, 1/B, 1/UH2, 2/B, 2/L, 1/E
Probe	2/P, 2/R, 2/O, 1/O1, 2/B
Probing	2/P, 2/R, 1/O, 2/O2, 2/B, 1/I, 2/NG
Problems	2/P, 2/R, 1/AH, 2/B, 2/L, 1/UH3, 1/M, 2/Z
Proceed	2/P, 2/R, 1/O2, 2/S, 2/E, 1/IY, 2/D
Proposition	2/P, 2/R, 1/AH1, 2/P, 1/UH3, 2/Z, 1/IH, 2/SH, 1/UH3, 1/N
Punch	2/P, 1/H, 1, UH1, 1/I2, 2/N, 1/T, 2/CH
Purple	2/P, 1/ER, 2/R, 2/P, 2/OO1, 2/L

Q	2/K, 1/IY, 1/U1, 1/U1
Quantity	2/Q, 2/W, 1/AW1, 2/N, 2/T, 1/I1, 2/T, 1/E
Quebec	2/Q, 2/W, 1/IY, 2/B, 1/EH, 2/K
Question	2/Q, 2/W, 1/EH, 2/S, 2/T, 1/CH, 1/I2, 1/UH2, 2/N

R	1/AH1, 1/UH3, 3/R
Ramp	2/R, 1/AE, 2/EHH, 2/M, 2/P, 2/H
Range	2/R, 1/A, 1/IY, 2/N, 1/D, 2/J
Rapidly	2/R, 1/AE, 2/P, 1/PAØ, 1/IH, 2/D, 1/PAØ, 1/L, 1/E
Rate	2/R, 1/A, 1/IY, 2/T
Reactor	3/R, 1/E, 2/AE1, 1/AE1, 2/K, 2/PAØ, 2/T, 1/ER, 2/R
Read (Reed)	3/R, 2/E, 1/IE, 2/D
Ready	2/R, 1/EH1, 2/EHH, 2/D, 2/Y
Recognize	2/R, 1/EH1, 1/K, 1/UH2, 1/G, 2/N, 1/UH3, 1/AH, 1/IY, 2/Z
Red (read)	2/R, 1/EH1, 2/EHH, 2/D
Reduce	2/R, 1/E, 2/D, 1/IU, 1/U1, 2/U1, 2/S, 1/S
Re-enter	2/R, 1/IE, 1/E, 1/PAØ, 2/EHH, 1/EH1, 2/N, 2/T, 1/ER
Reliable	2/R, 1/IH, 2/L, 2/AH, 1/EH1, 1/UH3, 2/B, 1/UH3, 2/L
Remove	2/R, 1/E, 2/M, 2/U1, 1/U, 2/V
Report	2/R, 1/E, 2/P, 2/O2, 1/O1, 2/R, 2/T
Request	2/R, 1/E, 2/Q, 2/W, 1/EH, 2/S, 2/T
Result	2/R, 1/IH, 2/Z, 1/UH2, 2/UH3, 2/L, 2/T
Rhode Island	2/R, 2/O, 1/O1, 2/D, 1/AH, 1/AH1, 1/IY, 2/L, 1/UH2, 2/N, 2/D
Right	2/R, 1/AH, 1/IY, 2/T
Rising	2/R, 2/AH1, 1/IY, 2/Z, 1/I, 1/NG

Road	2/R, 1/UH3, 2/O2, 1/O1, 1/U1, 2/D
Romeo	2/R, 2/O2, 1/O1, 1/M, 1/IY, 1/O2, 2/O2
Row	1/R, 1/UH3, 1/O, 2/O1
Runway	2/R, 2/UH, 1/N, 1/W, 1/A, 1/Y

S	1/EH, 2/S, 1/S
Said	2/S, 1/EH, 1/IH, 2/D
Sank	2/S, 1/AE1, 1/AE1, 1/EHH, 2/NG, 2/K
Scan	1/S, 2/K, 1/AE1, 1/AE1, 2/IH, 2/N, 1/N
Scene	2/S, 1/E, 1/E, 2/N, 1/N
Scitronix	2/S, 1/AH1, 1/IY, 1/T, 2/R, 1/AH1, 2/N, 1/IH, 2/K, 2/S
Screw	2/S, 2/K, 2/R, 1/IU, 1/U
Scrub	2/S, 2/K, 2/R, 1/UH, 2/B
Seat	2/S, 1/IE, 1/E, 2/T
Seconds	2/S, 1/EH, 2/K, 1/UH2, 2/N, 1/D, 2/Z
Sector	2/S, 1/EH, 2/K, 1/PAØ, 2/T, 1/ER, 2/R
See	2/S, 1/IE, 1/E, 2/E
Seek	2/S, 1/IE, 1/E, 2/K
Seen	2/S, 2/IE, 1/E, 1/N, 2/N
Sense	2/S, 1/EH, 2/N, 1/T, 2/S
Service	2/S, 2/ER, 1/R, 1/V, 1/IH, 2/S
Seven	4/S, 2/EH1, 1/V, 2/EH2, 3/N
Seventeen	3/S, 2/EH1, 1/V, 2/EH2, 2/N, 1/T, 2/IE, 3/Y, 3/N, 3/N
Seventy	3/S, 2/EH1, 1/V, 2/EH2, 1/N, 2/T, 3/Y
Sheet	2/SH, 1/IE, 2/E, 2/T

Ship	2/SH, 3/I1, 1/I2, 2/P, 1/H
Ship-To	2/SH, 1/I, 2/P, 1/H, 2/PAØ, 2/T, 1/IU, 1/U1, 2/U1
Should	2/SH, 1/IU, 1/OO1, 1/OO1, 2/D
Sick	2/S, 1/I, 2/I1, 2/K
Sierra	2/S, 1/IE, 1/Y1, 2/EH1, 1/EHH, 1/R, 1/UH2
Sight	2/S, 1/AH, 1/IY, 2/T
Since	2/S, 2/I, 1/I1, 1/N, 1/T, 2/S
Sing	2/S, 2/I1, 1/I, 1/NG
Single	2/S, 1/I, 2/NG, 1/G, 1/UH3, 2/L
Sink	2/S, 2/I1, 1/I, 1/NG, 2/K
Six	2/S, 2/I, 1/K, 1/S
Sixteen	2/S, 1/I, 1/K, 1/S, 1/T, 1/IE, 2/Y1, 3/N, 3/N
Sixty	2/S, 2/I, 1/K, 1/S, 2/T, 2/E
Skip	2/S, 2/K, 1/I2, 2/I2, 3/I2, 2/P
Skunk	2/S, 2/K, 1/UH, 1/NG, 2/K
Slightly	2/S, 2/L, 1/AH1, 1/IY, 1/T, 2/L, 1/IE, 1/Y
Slowly	2/S, 2/L, 1/UH3, 2/O2, 1/U1, 2/L, 1/IE, 1/E
Smoke	2/S, 1/M, 1/UH3, 1/O, 1/U1, 2/K
So (sew)	2/S, 1/UH3, 1/O2, 1/O1, 1/U1
Some	2/S, 1/UH, 1/M, 1/M

Sorry	2/S, 1/AW, 1/R, 1/Y
South Carolina	2/S, 1/UH3, 1/AH1, 1/U1, 1/TH, 2/K, 1/AE1, 1/R, 1/UH3, 2/L 1/AH1, 1/IY, 2/N, 2/UH2
South Dakota	2/S, 1/UH3, 1/AH1, 1/U1, 1/TH, 2/D, 1/UH2, 2/K, 2/O, 1/U1, 2/T, 1/UH2
Speed	2/S, 2/P, 1/E, 1/E, 2/D
Splash	2/S, 2/P, 2/L, 2/AE1, 1/AE1, 2/SH, 2/SH
Split	2/S, 2/P, 2/L, 1/I, 2/T
Spot	2/S, 2/P, 1/AH1, 1/AH1, 2/T
Squawk	2/S, 2/K, 2/W, 1/AH1, 1/AH1, 2/K
Stabilizer	2/S, 2/T, 2/A, 1/AY, 2/B, 1/UH3, 1/L, 1/AH1, 1/IY, 2/Z, 1/ER
Stall	2/S, 2/T, 1/AW1, 1/AW1, 2/L
Starboard	2/S, 2/T, 1/AH1, 1/ER, 2/B (1/O2), 1/ER, 2/D
State	2/S, 2/T, 1/A, 1/IY, 2/T
Steady	2/S, 2/T, 1/EH2, 1/EH2, 2/D, 2/Y
Stop	2/S, 2/T, 1/AH1, 1/AH1, 2/P
Straight	2/S, 2/T, 3/R, 1/A, 1/IY, 1/T
Stranger	2/S, 2/T, 2/R, 1/A, 1/AY, 2/N, 1/N, 2/J, 1/ER
Stripe	2/S, 2/T, 2/R, 1/AH1, 1/IY, 2/P
Stub	2/S, 2/T, 1/UH, 1/UH1, 2/B
Sweet	2/S, 2/W, 1/E, 2/E, 2/T
Switch	2/S, 2/W, 2/I, 1/T, 1/CH

Synthesizer	2/S, 1/I, 2/N, 2/TH, 1/UH3, 2/S, 1/AH1, 1/IY, 2/Z, 1/ER
Systems	2/S, 1/I, 2/S, 2/T, 1/UH2, 2/M, 2/Z

T	2/T, 2/IE, 1/E, 2/E
Tango	2/T, 1/AE, 1/AY, 2/NG, 1/G, 1/OO1, 1/O
Tape	2/T, 2/A, 1/IY, 2/P
Target	2/T, 1/AH1, 2/R, 2/G, 1/EH2, 1/T
Taxi	2/T, 2/AE1, 1/AE1, 2/K, 2/S, 1/PAØ, 1/Y
Tea	2/T, 1/IE, 1/E, 2/E
Tell	2/T, 1/EH, 1/UH2, 2/L
Temperature	2/T, 2/EH2, 2/EH2, 1/M, 2/P, 2/R, 1/UH3, 1/T, 1/CH, 1/ER
Ten	1/T, 1/EH1, 2/EH2, 3/N
Tennessee	2/T, 1/EH, 1/N, 1/UH3, 2/S, 2/S, 1/E, 1/Y
Terminal	2/T, 1/ER, 1/M, 1/I2, 2/N, 1/UH3, 2/L
Test	2/T, 1/EH, 1/EHH, 2/S, 2/T
Texas	2/T, 1/EH, 2/K, 2/S, 1/UH2, 2/S
There	2/TH, 1/A1, 1/EH1, 1/ER
Thirteen	2/TH, 1/ER, 1/H, 1/PAØ, 1/T, 1/IE, 2/Y, 3/N
Thirty	2/TH, 1/ER, 2/T, 3/Y
Thousand	2/TH, 2/AH1, 1/O1, 1/Z, 2/IH, 3/N, 3/D
Three	2/TH, 1/ER, 2/IE, 3/Y
Threshold	1/TH, 1/R, 1/EH, 1/SH, 1/PAØ, 1/H, 1/O2, 2/O2, 1/O2, 2/L, 2/D
Time	1/T, 1/AH1, 1/AE1, 1/IY, 1/M
Tip	2/T, 1/I2, 2/I1, 2/P
To (too)	2/T, 1/IU, 1/U1, 2/U1
Tool	2/T, 1/U, 1/U1, 1/O2, 2/L

Touch	2/T, 2/UH3, 3/UH3, 1/UH2, 1/T, 2/CH
Touchdown	2/T, 2/UH3, 3/UH3, 1/UH2, 1/T, 2/CH, 1/PAØ, 2/D, 1/AH1, 1/AW1, 1/U1, 1/N
Tower	2/T, 2/AH, 1/AW1, 1/W, 1/ER, 2/R
Track	2/T, 2/R, 1/AE1, 1/AE1, 2/K
Trade	2/T, 2/R, 1/A, 1/IY, 2/D
Trailer	2/T, 2/R, 1/A, 1/IY, 2/L, 1/ER
Transmission	2/T, 2/R, 1/AE1, 1/AE1, 2/N, 2/Z, 2/M, 2/I, 1/SH, 1/UH3, 2/N, 3/N
Trot	2/T, 2/R, 1/UH3, 1/AH1, 2/T
Tune-Up	2/T, 3/U, 1/N, 3/N, 1/PAØ, 2/UH3, 1/UH3, 2/P
Turbine	2/T, 2/ER, 3/R, 2/B, 1/I, 2/N
Turn	2/T, 2/ER, 3/R, 2/N, 2/N
Twelve	2/T, 2/W, 1/EH1, 2/UH2, 3/L, 2/V
Twenty	2/T, 2/W, 1/EH1, 1/N, 1/T, 2/Y
Two	2/T, 1/IU, 1/U1, 2/U1

U	1/Y, 1/OOH, 3/U
Unable	1/UH2, 2/N, 2/A, 1/IY, 2/B, 1/UH3, 2/L
Uniform	2/Y1, 1/IU, 2/OOH, 2/N, 1/I, 2/F, 1/O, 2/R, 2/M
Unit	2/Y1, 1/IU, 1/U, 2/N, 1/IH, 2/T
Up	1/UH3, 2/UH3, 3/UH3, 2/P
Upon	1/UH3, 2/P, 1/AH1, 1/AW1, 1/UH3, 2/N
User	2/Y1, 2/IU, 1/U, 2/Z, 2/ER
Utah	2/Y1, 2/IU, 2/U1, 1/U1, 1/T, 1/AW, 1/UH2

V	2/V, 2/IE, 1/E, 2/E
Vector	2/V, 1/EH1, 2/K, 1/PAØ, 2/T, 1/ER
Verify	2/V, 2/EH1, 1/R, 1/UH2, 2/F, 1/AH1, 1/IE, 1/IE
Vermont	2/V, 2/ER, 1/M, 1/AH1, 1/AH1, 2/N, 2/T
Very	2/V, 2/EH, 2/R, 2/Y
Victor	2/V, 1/I, 2/K, 1/PAØ, 2/T, 1/ER
Virginia	2/V, 1/ER, 2/D, 2/J, 1/I, 2/N, 2/Y1, 1/UH3
Visible	2/V, 1/I, 2/Z, 1/UH2, 2/B, 1/UH3, 2/L
VOTRAX	1/B, 2/V, 1/UH3, 2/O1, 2/U1, 2/T, 2/R, 1/AE1, 1/IH, 2/K, 2/S

W	2/D, 2/UH1, 2/B, 1/UH3, 2/L, 2/PAØ, 1/Y1, 1/IU, 2/U1
Want	2/W, 1/AH, 1/AH1, 2/N, 2/T
Warning	2/W, 2/O, 1/O2, 1/R, 1/N, 1/I, 1/NG
Washington	2/W, 1/AW, 2/SH, 1/I, 1/NG, 2/T, 1/UH2, 2/N
Watch	2/W, 1/AH, 1/AH1, 2/T, 2/CH
Water	2/W, 1/AW1, 1/AH1, 2/T, 1/ER
Wave	2/W, 2/A, 1/IY, 2/V
Weapon	2/W, 1/EH1, 2/P, 1/UH2, 2/N
We	2/W, 1/IE, 1/E, 1/E
Well	2/W, 1/EH, 1/UH3, 2/L
Were	2/W, 1/ER, 3/R
West Virginia	2/W, 1/EH, 2/S, 2/T, 1/PAØ, 2/V, 1/ER, 2/D, 2/J, 1/I, 2/N, 2/Y1, 1/UH3
Wheels	2/W, 1/IE, 1/E, 1/UH3, 1/L, 2/Z
Where (wear)	2/W, 2/EHH, 1/EH, 1/ER, 2/R
Which	2/W, 1/I, 2/I2, 1/T, 2/CH
Whiskey	1/W, 2/I2, 2/I1, 2/S, 2/PAØ, 2/K, 1/IE, 2/Y1
Who	2/H, 1/U, 2/U1
Will	2/W, 1/I, 2/L
Wind	2/W, 1/I, 2/N, 2/D

Wisconsin	2/W, 1/I, 2/S, 2/K, 2/AH1, 1/AH1, 2/N, 2/S, 1/UH2, 2/N
With	2/W, 1/I, 1/EHH, 2/TH
Within	2/W, 1/I, 2/TH, 1/IH, 2/I, 2/N
Work	2/W, 2/ER, 1/R, 2/K
Works	2/W, 2/ER, 1/R, 2/K, 2/S
Worth	2/W, 2/ER, 1/R, 2/TH
Write	2/R, 1/AH, 1/IY, 2/T
Wrong	2/R, 1/AW, 1/AW1, 2/NG
Wyoming	2/W, 1/AH1, 1/IY, 1/O, 1/O1, 1/M, 1/I, 2/NG

X	1/EH, 2/K, 2/S, 1/S
X-Ray	1/EH, 2/K, 2/S, 2/R, 1/A, 1/IY

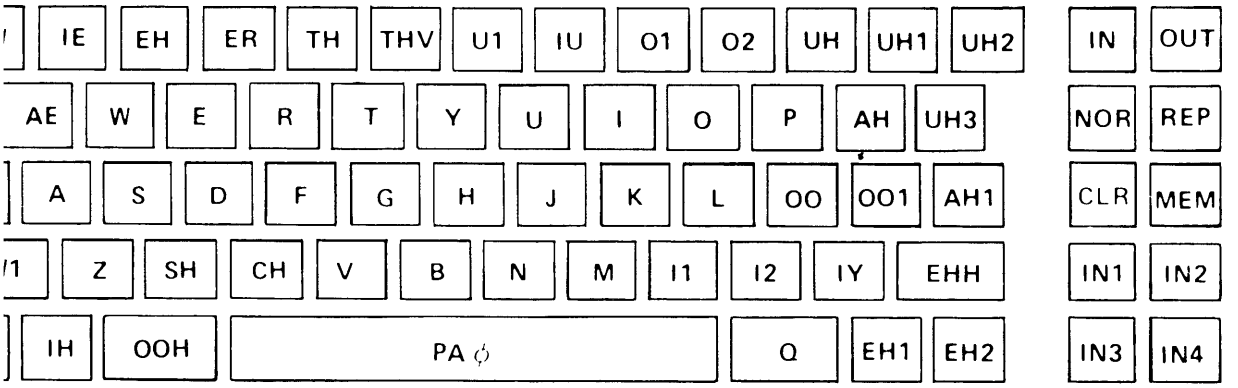
Y	1/W, 1/AH, 3/E
Yankee	2/Y1, 1/AE, 1/AY, 1/NG, 1/K, 1/IE, 1/E
Yellow	2/Y1, 1/EH2, 1/EH2, 1/L, 1/O1, 1/O
Yesterday	1/Y1, 1/EH1, 2/S, 2/T, 1/ER, 2/D, 1/A, 1/IY
Your	2/Y1, 1/UH3, 2/O2, 1/O1, 2/R

Z	2/Z, 1/IE, 1/E, 2/E
Zero	2/Z, 1/IE, 1/I2, 2/R, 1/UH3, 2/O
Zoo	2/Z, 1/OOH, 1/U, 1/U1
Zulu	2/Z, 1/OOH, 1/U, 2/L, 1/OOH, 1/U

EYBOARD OPERATING INSTRUCTIONS

BULLETIN #
ETB-5-0628 ME

Ref. Model # 5-2219-232-02 and 5-2219-232-02A



CTION

bulletin contains basic operating, programming, and troubleshooting uctions for the Votrax™ Voice Synthesizer. Keyboard operation is mplished by following the enclosed logic diagram, which relates to the ol and phoneme keys in the above illustration. Once the operator has me familiar with these procedures, phonetic language rules can be ered. These rules are detailed in bulletin ETB-2-1115 RG; since the ds present in words are not often what they are thought to be, following rules will result in proper voice synthesis.

Synthesizer memory consists of a 128 byte buffer. Each command ists of an inflection input and a phoneme input. Since the inflection controls phoneme loudness and stress, this information must be able before an active phoneme is entered into the buffer, or a al stress (IN2) will result.

L KEYS

e above illustration, notice the two columns of keys on the right side of the oard; these are the control keys. Their functions are as follows:

epressing the IN key places the Synthesizer in the keyboard input mode.
epressing the OUT key places the Synthesizer in the output speaking mode.
epressing the NOR key prevents the buffer information from recirculating; is key is normally used to clear the buffer while speaking.
epressing the REP key causes the buffer information to recirculate; this ey is normally used to repeat speech output.
epressing the CLR key causes the buffer to be immediately cleared f any information.
he MEM key is used to control buffer editing.
he inflection keys (IN1 through IN4) control phoneme loudness and stress.

E KEYS

emaining keys in the above illustration are phoneme keys. The active eme keys generate the basic consonant and vowel sounds. The inactive eme keys generate short silent intervals (PAØ, PA1, and PA2). Inactive emes are used to separate words, phrases, and sentences.

PA1	AW	IE	EH	ER	TH	THV	U1	IU	O1	O2	UH	UH1	UH2	IN OUT
PA2	AE1	AE	W	E	R	T	Y	U	I	O	P	AH	UH3	NOR REP
Y1	AY	A	S	D	F	G	H	J	K	L	OO	OO1	AH1	CLR MEM
NG	AW1	Z	SH	CH	V	B	N	M	I1	I2	IY	EHH		IN1 IN2
ZH	A1	IH	OOH	PAØ						Q	EH1	EH2		IN3 IN4

INITIAL START

Place the Synthesizer POWER switch in the ON position.

Depress the CLR key.

Clear the buffer.

Depress the NOR key.

Depress the IN key to put the buffer in keyboard input mode.

Depress and hold the desired inflection key (IN1 thru IN4).

Depress the desired phoneme key.

Release the inflection key.

Have you completed your input (no more than 128 commands including PAØ, PA1, and PA2) ?

No

Yes

To clear the buffer information, proceed as follows:

CLEAR START

Depre th NOR key.

Synthesizer will stop its utterance.

Depress PAØ, as required, until the required phoneme is uttered.

Depress th IN key at the start of the wor to modified.

To edit th inf mation in the buffer, proceed as follows:

E T ST RT

You are ready for playout.

This completes the message entry procedure. Th buffer will now recirculate nd initely; the message is uttered repeatedly.

Depr ss e OUT key.

Depress the REP key.

Depress the PA2 key three times.

Separates en f m ssage from beginning.

Is the phrase to be repeated ?

Yes

No

Depress the OUT key.

Buffer clears coincident with playout.

Depress the NOR key.

Do you wish to modify this phoneme, or insert a new phoneme in front of this phoneme ?

Modify

Insert

Depress and hold the inflection key.

Depress the phoneme key.

Release the inflection key.

Do you wish to insert another phoneme ?

Yes

No

Depress and hold the MEM key.

Depress and hold the inflection key.

Depress the phoneme key.

Synthesizer will advance to next phoneme.

Release the inflection and MEM keys.

Do you wish to modify the next phoneme ?

Yes

No

TROUBLESHOOTING

Trouble	Probable Cause	Remedy
Synthesizer does not work.	1. Speaker is not securely plugged into the unit.	1. Fully insert and secure the connector.
	2. Keyboard is not securely plugged into the unit.	2. Fully insert and secure the connector.
	3. The volume control has not been advanced to an audible level.	3. Rotate the volume control until the output is adequate.
	4. Electrical power is not reaching the unit.	4. Connect input power line and check for power.
		5. Check front panel for defective fuse.
		6. Place the power switch in the ON position.
Speech rate is improper.	1. The rate control is out of adjustment.	1. Rotate the rate control as required.
Static is heard in the output.	1. High volume will cause the audio to break up.	1. Rotate the volume control until the output is free of static.
	2. The speaker connection is not secure.	2. Fully insert and secure the connector.
	3. The speaker has been damaged.	3. Replace the speaker.

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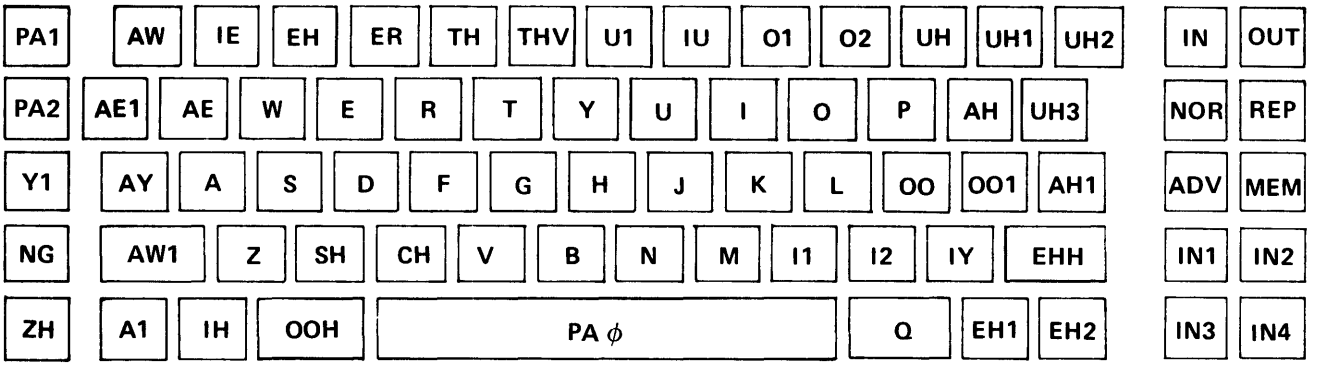
KEYBOARD INSTRUCTION AND PHONETIC RULES FOR LANGUAGE



PROGRAMMING THE VOTRAX ™ VOICE SYNTHESIZER

Programming Votrax ™ is quite simple once the phonetic rules for the language are mastered. The sounds present in a word are often not what we think they are, but by following these rules, any word in the English language may be synthesized properly.

Sounds which are considered to be only one basic sound can in reality be a glide of numerous sounds such as long A, short A, long E, short E, long I, short I, long O, and long U. Other sounds are combinations of two sounds such as J, Q, and CH.

The basic sounds, the vowels and consonants, are called phonemes. The secret of obtaining good quality pronunciation from Votrax ™ is proper phonetic programming. The stress on a syllable of a word is determined by the loudness and duration of its vowel or vowels. This is selected by the inflection commands (IN1 through IN4) and by the various choices on a given vowel. A higher number on a vowel calls forth the same vowel at a lower stress level, for instance:

UH is full stress
UH1 is normal stress
UH2 is weak stress
UH3 is very weak stress

E	USAGE
	ten
	sixty
	six
	no
	nine
	ed
	azure
	station
	sin
	bush
	quick

Here is a list of all the phonemes and their probable usage.

PH. NAME	USAGE	PH. NAME	USAGE	PH. NAME	USAGE	PH. NA
AW	law	ER	weather	UH	but	T
IE	zero	TH	three	AE	cat	Y
IE,E	three	THV	then	W	won	I
EH	ten	IU,U	two	R	three	O
P	penny	G	get	Z	zero	AH,IY
AH	car	H	hello	SH	show	EH,EH
Y1	yes	D,J	edge	T,CH	chair	ZH
A,AY	eight	K	came	V	seven	IH
S	six	L	hello	B	bed	I,IH
D	do	OO	book	N	nine	OO,OO
F	for	NG	ring	M	mile	Q

PA0 or space	forms the gap between words.
PA1	forms the gap at a comma.
PA2	forms the gap at the end of a statement.

The other numbered phonemes are lesser stressed versions of those on above list.

It is important to know the many glides found in English and how to generate them.

COMMON PHONEME NAME	VOTRAX ™ PHONEME EQUIVALEN
long A in name	A,AY
short A in hand	AE,EHH
AW in raw	UH,AW
long E in three	IE,E or IE,Y
short E in Ed	EH,EHH
long I in high	AH,IY
short I in is	I,IH
long O in low	UH,O
OW in cow or OU in out	AH,O
OI in noise	O,I2,Y1
short O in hop	UH,AH
long U in tune	IU,U
double O in took	OOH,OO
double O sound in bush	OO,OOH

Other important programming rules to consider:

J,DG in edge, and G in George	D,J
CH in chair	T,CH
NK in thank	NG,K
NG in engage	N,G
NG in engine	N,D,J
beginning Y like in yes	Y1
ending Y like in Mary	Y

With all vowels, appropriate stress must be determined and the corresponding phoneme chosen. The word eight, for example, is programmed A,AY,T while the word eighty is programmed A1,AY,T,Y. The A1 in place of A shortens the first syllable of eighty to correspond with our natural pronunciation of that word. As a general rule, longer words have shorter syllables and require more higher numbered, shorter vowel commands.

It may now be seen that many sounds which are normally thought of as single sounds are actually glides which must be represented by two phonemes. This characteristic in English is called dipthongization. We make dipthongs (glides) out of nearly all vowels much to the distress of foreigners trying to learn how to speak English.

Foreigners whose native tongue is not English will invariably pronounce the word three as THREE instead of our normal dipthongized version, THRIE; For the same reason pronunciation keys in dictionaries are of limited usefulness in programming Votrax ™. With practice, the user will rapidly learn to use Votrax ™ to its fullest capacity, producing well articulated speech more natural sounding than any other speech synthesis technique to date. The user is able to synthesize any word he chooses; recommended pronunciation codes on commonly used words are available on request.

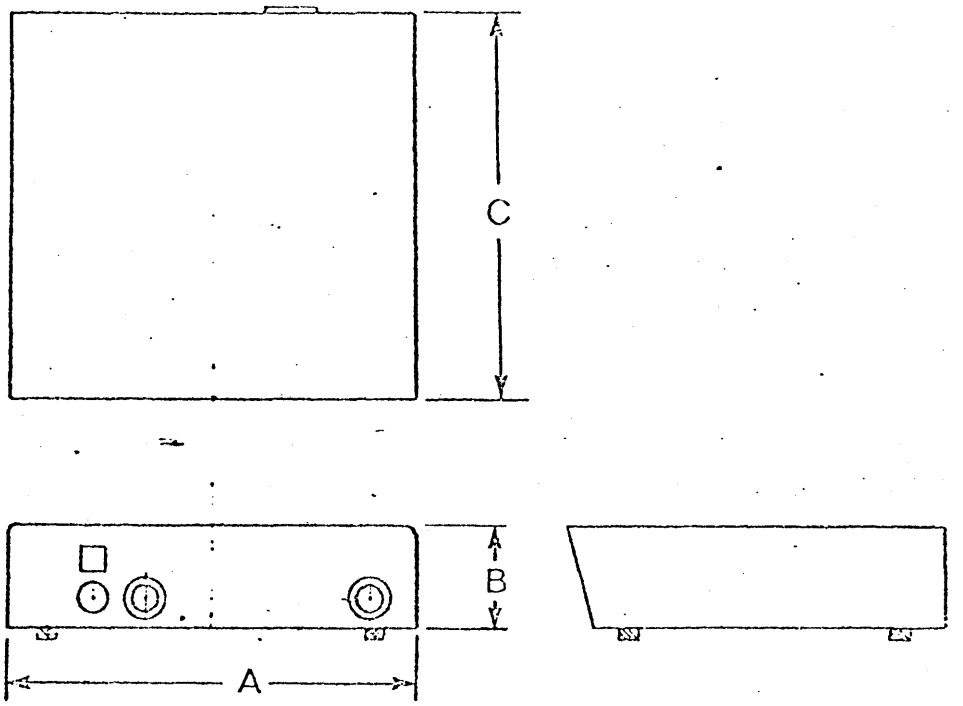
The space bar on the keyboard or PAO generates the binary word for the number sixty. It produces a short silent interval, and is usually used between words to keep the speech from "running together." Its use is not essential. The PA1 key produces a comma length pause and PA2 produces a period length pause. The phoneme commands consist of the binary equivalents of octal numbers from 1 to 63. A Binary pattern of all zero's must drive the synthesizer to maintain it in the resting position; During this command the synthesizer will be silent unless an audible phoneme command was presented during the previous 120 milliseconds. The binary number equivalents for all phoneme commands start with the number one in the upper left hand corner of the keyboard (note diagram) for PA1 and proceed from left to right a row at a time just like printed matter down to EH2 in the lower right hand corner which is phoneme number sixty-three.

Each phoneme should be accompanied by an inflection command. On keyboard versions of Votrax, the appropriate inflection key must be depressed before the phoneme key carrying that inflection is depressed. The reason for this is that the phoneme keys generate the strobe pulses which enter the composite phoneme/inflection commands into the buffer in the synthesizer. It is essential that the inflection commands be present at the keyboard output lines before the phoneme data is stored in the buffer. If no inflection key is depressed on keyboard versions, the inflection on such commands will be IN2 which is the neutral inflection of the system. When under computer control, the two phoneme inflection commands bits and the six phoneme selection command bits are presented simultaneously during the duration of the input strobe pulse.

An advantage of Votrax [TM] is that under computer control, inflection may be made content oriented producing a natural inflection impossible to achieve with systems utilizing pre-recorded human speech. This, however, is not necessary and very intelligible sentences may be constructed from words with preset inflections. Inflection commands on Votrax [TM], control pitch, timing, and volume just as they are controlled in the human vocal system. In normal speech, a stressed syllable is lengthened in time, is louder, and is higher pitched. Inflection commands on unvoiced sounds and pauses are also important because they affect adjacent phonemes. The sequence of inflection commands on a word is referred to as the inflection contour. A good natural contour for short words if it is unknown where the words will be placed in the sentences is 1234 or 2123 or 2124. The inflection on longer words depends on which syllables are stressed and which are unstressed, therefore no general rules can be stated. When a word ends a question, its inflection should be rising; If a word ends a statement or command, its inflection should be falling.

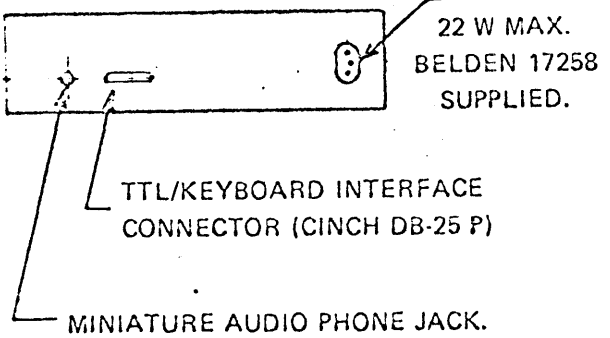
To operate Votrax [TM] from its keyboard depress both the IN key and the NOR (normal) key. Enter phoneme commands as previously described by depressing first the inflection desired and then the phoneme required. Do this repeatedly until all phonemes and corresponding inflections have been entered into the Votrax [TM] memory buffer. Do not enter more than 127 commands in one buffer loading sequence. Votrax [TM] will utter the commanded words when the OUT key is depressed. Depressing the repeat (REP) key prior to depressing the OUT key will cause the buffer to recirculate indefinitely and the message may be heard repeatedly for further evaluation. Depressing the NOR key while in this mode will cause the buffer memory to be emptied as the Votrax [TM] talks. To stop talking while in repeat mode and retain what is in memory, depress (IN) key. The advance (ADV) key will cycle the buffer at high speed and allow erasure in roughly half a second.

STAND ALONE CABINET, PT. #5-0301-301-01

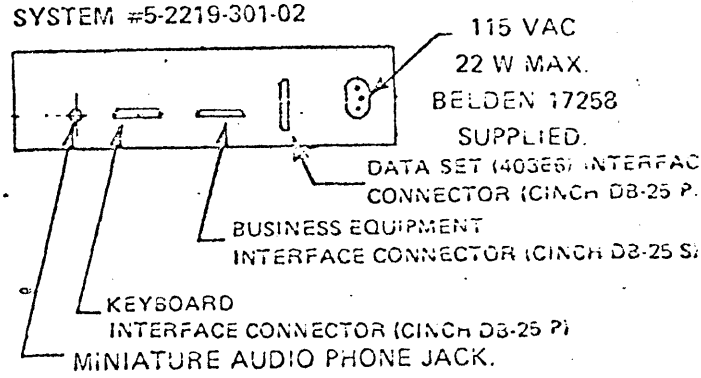


REAR VIEW INFORMATION

TTL/KEYBOARD
SYSTEM #5-2219-301-00



RS-232/KEYBOARD
SYSTEM #5-2219-301-02



VOTRAX DIMENSIONAL CHARACTERISTICS

MODEL	A	B	C
STAND ALONE	11.87	3.06	11.25