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PC Mate Speech board

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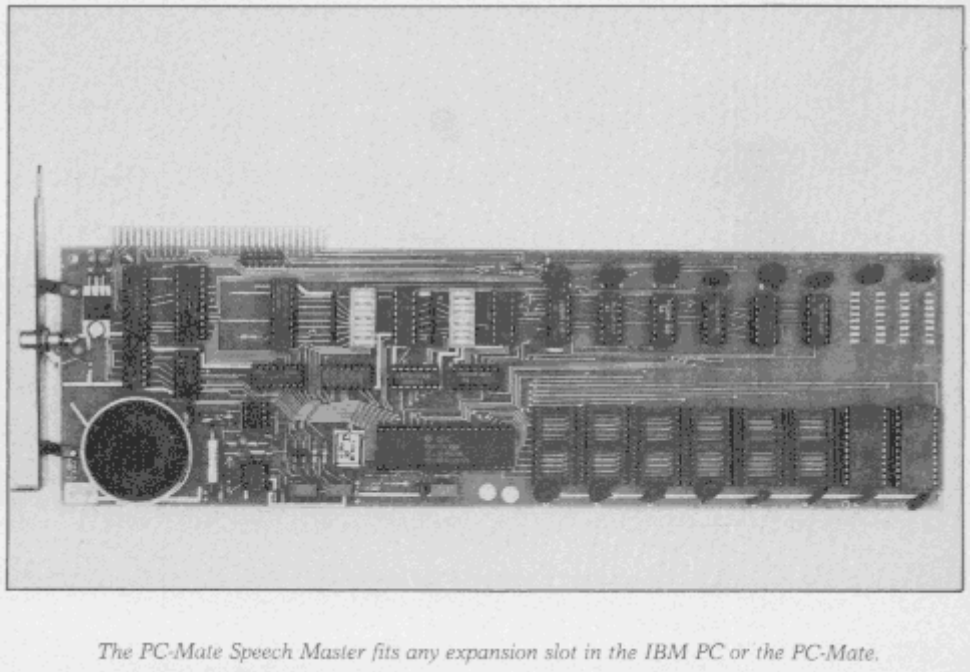

The PC-Mate Speech Master fits any expansion slot in the IBM PC or the PC-Mate.

PC Mate Speech Board

The Perfect Mate For the IBM PC
This is no silent partner' the PC-Mate Speech Master synthesizer board from Tecmar gives quality speech to your IBM.
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Would you like your IBM Personal Computer to talk to you? There is a speech synthesizer board that can do just that-the PC-Mate Speech Master from Tecmar, Inc. (23600 Mercantile Road, Cleveland, OH 44122). The board costs $395 and is one of the products in the PC-Mate line of expansion chassis, memory and board addons for the IBM Personal Computer from Tecmar. This board will go into any expansion slot in the IBM PC or the PC-Mate.
It performs text-to-speech conversion using both phoneme access, with the Federal Screw Works Votrax chip, and fixed vocabulary in ROM, with National Semiconductor's Speech Processor Chip (SPC). The software driver (SPEECH) for the board is supplied on disk and is functionally an overlay to PC-DOS. It does its job with minimal programming effort on the part of the user.

Hardware

National Semiconductor's SPC, the Digitalker, comes with vocabulary in pairs of ROMs and delivers high-quality nonmechanical speech. The two-ROM set that comes with the Speech Master contains 143 words; two more ROMs would yield another 100 to 150 words. Since there are eight sockets for ROMs, there is a possible vocabulary of about 560 words. Additional vocabulary ROMs are available in pairs in add-on kits.

Votrax, on the other hand, works with phonemes and has no problems with enunciating words without a lexicon. This chip produces speech which has a flat, mechanical quality without inflection or variance-but the Speech Master board does permit some output compensations.

There are three trim pots on the board for tone and volume control. They are located at the top so they can be reached and tweaked with the board installed and running. You can use them to match the Votrax and Digitalker output, adjust the board speaker volume and adjust phoneme pitch.

DIP switches are used to set the board's base address, 0B00 (hexadecimal). Actually, the Speech Master uses four ports-0B00 through 0B03. The first two of these ports are used for controlling access to the fixed vocabulary, the third is for phoneme access and the fourth for interrupts, status and module selection.

Interrupts shouldn't be used until you understand their use in the IBM PC. A single jumper (only one, no more) may be used to gain access to one interrupt request line out of the six that are available.

Speech Master has an on-board mixer, amplifier and speaker, which is enough for most tasks. An RCA phone plug is available on-board to enable use of an external speaker if that's needed. Power available on the board is adequate to drive an 8-ohm speaker, but anything more than that will experience distortion unless it has its own power and amplifier.

Software

Driver software must be reloaded when the computer is powered up and after each program reset. Do this by running the program named English. Once this software is loaded, output from the Speech Master can be obtained via print statements. For example, a Basic print instruction LPRINT CHR$(255) + HOW ARE YOU TODAY? would transmit the message to the talker instead of the printer due to the presence of the special character, CHR$(255), transmitted in the lead position. This example would select the Votrax device and the output would be phonemic.

One of the nice features of the software furnished by IBM with the PC is the control-P command, which causes printer output to be displayed on the CRT screen. In similar fashion, Tecmar software for this board has been written to use a control-T command to output to both the screen and the talker. A number of special operator command choices are available that permit complete flexibility in the choice of output modes.

Using Vocabulary

The vocabulary furnished in the two ROMs on the board is shown in Table 1. If you want to use any of these words, select the Digitalker with a CHR$(254) and then specify them in the following manner: LPRINT CHR$(254 + CHR$(26) + CHR$(77) +CHR$(129) This message is, "Eighty degrees."

Word	Code	Word	Word	Code	Word	Word	Code	Word
0	(0 Hex)	This is digitalker	48	(30 Hex)	Q	96	(60 Hex)	Is
1	(1 Hex)	One	49	(31 Hex)	R	97	(61 Hex)	It
2	(2 Hex)	Two	50	(32 Hex)	S	98	(62 Hex)	Kilo
3	(3 Hex)	Three	51	(33 Hex)	T	99	(63 Hex)	Left
4	(4 Hex)	Four	52	(34 Hex)	U	100	(64 Hex)	Less
5	(5 Hex)	Five	53	(35 Hex)	V	101	(65 Hex)	Lesser
6	(6 Hex)	Six	54	(36 Hex)	W	102	(66 Hex)	Limit
7	(7 Hex)	Seven	55	(37 Hex)	X	103	(67 Hex)	Low
8	(8 Hex)	Eight	56	(38 Hex)	Y	104	(68 Hex)	Lower
9	(9 Hex)	Nine	57	(39 Hex)	Z	105	(69 Hex)	Mark
10	(A Hex)	Ten	58	(3A Hex)	Again	106	(6A Hex)	Meter
11	(B Hex)	Eleven	59	(3B Hex)	Ampere	107	(6B Hex)	Mile
12	(C Hex)	Twelve	60	(3C Hex)	And	108	(6C Hex)	Milli
13	(D Hex)	Thirteen	61	(3D Hex)	At	109	(6D Hex)	Minus
14	(E Hex)	Fourteen	62	(3E Hex)	Cancel	110	(6E Hex)	Minute
15	(F Hex)	Fifteen	63	(3F Hex)	Case	111	(6F Hex)	Near
16	(10 Hex)	Sixteen	64	(40 Hex)	Cent	112	(70 Hex)	Number
17	(11 Hex)	Seventeen	65	(41 Hex)	400Hz Tone	113	(71 Hex)	Of
18	(12 Hex)	Eighteen	66	(42 Hex)	80Hz Tone	114	(72 Hex)	Off
19	(13 Hex)	Nineteen	67	(43 Hex)	20MS Silence	115	(73 Hex)	On
20	(14 Hex)	Twenty	68	(44 Hex)	40MS Silence	116	(74 Hex)	Out
21	(15 Hex)	Thirty	69	(45 Hex)	80MS Silence	117	(75 Hex)	Over
22	(16 Hex)	Forty	70	(46 Hex)	160MS Silence	118	(76 Hex)	Parenthesis
23	(17 Hex)	Fifty	71	(47 Hex)	320MS Silence	119	(77 Hex)	Percent
24	(18 Hex)	Sixty	72	(48 Hex)	Centi	120	(78 Hex)	Please
25	(19 Hex)	Seventy	73	(49 Hex)	Check	121	(79 Hex)	Plus
26	(1A Hex)	Eighty	74	(4A Hex)	Comma	122	(7A Hex)	Point
27	(1B Hex)	Ninety	75	(4B Hex)	Control	123	(7B Hex)	Pound
28	(1C Hex)	Hundred	76	(4C Hex)	Danger	124	(7C Hex)	Pulses
29	(1D Hex)	Thousand	77	(4D Hex)	Degree	125	(7D Hex)	Rate
30	(1E Hex)	Million	78	(4E Hex)	Dollar	126	(7E Hex)	Re
31	(1F Hex)	Zero	79	(4F Hex)	Down	127	(7F Hex)	Ready
32	(20 Hex)	A	80	(50 Hex)	Equal	128	(80 Hex)	Right
33	(21 Hex)	B	81	(51 Hex)	Error	129	(81 Hex)	SS (1)
34	(22 Hex)	C	82	(52 Hex)	Feet	130	(82 Hex)	Second
35	(23 Hex)	D	83	(53 Hex)	Flow	131	(83 Hex)	Set
36	(24 Hex)	E	84	(54 Hex)	Fuel	132	(84 Hex)	Space
37	(25 Hex)	F	85	(55 Hex)	Gallon	133	(85 Hex)	Speed
38	(26 Hex)	G	86	(56 Hex)	Go	134	(86 Hex)	Star
39	(27 Hex)	H	87	(57 Hex)	Gram	135	(87 Hex)	Start
40	(28 Hex)	I	88	(58 Hex)	Great	136	(88 Hex)	Stop
41	(29 Hex)	J	89	(59 Hex)	Greater	137	(89 Hex)	Than
42	(2A Hex)	K	90	(5A Hex)	Have	138	(8A Hex)	The
43	(2B Hex)	L	91	(5B Hex)	High	139	(8B Hex)	Time
44	(2C Hex)	M	92	(5C Hex)	Higher	140	(8C Hex)	Try
45	(2D Hex)	N	93	(5D Hex)	Hour	141	(8D Hex)	Up
46	(2E Hex)	O	94	(5E Hex)	In	142	(8E Hex)	Volt
47	(2F Hex)	P	95	(5F Hex)	Inches	143	(8F Hex)	Weight (2)

Note 1: 'SS' makes any singular word plural. 'S' must be the statement that follows the word that is to be plural. It adds an 'S' to that statement. For example, 'DOG' becomes 'DOGS'.

Note 2: Address 143 is the last legal address in this particular word list. Exceeding address 143 will produce pieces of unintelligible invalid speech data.

Table 1. Vocabulary contained in the National Semiconductor SPC Digitalker ROMs furnished with the Tecmar PC Mate Speech Master.

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Using Phonemes

Phonemes available with the Votrax chip are given in Table 2; Table 3 has the same list rearranged according to the type of sound involved.

Software adjustment for the flatness of the phoneme speech output is done with pauses based upon encountering (and recognizing) commas, periods, colons and semicolons. Pitch changes are also used to inflect sentence completion at a period and inquiry at a question mark.

Speech output is also better if you spell words phonetically, such as compewter in place of computer. The program listing might look bad, but the sound will improve. Experiment a little.

In order to output the message Eighty degrees using phonemes, select the Votrax chip with the code CHR$(255) and give it the text: LPRINT CRR$(255) + "EIGHTY DEGREES"

Vocabulary and phoneme outputs may be mixed if you want the best of both worlds.

Phoneme Codes	Phoneme Symbol	Duration in msec.	Example Word	Phoneme Codes	Phoneme Symbol	Duration (ms)	Example Word
0 (00 Hex)	EH3	59	jacket	32 (20 Hex)	A	185	day
1 (01 Hex)	EH2	71	enlist	33 (21 Hex)	AY	65	day
2 (02 Hex)	EH1	121	heavy	34 (22 Hex)	Y1	80	yard
3 (03 Hex)	PA0	47	no sound	35 (23 Hex)	UH3	47	mission
4 (04 Hex)	DT	47	butter	36 (24 Hex)	AH	250	mop
5 (05 Hex)	A2	71	made	37 (25 Hex)	P	105	past
6 (06 Hex)	A1	103	made	38 (26 Hex)	O	185	cold
7 (07 Hex)	ZH	90	azure	39 (27 Hex)	I	185	pin
8 (08 Hex)	AH2	71	honest	40 (28 Hex)	U	185	move
9 (09 Hex)	I3	55	inhibit	41 (29 Hex)	V	103	any
10 (0A Hex)	I2	80	inhibit	42 (2A Hex)	T	71	tap
11 (0B Hex)	I1	121	inhibit	43 (2B Hex)	R	90	red
12 (0C Hex)	M	103	mat	44 (2C Hex)	E	185	meet
13 (0D Hex)	N	80	sun	45 (2D Hex)	W	80	win
14 (0E Hex)	B	71	bag	46 (2E Hex)	AE	185	dad
15 (0F Hex)	V	71	van	47 (2F Hex)	AE1	103	after
16 (10 Hex)	CH*	71	chip	48 (30 Hex)	AW2	90	salty
17 (11 Hex)	SH	121	shop	49 (31 Hex)	UH2	71	about
18 (12 Hex)	Z	71	zoo	50 (32 Hex)	UH1	103	uncle
19 (13 Hex)	AW1	146	lawful	51 (33 Hex)	UH	185	cup
20 (14 Hex)	NG	121	thing	52 (34 Hex)	O2	80	for
21 (15 Hex)	AH1	146	father	53 (35 Hex)	O1	121	aboard
22 (16 Hex)	OO1	103	looking	54 (36 Hex)	IU	59	you
23 (17 Hex)	OO	185	book	55 (37 Hex)	UI	90	you
24 (18 Hex)	L	103	land	56 (38 Hex)	THV	80	the
25 (19 Hex)	K	80	trick	57 (39 Hex)	TH	71	thin
26 (1A Hex)	J*	47	judge	58 (3A Hex)	ER	146	bird
27 (1B Hex)	H	71	hello	59 (3B Hex)	EH	185	get
28 (1C Hex)	G	71	get	60 (3C Hex)	E1	121	be
29 (1D Hex)	F	103	fast	61 (3D Hex)	AW	250	call
30 (1E Hex)	D	55	paid	62 (3E Hex)	PA1	185	no sound
31 (1F Hex)	S	90	pass	63 (3F Hex)	STOP	47	no sound

'T' must precede 'CH' to produce CH sound

'D' must precede 'J' to produce J sound

Table 2. Phonemes and their durations for the Federal Screw Works Votrax device used with the Terrmar PC-Mate Speech Master.

Phoneme Categories According to Production Features

Voiced	'Voiced' Fricat.	'Voiced' Stop	Fricative Stop	Fricative	Nasal	No Sound
E EH AE UH	OO1 Z	B	T	S	M	PAQ
E1 EH1 AE1 UH1	R ZH	D	DT	SH	N	PA1
Y EH2 AH UH2	LR J	G	K	CH	NG	STOP
Y1 EH3 AH1 UH3	L V		P	TH		
I A AH2 O	IU THV			F		
11 A1 AW O1	U			H		
12 A2 AW1 O2	U1					
13 AY AW2 OO	W					

Table 3. Votrax phonemes grouped by production features: voiced, fricative and nasal.

More Advanced Programming

There are more complicated matters for those who like to deal with such things. Fortunately, you don't need to know assembly language because sufficient instructions are available in Basic.

You will find that the Digitalker output can be terminated before it is complete by presenting the next request to the input port before the prior instruction is finished. The Votrax chip, on the other hand, doesn't turn off a phoneme until it is commanded to do so.

Communication with the Speech Master is handled through the four ports that carry the addresses 0B00 through 0B03 (2816 through 2819 decimal). The documentation that comes with the board contains two small Basic demonstration routines illustrating methods of handling the devices (see Listing 1).

The Out function transmits data that follows the comma to the given address; e.g., line 30 transmits an 8 to address 2819 (which turns on bit 3 and turns off all other bits) to enable the Votrax chip. The program then calls for the 64 phonemes available to be spoken in turn, each executing the loop in lines 100 and 110 while waiting for the previous phoneme to finish.

A similar demonstration program is available to exercise the SPC digigitalker chip and the ROM vocabulary. The SPC is enabled by turning on bit 2, address

2819, and turning off all other bits at that address, line 30 (see Listing 2).

Applications

Uses for the Speech Master have been found in business and industrial automation areas where the audio output permits the operator to keep his attention riveted on his job. Any anomaly found by the microcomputer in processing its tasks for the operator's work station will be made clear by the audio output of the talker. The operator is free to make corrections without needing to redirect his attention to a CRT screen or printer.

Other useful applications can be found as teaching aids, voice response in automatic telephone answering sys tems and even limited work with foreign languages (phonemes aren't just for English, you know).

Increasing use of computers by the blind due to availability of audible output (and Braille in lieu of printing) is another high value application that may be a social bonanza.

These are only a few of the possible ways to use speech synthesizers. Try the PC-Mate Speech Master with your IBM PC and find your own application.

Listing 1. Basic phoneme demonstration program.

```
10 REM PHONEME DEMONSTRATION
20 A=2816: REM BASE PORT ADDRESS
30 OUT A+3,8: REM ENABLE PHONEME CHIP
40 FOR N=0 TO 63: REM SAY ALL PHONEMES
50 OUT A+2,N: REM ADDRESS 2818
60 GOSUB 100: REM TEST FOR COMPLETION
70 NEXT N
80 END
100 S=INP(A+3): REM ASK FOR COMPLETION STATUS
110 IF S * 128 THEN RETURN ELSE GOTO 100:REM DONE? *>
```

Listing 2. Basic vocabulary demonstration program.

```
10 REM VOCABULARY DEMONSTRATION
20 A+2816: REM BASE PORT ADDRESS
30 OUT A + 3,4: REM ENABLE DIGITALKER
40 FOR N=0 TO 143: REM SAY ALL VOCABULARY WORDS
50 OUT A, N: REM ADDRESS IS 2816
60 GOSUB 100: REM TEST FOR WORD COMPLETION
70 NEXT N
80 END
100 S=INP(A+3): REM ASK FOR COMPLETION STATUS
110 IF S * 128 THEN RETURN ELSE GOTO 100: REM DONE? * >
```

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