

DT1050 DIGITALKER™ Standard Vocabulary Kit

General Description

The DIGITALKER™ is a speech synthesis system consisting of several N-channel MOS integrated circuits. It contains a speech processor chip (SPC) and speech ROM and when used with external filter, amplifier, and speaker, produces a system which generates high quality speech including the natural inflection and emphasis of the original speech. Male, female, and children's voices can be synthesized.

The SPC communicates with the speech ROM, which contains the compressed speech data as well as the frequency and amplitude data required for speech output. Up to 128k bits of speech data can be directly accessed.

With the addition of an external resistor, on-chip debounce is provided for use with a switch interface.

An interrupt is generated at the end of each speech sequence so that several sequences or words can be cascaded to form different speech expressions.

The DT1050 is a standard DIGITALKER kit encoded with 137 separate and useful words, 2 tones, and 5 different silence durations. (See the Master Word List Table I). The words and tones have been assigned discrete addresses, making it possible to output single words or words concatenated into phrases or even sentences.

The "voice" output of the DT1050 is a highly intelligible male voice. The vocabulary is chosen so that it is applicable to many products and markets.

Features

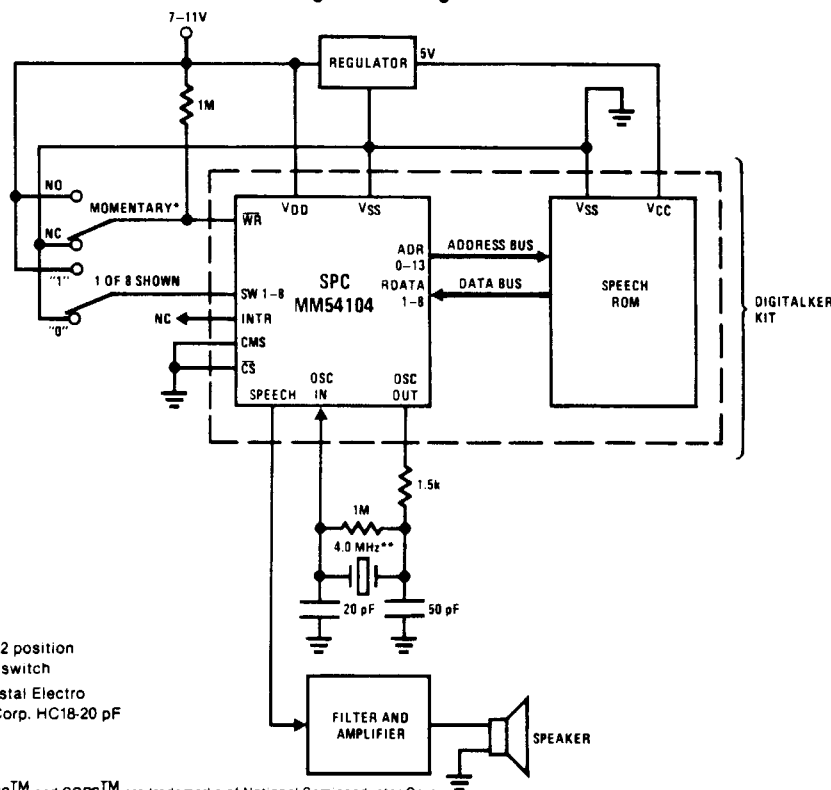
- COPST™ and MICROBUS™ compatible
- Designed to be easily interfaced to other popular microprocessors
- 144 addressable expressions, including numbers
- Natural inflection and emphasis of original speech
- Addresses 128k of ROM directly
- TTL compatible
- On-chip switch debounce for interfacing to manual switches independent of a microprocessor
- Interrupt capability for cascading words or phrases
- Crystal controlled or externally driven oscillator

Applications

- | | |
|----------------------|------------------------|
| ■ Telecommunications | ■ Consumer products |
| ■ Appliance | ■ Clocks |
| ■ Automotive | ■ Language translation |
| ■ Teaching aids | ■ Annunciators |

Typical Applications

Minimum Configuration Using Switch Interface



* Single pole 2 position momentary switch

** 4.0 MHz crystal Electro Dynamics Corp. HC18-20 pF

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Absolute Maximum Ratings*

Storage Temperature Range	- 65°C to + 150°C	Voltage at Any Pin	12V
Operating Temperature Range	0°C to 70°C	Operating Voltage Range, $V_{DD}-V_{SS}$	7V to 11V
$V_{DD}-V_{SS}$	12V	Lead Temperature (Soldering, 10 seconds)	300°C

DC Electrical Characteristics* $T_A = 0^\circ\text{C}$ to 70°C , $V_{DD} = 7\text{V}-11\text{V}$, $V_{SS} = 0\text{V}$, unless otherwise specified.

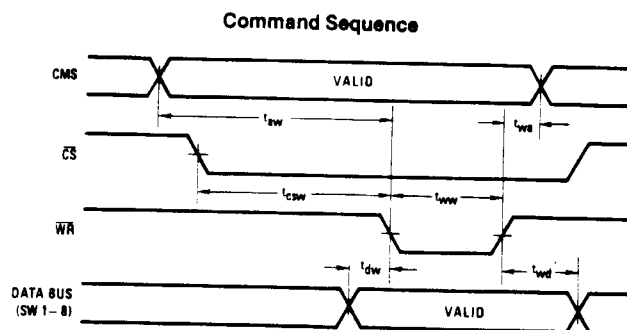
Symbol	Parameter	Conditions	Min	Typ	Max	Units
V_{IL}	Input Low Voltage		- 0.3		0.8	V
V_{IH}	Input High Voltage		2.0		V_{DD}	V
V_{OL}	Output Low Voltage	$I_{OL} = 1.6\text{ mA}$			0.4	V
V_{OH}	Output High Voltage	$I_{OH} = - 100\text{ }\mu\text{A}$	2.4		5.0	V
V_{ILX}	Clock Input Low Voltage		- 0.3		1.2	V
V_{IHx}	Clock Input High Voltage		5.5		V_{DD}	V
I_{DD}	Power Supply Current				45	mA
I_{IL}	Input Leakage				± 10	μA
I_{ILX}	Clock Input Leakage				± 10	μA
V_S	Silence Voltage					V
V_{OUT}	Peak to Peak Speech Output	$V_{DD} = 11\text{V}$		0.45 V_{DD}		V
R_{EXT}	External Load on Speech Output	R_{EXT} Connected Between Speech Output and V_{SS}	50	2.0		k Ω

AC Electrical Characteristics* $T_A = 0^\circ\text{C}$ to 70°C , $V_{DD} = 7\text{V}-11\text{V}$, $V_{SS} = 0\text{V}$, unless otherwise specified.

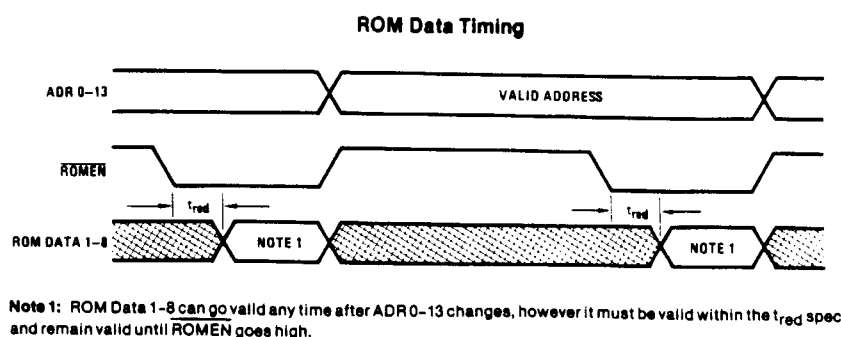
Symbol	Parameter	Min	Max	Units
t_{aw}	CMS Valid to Write Strobe	350		ns
t_{csw}	Chip Select ON to Write Strobe	310		ns
t_{dw}	Data Bus Valid to Write Strobe	50		ns
t_{wa}	CMS Hold Time after Write Strobe	50		ns
t_{wd}	Data Bus Hold Time after Write Strobe	100		ns
t_{ww}	Write Strobe Width (50% Point)	430		ns
t_{red}	$\overline{\text{ROMEN}}$ ON to Valid ROM Data		2	μs
t_{wss}	Write Strobe to Speech Output Delay		410	μs
f_t	External Clock Frequency	3.92	4.08	MHz

Note: Rise and fall times (10% to 90%) of MICROBUS signals should be 50 ns maximum.
 *SPC characteristics only. ROM characteristics covered by separate data sheet for MM52164.

Timing Waveforms



Timing Waveforms (Continued)



Functional Description

The following describes the function of all SPC input and output pins.

Note: In the following descriptions, a low represents a logic 0 (0.4V nominal), and a high represents a logic 1 (2.4V nominal).

INPUT SIGNALS

Chip Select (\overline{CS}): The SPC is selected when \overline{CS} is low. It is only necessary to have \overline{CS} low during a command to the SPC. It is not necessary to hold \overline{CS} low for the duration of the speech data.

Data Bus (SW 1-8): This is an 8-bit parallel data bus which contains the starting address of the speech data.

Data bus inputs SW 1-SW 8 accept an 8-bit binary address which is the address of the word which is to be "spoken" from the DIGITALKER output. See the Master Word List (Table I) for the complete listing of words and their respective addresses. If the entire word list is not used, unused inputs must be connected to V_{SS} .

Command Select (CMS): This line specifies the two commands to the SPC.

CMS	Function
0	Reset interrupt and start speech sequence
1	Reset interrupt only

Write Strobe (\overline{WR}): This line latches the starting address (SW 1-SW 8) into a register. On the rising edge of the \overline{WR} , the SPC starts execution of the command specified by CMS. The command sequence is shown in the timing waveform section. If a command to start a new speech sequence is issued during a speech sequence, the new speech sequence will be started immediately. When connecting \overline{WR} to a switch, it must be a single pole 2 position switch as shown on page 1.

ROM Data (RDATA 1-8): This is an 8-bit parallel data bus which contains the speech data from the speech ROM.

OUTPUT SIGNALS

Interrupt (INTR): This signal goes high at the completion of any speech sequence. It is reset by the next valid command. It is also reset at power up.

ROM Address (ADR 0-ADR 13): This is a 14-bit parallel bus that supplies the address of the speech data to the speech ROM.

ROM Enable (\overline{ROMEN}): For low power applications, this line can be used to drive a transistor that switches the supply for static speech ROMs. See ROM data timing.

Speech Output (Speech Out): This is the analog output that represents the speech data. See frequency response section.

INPUT/OUTPUT SIGNALS

Clock Input/Output (OSC IN, OSC OUT): These two pins connect the main timing reference (crystal) to the SPC.

PHRASE QUALITY

In normal human speech, the brain puts durations of silence between the words to make the sentence flow smoothly. Since several durations of silence are provided in the Master Word List, the actual quality of any phrase can be significantly improved by adding durations of silence (also assigned addresses) between the words. As one thinks about how the phrase is actually spoken, one might assume the approximate duration of silence between each word, and insert the closest duration of silence from the word list. A hint in this area would be that for words beginning with the letters, K, T, P, B, D, and G insert 80 milliseconds silence prior to the words, and for words ending in the same letters as above, 40 milliseconds silence following the word is recommended.

Functional Description (Continued)

TABLE I. DT1050 MASTER WORD LIST

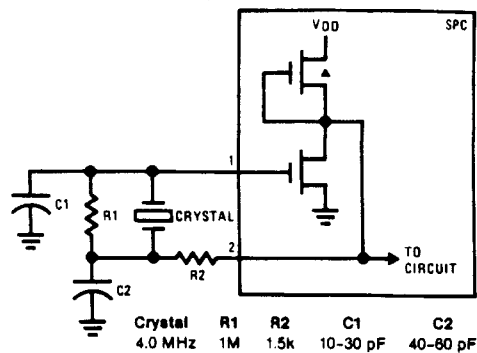
Word	8-Bit Binary Address			8-Bit Binary Address			8-Bit Binary Address	
	SW 8	SW 1		SW 8	SW 1		SW 8	SW 1
THIS IS DIGITALKER	00000000		Q	00110000		IS	01100000	
ONE	00000001		R	00110001		IT	01100001	
TWO	00000010		S	00110010		KILO	01100010	
THREE	00000011		T	00110011		LEFT	01100011	
FOUR	00000100		U	00110100		LESS	01100100	
FIVE	00000101		V	00110101		LESSER	01100101	
SIX	00000110		W	00110110		LIMIT	01100110	
SEVEN	00000111		X	00110111		LOW	01100111	
EIGHT	00001000		Y	00111000		LOWER	01101000	
NINE	00001001		Z	00111001		MARK	01101001	
TEN	00001010		AGAIN	00111010		METER	01101010	
ELEVEN	00001011		AMPERE	00111011		MILE	01101011	
TWELVE	00001100		AND	00111100		MILLI	01101100	
THIRTEEN	00001101		AT	00111101		MINUS	01101101	
FOURTEEN	00001110		CANCEL	00111110		MINUTE	01101110	
FIFTEEN	00001111		CASE	00111111		NEAR	01101111	
SIXTEEN	00010000		CENT	01000000		NUMBER	01110000	
SEVENTEEN	00010001		400HERTZ TONE	01000001		OF	01110001	
EIGHTEEN	00010010		80HERTZ TONE	01000010		OFF	01110010	
NINETEEN	00010011		20MS SILENCE	01000011		ON	01110011	
TWENTY	00010100		40MS SILENCE	01000100		OUT	01110100	
THIRTY	00010101		80MS SILENCE	01000101		OVER	01110101	
FORTY	00010110		160MS SILENCE	01000110		PARENTHESIS	01110110	
FIFTY	00010111		320MS SILENCE	01000111		PERCENT	01110111	
SIXTY	00011000		CENTI	01001000		PLEASE	01111000	
SEVENTY	00011001		CHECK	01001001		PLUS	01111001	
EIGHTY	00011010		COMMA	01001010		POINT	01111010	
NINETY	00011011		CONTROL	01001011		POUND	01111011	
HUNDRED	00011100		DANGER	01001100		PULSES	01111100	
THOUSAND	00011101		DEGREE	01001101		RATE	01111101	
MILLION	00011110		DOLLAR	01001110		RE	01111110	
ZERO	00011111		DOWN	01001111		READY	01111111	
A	00100000		EQUAL	01010000		RIGHT	10000000	
B	00100001		ERROR	01010001		SS (Note 1)	10000001	
C	00100010		FEET	01010010		SECOND	10000010	
D	00100011		FLOW	01010011		SET	10000011	
E	00100100		FUEL	01010100		SPACE	10000100	
F	00100101		GALLON	01010101		SPEED	10000101	
G	00100110		GO	01010110		STAR	10000110	
H	00100111		GRAM	01010111		START	10000111	
I	00101000		GREAT	01011000		STOP	10001000	
J	00101001		GREATER	01011001		THAN	10001001	
K	00101010		HAVE	01011010		THE	10001010	
L	00101011		HIGH	01011011		TIME	10001011	
M	00101100		HIGHER	01011100		TRY	10001100	
N	00101101		HOUR	01011101		UP	10001101	
O	00101110		IN	01011110		VOLT	10001110	
P	00101111		INCHES	01011111		WEIGHT (Note 2)	10001111	

Note 1: "SS" makes any singular word plural

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.

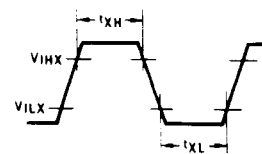
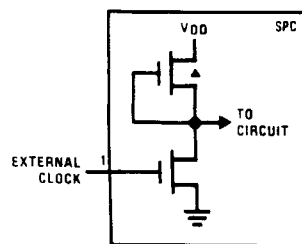
Crystal Circuit Information

Typical Crystal Oscillator Network



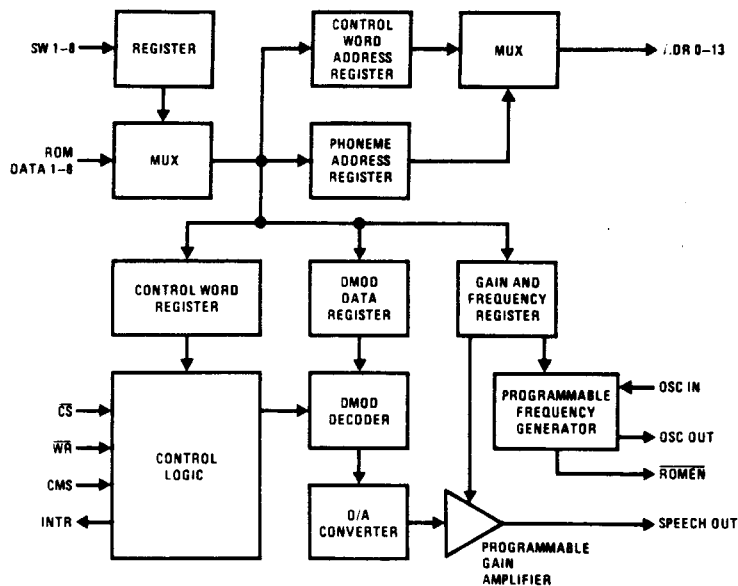
(4.0 MHz crystal manufactured by Electro Dynamics Corp. P/N HC18-20 pF)

External Clock Input (4.0 MHz)

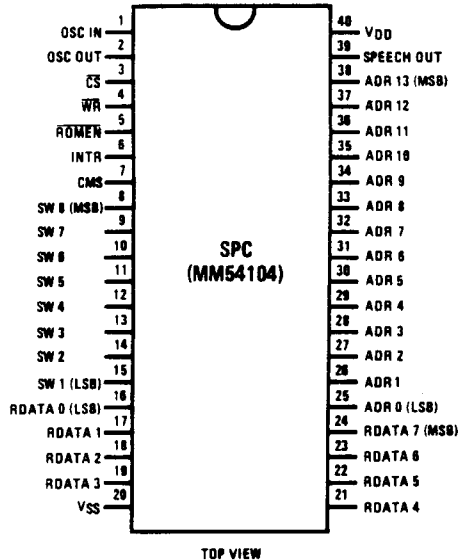


Timing	Min	Units
tXH	100	ns
tXL	100	ns

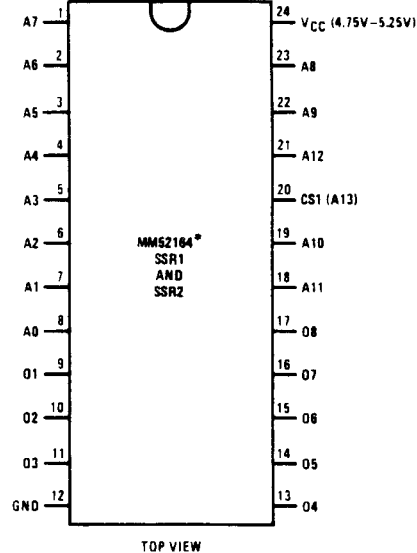
SPC Block and Connection Diagrams



Dual-In-Line Package

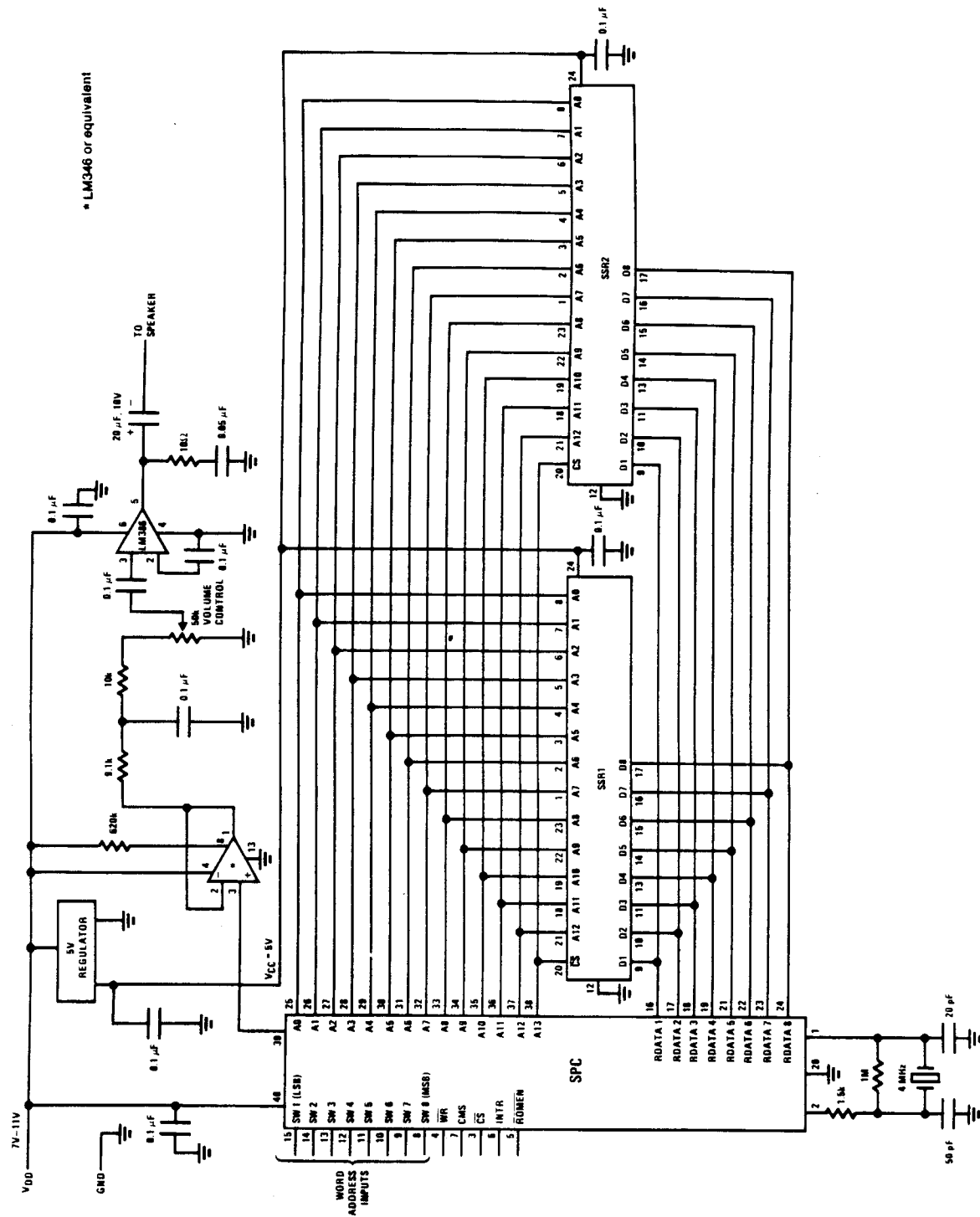


Dual-In-Line Package

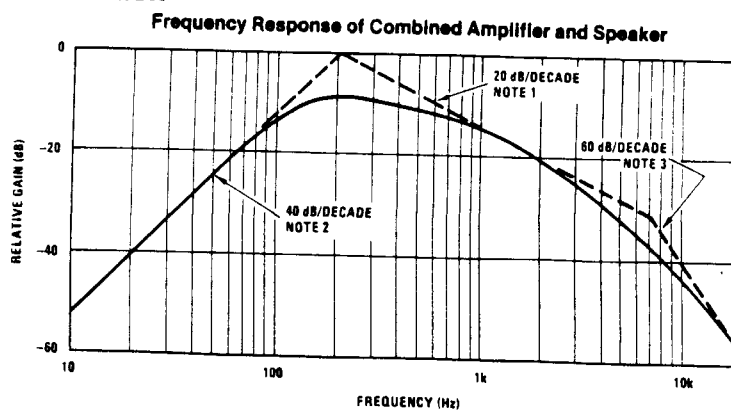


* For specific ROM device information, see MMS2164 data sheet.

Recommended Schematic Diagram



Applications Information



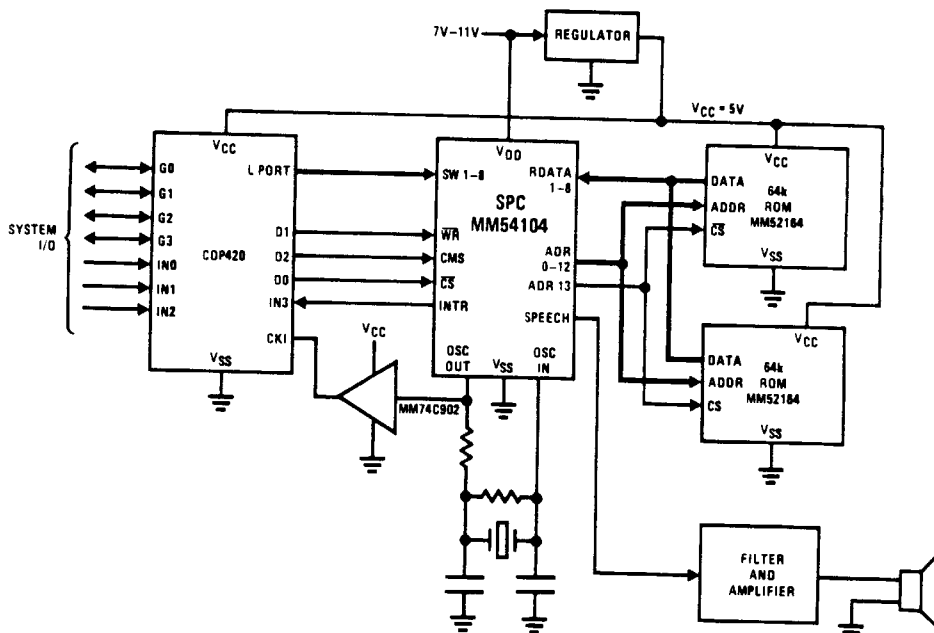
Note 1: This curve is the desired response of the entire audio system including speaker. Minimum response is a low pass filter with a cutoff frequency of 200 Hz. For an audio system with a natural cutoff frequency around 200 Hz, this filter can be eliminated. This cutoff frequency may be tuned for the particular voice being synthesized. For a low pitched male voice it may be 100 Hz, while for a high pitched female or child's voice it might be 300 Hz.

Note 2: This is optional filtering that can be eliminated by proper selection of the speaker. If this 2 pole response is electronically produced, it should be adjusted as described in Note 1.

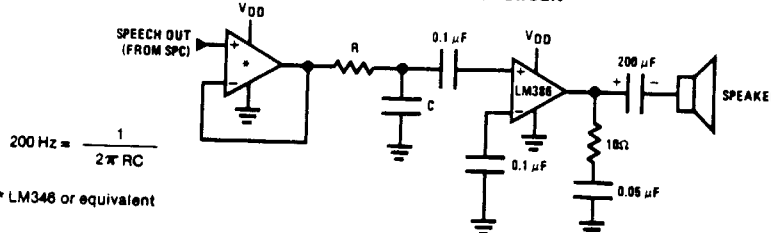
Note 3: This is optional filtering that can be eliminated for simpler systems. The acceptable range for this cutoff frequency is 6000 Hz-8000 Hz.

Typical Applications (Continued)

DIGITAL TALKER System Using COP420 Interface

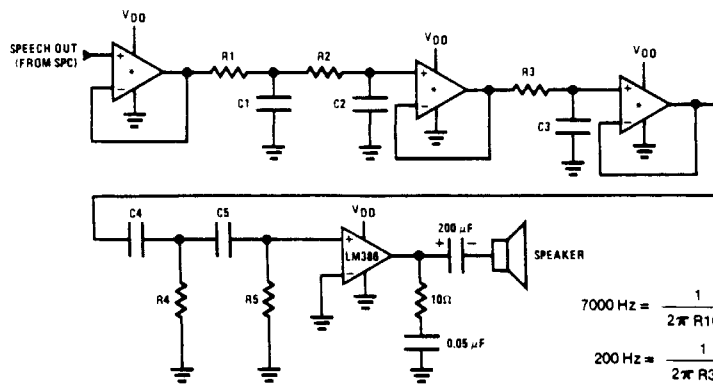


Minimum Filter Circuit



Typical Applications (Continued)

Filter Circuit to Produce Maximum Frequency Response

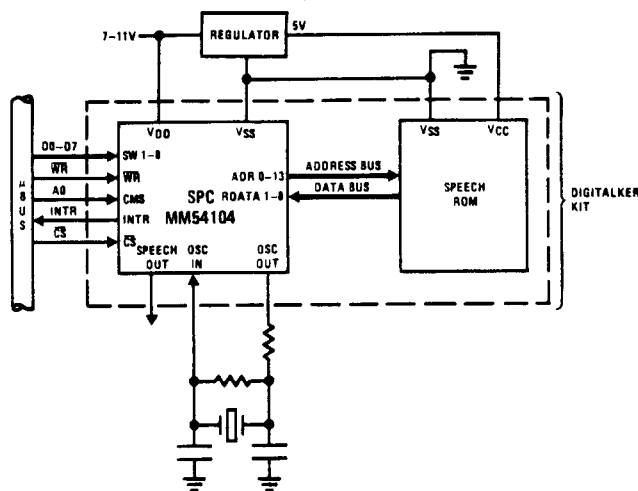


$$7000 \text{ Hz} = \frac{1}{2\pi R1C1} = \frac{1}{2\pi R2C2}$$

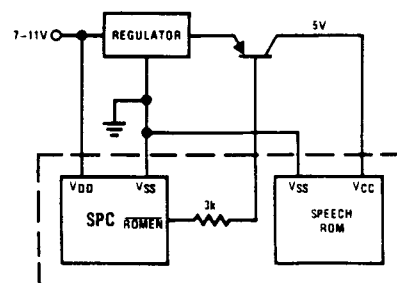
$$200 \text{ Hz} = \frac{1}{2\pi R3C3} = \frac{1}{2\pi R4C4} = \frac{1}{2\pi R5C5}$$

* LM348 or equivalent

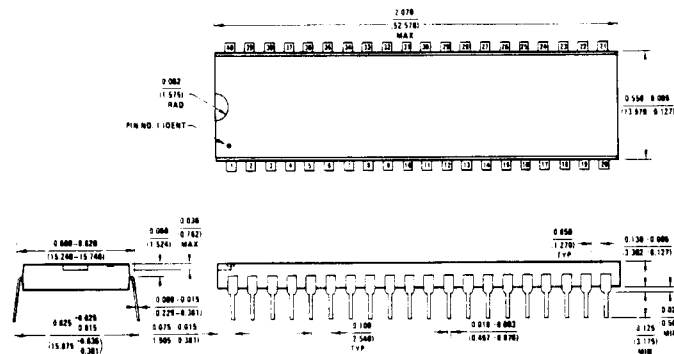
DIGITAL TALKER System Utilizing MICROBUS™ Interface



Low Power Configuration Using Static ROM



Physical Dimensions inches (millimeters)



Molded Dual-In-Line Package (N) NS Package Number N40A



National Semiconductor Corporation
2900 Semiconductor Drive
Santa Clara, California 95051
Tel.: (408) 737-5000
TWX: (910) 339-9240

National Semiconductor GmbH
Eisenheimerstrasse 61/11
8000 München 21
West Germany
Tel.: (089) 575091
Telex: 05-22772

NS International Inc., Japan
Miyake Building
1-9 Yotsuya, Shinjuku-ku 160
Tokyo, Japan
Tel.: (03) 355-3711
TWX: 232-2015 NSCJ J

National Semiconductor (Hong Kong) Ltd.
8th Floor
Cheung Kong Electronic Bldg.
4 Hing-rip Street
Kwun Tong
Kowloon, Hong Kong
Tel.: 3 690235
Telex: 43866 NSEHK HX
Cable: NATSEMI

NS Electronics Do Brasil
Avda. Brigadier Faria Lima 844
11 Andar Conjunto 1104
Jardim Paulistano
São Paulo, Brasil
Telex: 1121008 CABINE SAO PAULO

NS Electronics Pty. Ltd.
Cnr. Stud Rd. & Mtn. Highway
Bayswater, Victoria 3153
Australia
Tel.: 03-729-6333
Telex: 32096