

## USING MC68HC05F6 AS TONE PULSE DIALER WITH MELODY-ON-HOLD

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### INTRODUCTION

The MC68HC05F6 is a fully static single chip CMOS Microcomputer. It has 288 bytes of RAM and 32 bytes of stack, 4608 bytes of ROM, on-chip oscillator, 4 I/O ports and also features a DTMF / Melody Generator (DMG), a high current port, keyboard interrupt port, Serial Peripheral Interface (SPI), 16-bit timer and a CPU core with two and four software selectable operating speeds respectively. Put simply, the MC68HC05F6 is specifically designed for telephone applications such as high end feature phones or telephone answering machines.

This application note illustrates a simple hardware and software implementation for using the MC68HC05F6 to achieve DTMF dialing, pulse dialing, pacifier tone, and melody-on-hold functions.

### DTMF / MELODY GENERATOR

The DMG is a multi-functional tone generator which supports DTMF, melody, and pacifier tone generation with user-selectable frequencies. The benefit of the DMG lies in its versatility. It has sine/square wave melody and pacifier tone generators built-in, thus eliminating a significant amount of external hardware.

As shown in Figure 1, DMG is basically a DTMF generator with row and column frequency dividers, memory scanners, memories for sine wave, resistor ladders for D/A conversion, and a current summer/low-pass active filter. The time base for this module is a 3.58MHz/2 clock source which is derived from the crystal oscillator. The row and column Frequency dividers divide this clock into the lower frequencies according to the number written into Row and Column Frequency Control Registers. The output of each frequency divider drives a memory scanner that sequentially scans one of the 28 locations of a sine wave memory. The frequencies for dual tone melody are also generated by this principle. A D/A converter, which has a built-in active low-pass filter, sums the currents generated by the row and the column resistor ladders. There is also a software option for square wave melody output which is achieved by masking the least five significant bits of the output of the sine wave memory. The pacifier tone is the

signal tapped from the most significant bit of the output of Row Sine Wave Memory.

### KEYBOARD INTERRUPT

Port A can be configured as a keyboard interrupt port by using software option. In the keyboard interrupt mode, this port is internally pulled high, thus a keyboard interrupt will be recognised when one of its inputs is externally pulled low.

### SPEECH CIRCUIT

MC34114 is a monolithic integrated telephone speech network which incorporates the functions of transmit/receive amplification and sidetone control, each with externally adjustable gain. Loop length equalization varies the gains based on loop current. The microphone amplifier has a differential input stage designed to reduce RFI and common mode noise pick up. A MUTE\* input mutes the microphone and receive amplifiers during dialing. A regulated output voltage is provided for biasing of the microphone, and a separate output voltage powers an external microprocessor. The MC34114 is designed to operate at a minimum of 1.2 volts, making party line operation possible.

### DESCRIPTION OF THE TELEPHONE SYSTEM

MC68HC05F6 is designed not only for performing telephone dialing functions but also for interfacing with external peripheral, for example, a telephone answering machine. However, only the former application, but not the latter is described in this application note. Thus, many I/O lines, which should be dedicated for controlling functions, are intentionally used to drive a simple 7-segment LED display.

### HARDWARE AND FUNCTIONAL DESCRIPTION

As shown in Figure 2, the telephone system consists of the MC68HC05F6, a 4x4 keyboard, two 7-segment LED displays, speech circuit MC34114P, telephone ringer MC34017-1, rectifier bridge and a transistorized pulse di-

aling circuit.

The two 7-segment LEDs are used to display the key number pressed. Note that key 'A' is displayed as '10', key '#' as '14' and key '\*' as '15'.

The speech circuit MC34114 is usually powered by the telephone line through the rectifier bridge. User could select between an external floating power supply and the regulated 3.3V from VDD of MC34114 through switch S2 according to the current limit requirement. A backup battery should also be used in the latter case, as MC34114 is powered off in on-hook condition.

Either pulse or DTMF dialing can be selected through switch S3. Square wave or sine wave melody can be output by pressing '\*' and '#' after switching on melody switch S4 during a conversation. A number is dialed by pressing the appropriate key, except that pressing numbers 'A' to 'D' and '\*' and '#' renders no response for pulse dialing.

Before pulse dialing, the MS pin of the speech circuit is first set high (clear for DTMF dialing) to select pulse dialing mode, and the MUTE\* pin is cleared to mute the microphone and the receiver amplifier. During pulse dialing, pulses 50ms wide and 50% mark-space ratio will be output through TCMP pin to the pulse dialing circuit. A pacifier tone will also be produced through TNX pin to the receiver according to the key pressed. The pulse dialing circuit consists of two transistors - one in a common

emitter and the other, a common base configuration. The TCMP, which is the output compare pin of the 16-bit timer, is set high before and after pulse dialing to bias the base of TR1. Thus, the current flows through R3 and turns on TR2, and consequently causes the loop current of about 10mA to flow. When the TCMP pin is low, transistors TR1 and TR2 will be turned off, causing the loop current to decrease. The pulse train at TCMP will therefore effect pulse dialing across tip and ring. After dialing, the speech circuit will be unmuted.

The mute and mode select operation for DTMF dialing is similar to that of pulse dialing. During DTMF dialing, DTMF tone will be generated as long as, and according to, the key pressed. An external pull-up resistor of 10K is required at the open collector output TNO. Resistor R17 is used to adjust the DTMF gain through the speech circuit. The output level of TNO is about -10dBm, but the DTMF gain when R17 is 10K is 8.5dBm. Hence, a lower resistance (i.e. about 5K Ohm) is required to bring the DTMF signals across tip and ring to an acceptable level.

**SOFTWARE**

Since the program is well-documented, please refer to the program listing for details.

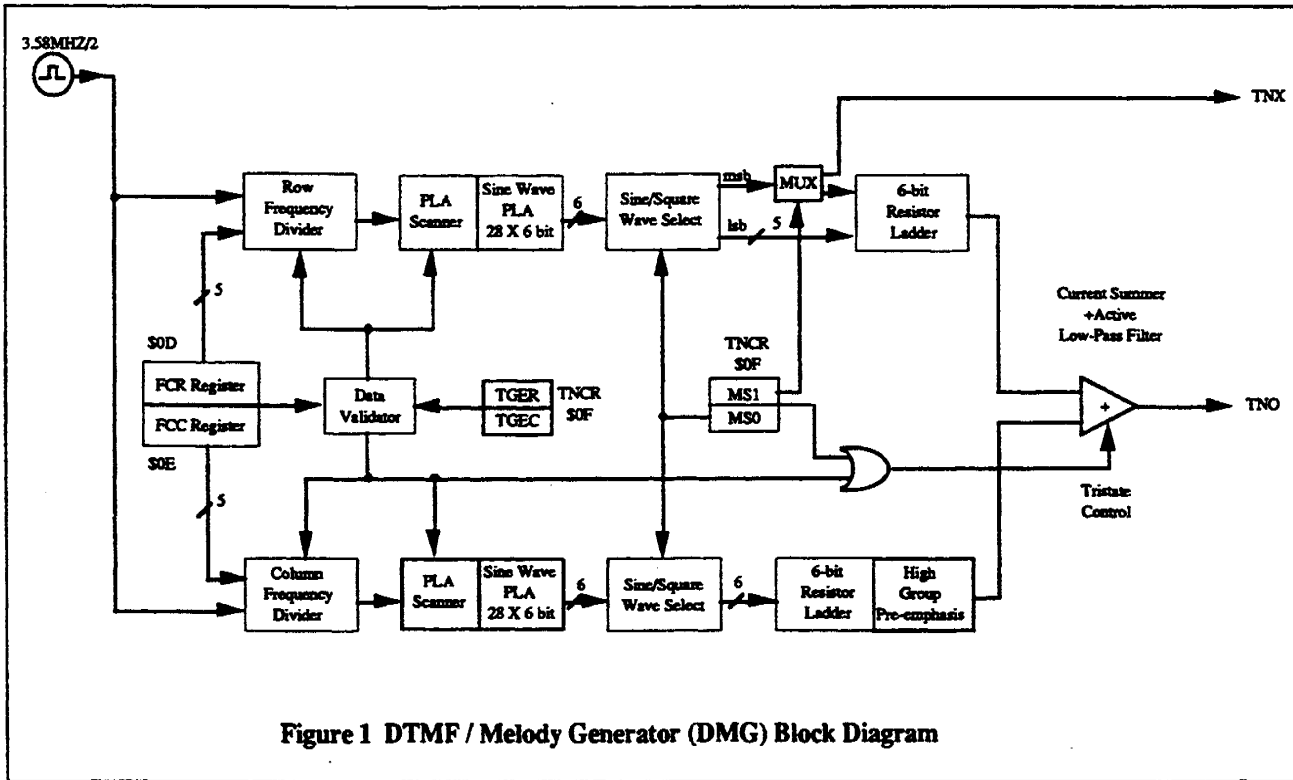
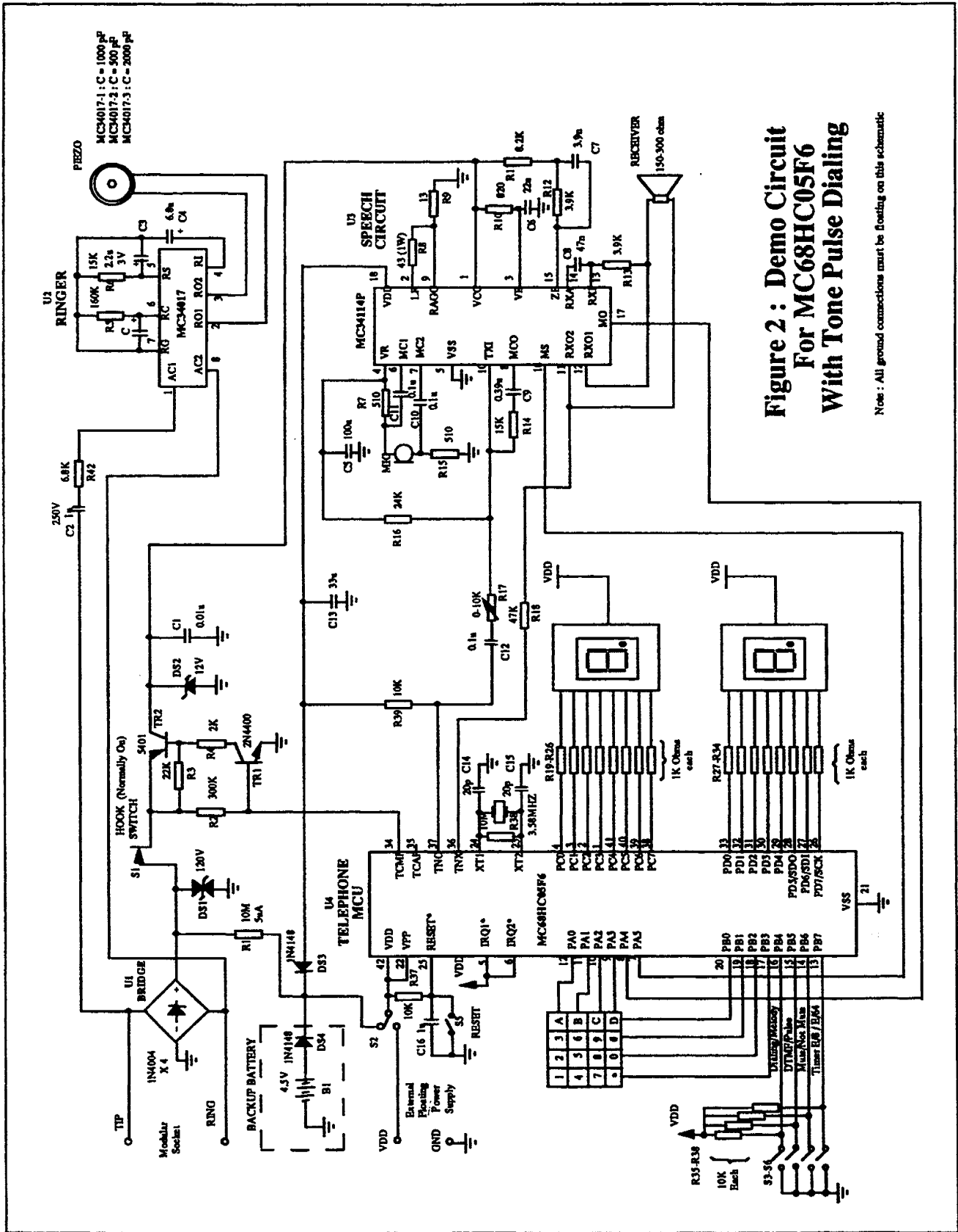


Figure 1 DTMF / Melody Generator (DMG) Block Diagram



**Figure 2: Demo Circuit For MC68HC05F6 With Tone Pulse Dialing**

Note: All ground connections must be floating on this schematic



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```

00004 *****
00005 *
00006 * APPLICATION PROGRAM *
00007 * FOR THE MC68HC05F6 *
00008 *
00009 * by Michael Chang *
00010 *
00011 *****
00012 *
00013 * I/O REGISTER DEFINITIONS *
00014 *
00015 0000 0000 PORTA EQU $00
00016 0000 0001 PORTB EQU $01
00017 0000 0002 PORTC EQU $02
00018 0000 0003 PORTD EQU $03
00019 0000 0004 DDRA EQU $04 DATA DIRECTION REGISTER A
00020 0000 0005 DDRB EQU $05 DATA DIRECTION REGISTER B
00021 0000 0006 DDRC EQU $06 DATA DIRECTION REGISTER C
00022 0000 0007 DDRD EQU $07 DATA DIRECTION REGISTER D
00023 *
00024 * SPI REGISTERS *
00025 *
00026 0000 000a SPCR EQU $0A SERIAL PERIPHERAL CONTROL
00027 0000 000b SPSR EQU $0B SERIAL PERIPHERAL STATUS
00028 0000 000c SPDAT EQU $0C SERIAL PERIPHERAL DATA
00029 0000 0007 SPIF EQU 7 SPI FLAG
00030 0000 0006 DCOL EQU 6 DATA COLLISION FLAG, BIT 6 OF STATUS REGISTER
00031 *
00032 * DMG REGISTERS *
00033 *
00034 0000 000d FCR EQU $0D ROW FREQUENCY CONTROL REGISTER
00035 0000 000e FCC EQU $0E COLUMN FREQUENCY CONTROL REGISTER
00036 0000 000f TNCR EQU $0F TONE CONTROL REGISTER
00037 0000 0007 MS1 EQU 7
00038 0000 0006 MS0 EQU 6
00039 0000 0005 TGER EQU 5 ROW TONE GENERATION ENABLE
00040 0000 0004 TGEC EQU 4 COLUMN TONE GENERATION ENABLE
00041 0000 0000 FR1 EQU $00
00042 0000 0001 FR2 EQU $01
00043 0000 0002 FR3 EQU $02
00044 0000 0003 FR4 EQU $03
00045 0000 0010 FC1 EQU $10
00046 0000 0011 FC2 EQU $11
00047 0000 0012 FC3 EQU $12
00048 0000 0013 FC4 EQU $13
00049 *
00050 * NOTES DEFINITIONS *
00051 *
00052 0000 0004 DS5 EQU $04
00055 0000 0007 FS5 EQU $07
00056 0000 0008 G5 EQU $08
00057 0000 0009 GS5 EQU $09
00058 0000 000a A5 EQU $0A
00059 0000 000b AS5 EQU $0B
00060 0000 000c B5 EQU $0C
00061 0000 000d C6 EQU $0D
00062 0000 000e CS6 EQU $0E
00063 0000 000f D6 EQU $0F
00064 0000 0014 DS6 EQU $14
00065 0000 0015 E6 EQU $15
00066 0000 0016 F6 EQU $16

```

00067	0000	0017	FS6	EQU \$17	
00068	0000	0018	G6	EQU \$18	
00069	0000	0019	GS6	EQU \$19	
00070	0000	001a	A6	EQU \$1A	
00071	0000	001b	AS6	EQU \$1B	
00072	0000	001c	B6	EQU \$1C	
00073	0000	001d	C7	EQU \$1D	
00074	0000	001e	CS7	EQU \$1E	
00075	0000	001f	D7	EQU \$1F	
00076	0000	0009	DLY1	EQU \$09	
00077	0000	0013	DLY2	EQU \$13	
00078	0000	003b	DLY6	EQU \$3B	
00079		*			
00080		*	MISCELLANEOUS DEFINITIONS		
00081		*			
00082	0000	0010	EVENR	EQU \$10	EVENT ENABLE REGISTER
00083	0000	0011	MISCR	EQU \$11	MISCELLANEOUS REGISTER
00084	0000	0004	KEYF	EQU 4	
00085		*			
00086		*	TIMER REGISTERS		
00087		*			
00088	0000	0012	TIMCR	EQU \$12	TIMER CONTROL
00089	0000	0013	TIMSR	EQU \$13	TIMER STATUS
00090	0000	0014	IPCAPH	EQU \$14	INPUT CAPTURE (HIGH BYTE)
00091	0000	0015	IPCAPL	EQU \$15	INPUT CAPTURE (LOW BYTE)
00092	0000	0016	OPCOMH	EQU \$16	OUTPUT CAPTURE (HIGH BYTE)
00093	0000	0017	OPCOML	EQU \$17	OUTPUT CAPTURE (LOW BYTE)
00094	0000	0018	COUNTH	EQU \$18	COUNTER (HIGH BYTE)
00095	0000	0019	COUNTL	EQU \$19	COUNTER (LOW BYTE)
00096	0000	001a	DUALTH	EQU \$1A	DUAL TM COUNTER (HIGH BYTE)
00097	0000	001b	DUALTL	EQU \$1B	DUAL TM COUNTER (LOW BYTE)
00098	0000	0006	OCF	EQU 6	OUTPUT COMPARE FLAG, BIT 6
00099	0000	0006	OCE	EQU 6	OUTPUT COMPARE ENANBLE, BIT 6
00100	0000	0000	OLVL	EQU 0	OUTPUT LEVEL AT TCMP OUTPUT
00101	0000	001f	KEYCR	EQU \$1F	KEYBOARD INTERRUPT REGISTER
00102	0000	002c	SYSOP	EQU \$2C	CLOCK OPTION REGISTER
00103	0000	0006	INTE1	EQU 6	IRQ1 ENABLE, BIT 6
00104	0000	0004	INTN1	EQU 4	IRQ1 EDGE SENSITIVITY, BIT 4
00105	0000	0006	INTF1	EQU 6	IRQ1 INTERRUPT FLAG, BIT 6
00106	0000	0007	KEYE	EQU 7	KEYBOARD INTERRUPT ENABLE, BIT 7
00107	0000	0001	KEYX1	EQU 1	KEYBOARD INTERRUPT EXTEND 1, BIT 1
00108	0000	0000	KEYX0	EQU 0	KEYBOARD INTERRUPT EXTEND 0, BIT 0
00109	0000	0007	SCS1	EQU 7	SYSTEM CLOCK SELECT 1, BIT 7
00110	0000	0006	SCS0	EQU 6	SYSTEM CLOCK SELECT 0, BIT 6
00111	0000	0005	TCS	EQU 5	TIMER CLOCK SELECT, BIT 5
00112		*			
00113		*	OPTION DEFINITIONS		
00114		*	(DEFINED BY PB4-5 INPUT PINS STATUS)		
00115		*			
00116	0000	0005	DILOP	EQU 5	DIALING OPTION
00117	0000	0004	FUNOP	EQU 4	FUNCTION OPTION
00118		*			
00119		*	SPEECH CCT CONTROL PIN DEFINITIONS		
00120		*	(DEFINED BY PA4-5 OUTPUT PIN STATUS)		
00121		*			
00122	0000	0004	MUTEB	EQU 4	MUTE CONTROL (1: NOT MUTE)
00123	0000	0005	DILMD	EQU 5	DIALING MODE (0:DTMF 1:PULSE)
00124		*			
00125		*	MEMORY MAP		
00126		*			
00127	0000	0030	COUNT	EQU \$30	TIMER HIGH BYTE FOR DELAY SUBROUTINE



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00128 0000 0031 KEYPOS EQU $31 KEY POSTION CODED BY COUNTING ROW AND COLUMN
00129 0000 0032 KEYNO EQU $32 KEY NUMBER ON KEY PAD
00130 0000 0033 KEYROW EQU $33 KEY ROW NUMBER
00131 0000 0034 KEYCOL EQU $34 KEY COLUMN NUMBER
00132 0000 0035 ROUND EQU $35 ROUND NUMBER OF MUSICAL PIECE
00133 0000 0036 HTEMP EQU $36 TEMPORARY LOCATION TO STORE HIGH BYTE
00134 *

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00135 0000 0042 MUL EQU $42 MULTIPLY INSTRUCTION
00136 *

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00137 *****

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00138 *
00139 *   INITIALISATION
00140 *
00141 *   BUS clock   : E
00142 *   Timer clock : E/8
00143 *   PORT A      : PA0-3 (INPUT) FOR KEYBOARD SENSING
00144 *                PA4=1 (NOT MUTE) PA5=0 (PULSE MODE)
00145 *   PORT B      : PB0-3 (OUTPUT ALL '0') FOR KEYBOARD SCAN
00146 *                PB4-5 (INPUT FOR OPTIONS)
00147 *   PORT C      : OUTPUT (OUTPUT ALL '1' ic. segment off)
00148 *   PORT D      : OUTPUT (OUTPUT ALL '1' ic. segment off)
00149 *

```

```

00150 *****
00151 *

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```

00152 0d00          ORG SD00
00153 0d00 a6 e0    START  LDA  #%11100000    SET MBUS CLOCK = E  TIMER CLOCK = E/8
00154 0d02 b7 2c          STA  SYSOP
00155 0d04 a6 7f    INIT1  LDA  #$7F
00156 0d06 b7 02          STA  PORTC      DISPLAY DOT IN MSB
00157 0d08 b7 03          STA  PORTD      DISPLAY DOT IN LSB
00158 0d0a 33 06          COM  DDRC      INIT PORTC and PORTD
00159 0d0c 33 07          COM  DDRD      TO DRIVE COMMON ANODE 7-SEG LED
00160 0d0e a6 10          LDA  #%00010000
00161 0d10 b7 00          STA  PORTA      SET NORMAL SPEECH MODE
00162 0d12 a6 f0          LDA  #$F0
00163 0d14 b7 04          STA  DDRA
00164 0d16 3f 01          CLR  PORTB
00165 0d18 43          COMA
00166 0d19 b7 05          STA  DDRB

```

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00167 *****

```

```

00168 *
00169 *   -- STARTUP DISLAY --
00170 *   THE DISPLAY WILL PERFORM A COUNT DOWN SEQUENCE FROM 9 TO 0 ON
00171 *   BOTH LED WHICH THE TIME INTERVAL IS ONE SECOND. AFTERWARDS
00172 *   THE KEYBOARD EXPECTS KEY PRESS FOR DIALING MODE OR MELODY.
00173 *

```

```

00174 *****
00175 *

```

```

00176 0d1b ae 09    INTRO  LDX  #9
00177 0d1d a6 14    INTRO1  LDA  #20      DELAY FOR 1 S
00178 0d1f b7 30          STA  COUNT
00179 0d21 cd 0dc1  DEL2    JSR  DELAY
00180 0d24 3a 30          DEC  COUNT      DELAY FOR .05S
00181 0d26 26 f9 0d21    BNE  DEL2
00182 0d28 d6 0e55    LDA  TBSEG.X    FETCH SEGMENT TABLE FOR DIGIT
00183 0d2b b7 03          STA  PORTD      DISPLAY LSB
00184 0d2d b7 02          STA  PORTC      DISPLAY MSB
00185 0d2f 5a          DECX      .. TIMER CLOCK
00186 0d30 2a eb 0d1d    BPL  INTRO1
00187 *
00188 0d32 ae 09          LDX  #$09      TO INITIALIZE TCMP PIN FOR DTMF AND
00189 0d34 b6 12  INITCMP  LDA  TIMCR      PULSE DIALING. H/W NEED.

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00242 0d80 20 d6 0d58          BRA RETURN
00243 0d82 0a 0118 0d9d DIAL1  BRSET DILOP,PORTB,DIAL2      **** ACTION FOR PULSE DIALING
00244 0d85 bc 32                LDX KEYNO
00245 0d87 a3 09                CPX #9                        CHECK IF VALID FOR PULSE DIALING
00246 0d89 22 0e 0d99          BHI NOPULS
00247 0d8b cd 0c29             JSR ECHOTX                    ECHO WITH PACIFIER TONE
00248 0d8e ad 1a 0daa          BSR RELEAS                    WAIT FOR KEY RELEASE
00249 0d90 3f 0f                CLR TNCR                      TURN OFF TONE GENERATION
00250 0d92 1a 00                BSET DILMD,PORTA             SELECT DTMF MODE FOR SPEECH CIRCUIT
00251 0d94 cd 0c33             JSR PUDIAL                    PERFORM PULSE DIALING
00252 0d97 20 bf 0d58          BRA RETURN
00253 0d99 ad 0f 0daa NOPULS  BSR RELEAS                    NO PULSE DIALING
00254 0d9b 20 bb0d58          BRA RETURN
00255 *
00256 * ACTION FOR TONE DIALING
00257 *
00258 0d9d 1b 00 DIAL2        BCLR DILMD,PORTA             SELECT DTMF MODE FOR SPEECH CIRCUIT
00259 0d9f cd 0c22             JSR TNDIAL                    PERFORM TONE DIALING
00260 0da2 ad 06 0daa          BSR RELEAS                    WAIT FOR KEY RELEASE
00261 0da4 3f 0f                CLR TNCR                      TURN OFF TONE GENERATION
00262 0da6 18 00                BSET MUTE B,PORTA            UNMUTE AFTER EACH DIAL
00263 0da8 20 ac 0d58          BRA RETURN
00264 *
00265 0daa b6 00 RELEAS        LDA PORTA                    CHECK IF KEY RELEASE
00266 0dac aa 0f                ORA #50F
00267 0dae b1 00                CMP PORTA
00268 0db0 26 f8 0daa          BNE RELEAS
00269 0db2 ad 07 0dbb          BSR DBOUNC
00270 0db4 b1 00                CMP PORTA
00271 0db6 27 f2 0daa          BEQ RELEAS
00272 0db8 3f 01                CLR PORTB                    PREPARE FOR NEXT SCAN
00273 0dba 81                    RTS
00274 *
00275 0dbb a6 ff DBOUNC        LDA #5FF
00276 0dbd 4a AGAIN           DECA                          LOOP 1536 TIMES FOR CMOS
00277 0dbe 26 fd 0dbd          BNE AGAIN
00278 0dc0 81                    RTS
00279 *
00280 0dc1 1c 12 DELAY         BSET OCE,TIMCR              PROVIDE 0.05S DELAY
00281 0dc3 b6 1a                LDA DUALTH
00282 0dc5 b7 36                STA HTEMP
00283 0dc7 a6 ed                LDA #237
00284 0dc9 bb 1b                ADD DUALTH
00285 0dc b7 17                STA OPCOML
00286 0dcd a6 0a                LDA #10
00287 0dcf b9 36                ADC HTEMP
00288 0dd1 b7 16                STA OPCOMH
00289 0dd3 b6 13                LDA TIMSR
00290 0dd5 b6 17                LDA OPCOML                    DUMMY INSTRUCTION
00291 0dd7 b7 17                STA OPCOML
00292 0dd9 0d 13fd0dd9 HOLD    BRCLR OCF,TIMSR,HOLD
00293 0ddc 1d 12                BCLR OCE,TIMCR
00294 0dde 81                    RTS
00295 *****
00296 *
00297 * DECODE SUBROUTINE
00298 * THE KEYS ARE DECODED INTO KEY POSITION(TOP AND RIGHT MOST IS 0
00299 * AND BOTTOM AND LEFT MOST IS 15) AND KEY NUMBER (THE NUMBER ON
00300 * THE KEYPAD WITH A=11, ... *=14, #=15 etc).
00301 *
00302 *****

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00303	0ddf 5f	DECCOL	CLR X	
00304	0de0 34 34	DDCOL	LSR KEYCOL	FIND COLUMN DETECTED
00305	0de2 24 03 0de7		BCC COLMUL	
00306	0de4 5c		INC X	COUNT COLUMN
00307	0de5 20 f9 0de0		BRA DDCOL	
00308		*		
00309	0de7 d6 0e4d	COLMUL	LDA TBTONC,X	STORE COLUMN TONE REQ'D
00310	0dea b7 0e		STA FCC	
00311	0dec a6 04		LDA #4	
00312	0dee 42		FCB MUL	MULTIPLY X BY 4
00313	0def b7 31		STA KEYPOS	RESULTS IN A AND STORE TO BUFFER
00314	0df1 34 33	DECROW	LSR KEYROW	FIND ROW DETECTED
00315	0df3 24 05 0dfa		BCC GETSEG	
00316	0df5 5c		INC X	
00317	0df6 3c 31		INC KEYPOS	COUNT ROW AND STORE KEY POSITION
00318	0df8 20 f7 0df1		BRA DECROW	
00319		*		
00320	0dfa d6 0e51	GETSEG	LDA TBTONR,X	STORE ROW TONE REQ'D
00321	0dfd b7 0d		STA FCR	
00322	0dff be 31		LDX KEYPOS	GET KEY POSITION
00323	0e01 d6 0e5f		LDA TBKEY,X	TRANSLATE TO KEY NUMBER
00324	0e04 b7 32		STA KEYNO	
00325	0e06 a0 0a		SUB #10	IS KEY NUMBER > 10 ?
00326	0e08 24 0a 0e14		BHS CARSEG	
00327	0e0a be 32		LDX KEYNO	
00328	0e0c d6 0e55		LDA TBSEG,X	
00329	0e0f b7 03		STA PORTD	
00330	0e11 5f		CLR X	
00331	0e12 20 08 0e1c		BRA OPSEG	
00332	0e14 97	CARSEG	TAX	KEY NUMBER >= 10, CARRY TO MSD
00333	0e15 d6 0e55		LDA TBSEG,X	
00334	0e18 b7 03		STA PORTD	
00335	0e1a ae 01		LDX #1	
00336	0e1c d6 0e55	OPSEG	LDA TBSEG,X	KEY NUMBER <= 10, DISPLAY AS NORMAL
00337	0e1f b7 02		STA PORTC	
00338	0e21 81		RTS	
00339		*		
00340		* TONE DIALING		
00341		*		
00342	0e22 19 00	TNDIAL	BCLR MUTEB,PORTA	MUTEB, PORTA
00343	0e24 a6 30	TNDIA1	LDA #%00110000	ENABLE DTMF TONE GENERATION
00344	0e26 b7 0f		STA TNCR	
00345	0e28 81		RTS	
00346		*		
00347		* PACIFIER TONE ECHO		
00348		*		
00349	0e29 d6 0e6f	ECHOTX	LDA TBTNX,X	GET PACIFIER TONE
00350	0e2c b7 0d		STA FCR	
00351	0e2e a6 a0		LDA #%10100000	ENABLE PACIFIER TONE GENERATION
00352	0e30 b7 0f		STA TNCR	
00353	0e32 81		RTS	
00354		*		
00355		* PULSE DIALING		
00356		*		
00357	0e33 be 32	PUDIAL	LDX KEYNO	
00358	0e35 26 02 0e39		BNE PDIAL1	
00359	0e37 ae 0a		LDX #10	
00360	0e39 19 00	PDIAL1	BCLR MUTEB,PORTA	MUTE SPEECH CIRCUIT
00361	0e3b b6 12	PDIAL2	LDA TIMCR	
00362	0e3d a8 01		EOR #%00000001	TOGGLE OP-COMPARE
00363	0e3f b7 12		STA TIMCR	

00364	0e41 cd	0dc1		JSR DELAY	
00365	0e44 01	12f4 0e3b		BRCLR OLVL,TIMCR,PDIAL2	
00366	0e47 5a			DECX	
00367	0e48 26	f1 0e3b		BNE PDIAL2	
00368	0e4a 18	00		BSET MUTEb,PORTA	UNMUTE BEFORE EXIT
00369	0e4c 81			RTS	
00370		*			
00371		*	TABLES FOR THE 7 SEGMENT DRIVE, KEYBOARD NUMBER, AND PACIFIER TONE		
00372		*			
00373	0e4d	13121110	TBTONC	FCB FC4,FC3,FC2,FC1	DTMF COL TONES
00374	0e51	00010203	TBTONR	FCB FR1,FR2,FR3,FR4	DTMF ROW TONES
00375	0e55	c0f9a4b0	TBSEG	FCB \$C0,\$F9,\$A4,\$B0,\$99	7-SEGMENT LEDS
00376	0e5a	9282f880		FCB \$92,\$82,\$F8,\$80,\$90	
00377	0e5f	0a0b0c0d	TBKEY	FCB \$0A,\$0B,\$0C,\$0D	KEYBOARD NUMBERS
00378	0e63	0306090e		FCB \$03,\$06,\$09,\$0E	
00379	0e67	02050800		FCB \$02,\$05,\$08,\$00	
00380	0e6b	0104070f		FCB \$01,\$04,\$07,\$0F	
00381	0e6f	04060809	TBTNX	FCB \$04,\$06,\$08,\$09,\$0B	PACIFIER TONES
00382	0e74	0d0f1416		FCB \$0D,\$0F,\$14,\$16,\$18	
00383		*			
00384		*	MELODY PERFORMANCE : MINUET BY J.S. BACH		
00385		*			
00386	0e79 3f	0f	MELODY	CLR TNCR	
00387	0e7b 01	3202 0e80		BRCLR 0,KEYNO,MELOD1	
00388	0e7e a6	40		LDA #%01000000	
00389	0e80 b7	0f	MELOD1	STA TNCR	SET DMG MODE
00390	0e82 5f			CLR X	RESET NOTE COUNTER
00391	0e83 3f	35		CLR ROUND	RESET TO FIRST ROUND
00392	0e85 d6	0ed0	ROWTON	LDA MINUET,X	GET ROW NOTE
00393	0e88 27	08 0e92		BEQ COLTON	IF BLANK GO TO COL NOTE
00394	0e8a b1	0d		CMP FCR	CHECK IF SAME NOTE
00395	0e8c 26	02 0e90		BNE ROWTN1	
00396	0e8e 1b	0f		BCLR TGER,TNCR	STOP TONE IF SAME NOTE
00397	0e90 b7	0d	ROWTN1	STA FCR	STORE TONE TO FCR
00398	0e92 5c		COLTON	INCX	INCREMENT NOTE COUNT
00399	0e93 d6	0ed0		LDA MINUET,X	GET COL NOTE
00400	0e96 27	080ea0		BEQ BEAT	IF BLANK GO TO BEAT DELAY
00401	0e98 b1	0e		CMP FCC	CHECK IF SAME NOTE
00402	0e9a 26	020e9e		BNE COLTN1	
00403	0e9c 19	0f		BCLR TGEC,TNCR	STOP TONE IF SAME NOTE
00404	0e9e b7	0e	COLTN1	STA FCC	STORE TONE TO FCC
00405	0ea0 cd	0dc1	BEAT	JSR DELAY	
00406	0ea3 b6	0f		LDA TNCR	TURN ON BOTH PATH
00407	0ea5 aa	30		ORA #%00110000	
00408	0ea7 b7	0f		STA TNCR	
00409	0ea9 5c			INCX	INCREMENT NOTE COUNT
00410	0eaa d6	0ed0		LDA MINUET,X	GET BEAT DELAY
00411	0ead b7	30		STA COUNT	
00412	0eaf cd	0dc1	DEL3	JSR DELAY	
00413	0eb2 3a	30		DEC COUNT	
00414	0eb4 26	f9 0caf		BNE DEL3	
00415	0eb6 3d	35		TST ROUND	
00416	0eb8 26	0c0ec6		BNE NXTON1	**** ROUND 0 ****
00417	0eba a3	59		CPX #89	END OF FINE1 ?
00418	0ebc 26	050ec3		BNE NXTON3	NEXT NOTE
00419	0ebe 5f			CLR X	RESET NOTE COUNT
00420	0ebf 33	35		COM ROUND	INCREMENT ROUND COUNT
00421	0ec1 20	c20e85		BRA ROWTON	
00422	0ec3 5c		NXTON3	INCX	
00423	0ec4 20	bf0e85		BRA ROWTON	**** ROUND 1 ****
00424	0ec6 a3	4d	NXTON1	CPX #77	TO FINE2?



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00425 0ec8 26 020ecc          BNE NXTON2
00426 0eca ae 5f             LDX #95
00427 0ecc a3 71           NXTON2      CPX #113
00428 0ece 26 f30ec3        BNE NXTON3
00429          *
00430          *   TABLE FOR DTMF & MELODY
00431          *
00432 0ed0 1b0409  MINUET    FCB AS6,DS5,DLY1 s
00433 0ed3 040009          FCB DS5,0,DLY1 d
00434 0ed6 060009          FCB F5,0,DLY1 r
00435 0ed9 080609          FCB G5,F5,DLY1 m
00436 0edc 090009          FCB GS5,0,DLY1 f
00437 0edf 0b0813          FCB AS5,G5,DLY2 s
00438 0ee2 040013          FCB DS5,0,DLY2 d
00439 0ee5 040013          FCB DS5,0,DLY2 d
00440 0ee8 0d0913          FCB C6,GS5,DLY2 l
00441 0eeb 090009          FCB GS5,0,DLY1 f
00442 0eee 0b0009          FCB AS5,0,DLY1 s
00443 0ef1 180009          FCB G6,0,DLY1 m
00444 0ef4 0f0009          FCB D6,0,DLY1 t
00445 0ef7 140813          FCB DS6,G5,DLY2 d2
00446 0efa 040009          FCB DS5,0,DLY1 d
00447 0efd 040009          FCB DS5,0,DLY1 d
00448 0f00 090613          FCB GS5,F5,DLY2 f
00449 0f03 0b0009          FCB AS5,0,DLY1 s
00450 0f06 090009          FCB GS5,0,DLY1 f
00451 0f09 080009          FCB G5,0,DLY1 m
00452 0f0c 060009          FCB F5,0,DLY1 r
00453 0f0f 080413          FCB G5,DS5,DLY2 m
00454 0f12 090009          FCB GS5,0,DLY1 f
00455 0f15 080413          FCB G5,DS5,DLY2 m
00456 0f18 060009          FCB F5,0,DLY1 r
00457 0f1b 040009          FCB DS5,0,DLY1 d
00458 0f1e 040b13  FINE1    FCB DS5,AS5,DLY2 d
00459 0f21 040809          FCB DS5,G5,DLY1 d
00460 0f24 060009          FCB F5,0,DLY1 r
00461 0f27 080b13          FCB G5,AS5,DLY2 m
00462 0f2a 060009          FCB F5,0,DLY1 r
00463 0f2d 001909          FCB 0,GS6,DLY1 f
00464 0f30 060913  FINE2    FCB F5,GS5,DLY2 r
00465 0f33 080b09          FCB G5,AS5,DLY1 m
00466 0f36 060009          FCB F5,0,DLY1 r
00467 0f39 040b09          FCB DS5,AS5,DLY1 d
00468 0f3c 060009          FCB F5,0,DLY1 r
00469 0f3f 04003b          FCB DS5,0,DLY6 d
00470          *
00471 1ffe .                ORG $1FFE
00472 1ffe 0d00  RSTV      FDB START
00473 1ff8                ORG $1FF8
00474 1ff8 0d46  KEYV      FDB KEYSCN
00475                END

```

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