

MAS Voice Board Application Note

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Chapter One - Introduction

The MAS Voice application board is a design kit developed for the MP3 player market that uses the following main components

- microcontroller PIC 16C74B PLCC44 from Microchip Technology, Inc.
- MPEG audio hardware decoder MAS 3507D-F10 from MICRONAS
- I²S high quality audio digital-analog converter DAC 3550A-C2 from MICRONAS
- 8 MByte SmartMedia Flash memory card

The design philosophy of this kit is centered around its flexibility for the end user with regard to items such as: the keypad input, display device, voice recording, file storage system, microprocessor upgrade, memory device, and MP3 bit rates. These items can be easily modified via microprocessor code and hardware options on the application board.

The board has been designed as a stand-alone reference design that can be run from a single AA battery. Total system power dissipation is approximately 200 mW for MP3 playback at 96 kbps. The MAS 3507D supplies power for all components with its built-in DC/DC converter. Please refer to the contact list Appendix F to access Data Sheets of all three ICs mentioned above.

PLEASE NOTE: The following precautions have to be taken when operating with the application kit

1. Do NOT remove or insert the SmartMedia Flash Card when the board is powered on, otherwise the Flash Card could be damaged
2. Run the Application Program for the Flash access BEFORE inserting the parallel port cable into P1. This initializes the port properly.

The features include

- MPEG layer 3 playback bitrates ranging from 8 kHz to 320 kHz
- keypad input, and LED display with 3 track positions
- single AA battery operation
- voice recording/playback through SC4-download software of MAS 3507D
- microphone input amplifier
- sine-wave generator through download software of the MAS 3507D
- Bass, Treble and Volume controls
- PC Application Programs for Flash access and hardware control

The Application Programs are described in Appendix A and the signal flow block diagram is shown in Appendix B.

Chapter Two - Hardware Operation

The development kit is controlled via pushbutton switches located by the battery socket and below the ICs. All switches are labeled with their corresponding functions. Please refer to the schematics – Appendix F – for the names of all components mentioned in this section.

Power-on and power-off

Power can be activated by placing a 1.5V AA battery cell (or DC power supply) into the battery holder P3 (Please make sure the polarity is correct) and pressing the POWER button (SW1).

Pressing the POWER OFF button (SW2) will turn off the power. When power is on, at least one of the LEDs will be on depending on what state the board is in. For example, at initial power on D1 (track 1 LED) will be on.

For details of the LED functionality, please refer to Appendix C.

Upon power-on the board is reset and the microprocessor PIC16C74 (U8) will initialize all components to their default states. The microprocessor will point to Track 1 in the Flash memory and activate the STOP (SW5) button, this will poll the LPT input (P1) and Keypad inputs until a change is made.

I²C communication

One LPT-I²C-adapter and a standard 9 pin Sub-D-cable is shipped with the MAS voice board to provide I²C-access to the MAS 3507D and the DAC 3550A. Connect the LPT-I²C-adapter to the parallel printer port of your PC and plug the male connector of the Sub-D-cable into the LPT-I²C-adapter. Please power up the board **BEFORE** inserting the female 9pin connector of the cable to the I²C-connector (P2). Please note that this I²C-input port is active at all times and some of the settings like the I²S-bit delay must not be driven from the PC to prevent audible noise or improper function when the board is performing I²C-telegrams. Of course, register polling through I²C is possible during audio decoding.

This connection is used for two of the four included Application Programs, the MAS3507D control program `masd32_v098b.exe` and DAC 3550A control program `dac3550a.exe`. Please refer to Appendix A for a detailed description of both programs.

LPT communication

After power-on, the LPT input (P1) will be polled only after activation of the stop button. LPT communication can begin after the STOP button has been pressed; this will activate the LED's D1 and D2 to signal that the Flash memory is ready for access.

Please note that for the LPT communication the following has to be applied in exactly the same order.

1. Ensure that the parallel port of your PC has been set to bi-directional in your PC setup. **PLEASE read the LPT-driver specifications of your PC carefully before applying higher voltages than 3.3 Volts to the MAS voice board as described in step 5. MICRONAS or MICROCHIP are NOT responsible for any damage that the informations in this note may cause to your PC-system**
2. Remove the battery and power the board with an adjustable power supply. Start with a supply voltage of 3.3 Volts. Press the POWER button SW1.
3. Now, run the DOS-based Application Program `pdrv.exe` once for the Flash access **BEFORE inserting the parallel port cable into P1**. Ignore the error message that may appear. This initializes the parallel port of your PC properly
4. Insert the included parallel port cable into the printer port of your PC system and into P1 of the MAS voice application board

5. Run the included DOS-based Application Program pdrv.exe to transfer the content to the SmartMedia Card. Please refer to Appendix A for details of the DOS-based Application Program. At this point MP3 files, SC4 files, and control programs may be either downloaded or uploaded to/from the Flash via the DOS-based Application Program. In case the return code from the board should remain at 0xFF try to rise the supply voltage in the specified range of 3.3 to 4.4 Volts in steps on 100 mV. **DO NOT exceed the maximum limit of 4.4 Volts.**
6. POWER OFF the board. Make sure either to lower the supply to 3.3 Volts or disconnect the power supply and reinsert the battery. Press the POWER button and check the Flash memory content by listening tests or by comparing the binary content

Playback mode

Playback of the Flash memory can be invoked by pressing the PLAY button (SW4). This will start decoding based on the track position; i.e., Tracks 1 and 2 will start MPEG audio decoding and Track 3 will start SC4 decoding. The end-of-track boundaries are not coded in the microprocessor so it is possible to program the entire Flash with a MPEG audio file and to play back the whole file when the track has been set to Track 1 or Track 2.

After pressing the STOP button (SW5), the FWD (SW6) and REW (SW3) buttons may be used to select the Tracks.

Volume control has been implemented with the VOL+ and VOL- buttons, SW7 and SW8. Each press of one of these buttons will change the volume level by 1.6 dB over the range of 0 to 56 (step 44 = 0dB) – step 0 causes the DAC 3550A to mute. Bass and treble functions have also been added with the TREB (SW9) and BASS (SW10) buttons, respectively. These buttons operate in a loop that cycles from 0, +6dB, -6dB, 0. The bass/treble LED's D4 and D5 will light up when the levels have been set to ±6 dB.

Record mode

The Flash memory has been organized into 4 sectors: SC4 program code (pages 0x00 – 0x1f), MP3 track 1 (pages 0x20 – 0x17ff), MP3 track 2 (pages 0x1800 – 0x37ff), and SC4 track (pages 0x3800 – 0x3fff). Track memory locations can be filled using the DOS-based Application Program and should contain only the appropriate file types in order to insure correct playback.

Track 3 can be filled in one of two ways: a file can be downloaded from the PC using the LPT communication, or a file can be encoded from the microphone input (J3) or the line input (J2). Please note that the MIC input is selected by default. The MIC input is applied to a non-linear amplifier (U10) with AGC and limiting, then it is fed to

the DAC 3550A (U9) where it is amplified and applied to the ADC (U11). The volume control can be used to set the DAC 3550A output level to the ADC – this offers an additional 16 dB of gain for the MIC input. Alternatively, the LINE input (J2) can be selected from the DAC 3550A for processing. However, this is only possible via the Application Program for the DAC 3550A, please refer to Appendix A for details.

In order to encode a file from either the MIC input or the LINE input, the REC button (SW11) must be pressed first, then the PLAY button. After the REC button is pressed, the PIC microcontroller will upload a binary file from the SmartMedia Flash Card into the MAS 3507D to configure it for SC4 encoding. Once the file has been uploaded and the MAS 3507D is ready for encoding, the REC LED (D6) will turn on. Recording will begin after the PLAY button is pressed and will continue until either the STOP button is pressed, or the Flash Card upper boundary is reached. The PLAY LED D3 will flash during voice recording. Upon completion of SC4 encoding, Track 3 will be selected and the file can be played back by pressing the PLAY button (SW4).

The DOS-based Application Program allows programming of each individual track or the entire Flash. Please note – SC4 decoding is limited to Track 3, if a longer recording time is desired then the microprocessor must be reprogrammed or the Application Program must be modified to download the SC4 decoder program via I²C.

PLEASE NOTE – During voice recording or playback (SC4 encoding or decoding), the BASS and TREB buttons are not functional

Chapter Three - Firmware Operation

The firmware operation of the Application Board is outlined in Appendix E as a program flowchart. The first page describes the system operation; subsequent blocks are outlined on the following pages. Each predefined function block (denoted by double vertical lines) has a corresponding routine in firmware. The firmware for this application has been written using MPASM (copyright Microchip Technology, Inc.) for the 16C74A microprocessor. Source code for the application is available from Microchip Technology, Inc.

Several hardware conditions must exist in order for the firmware to work as described in the system flowcharts, so notes have been added to the appropriate blocks. A table at the end of Appendix D has been added to detail the status, control, and variable registers used in RAM. Registers for I²C are not included since these are part of a separate firmware program “..MPASM\I²C_PIC4.asm” that has been developed specifically for this hardware. This program will not be described since it depends upon microprocessor selection and comparable programs are readily available from Microchip Technology, Inc.

A detailed explanation of the firmware loops requires a fundamental understanding of the MAS 3507D operation and will not be covered in this manual. For further reference, see the application notes for MAS 3507D available from Micronas Semiconductors (refer to Appendix F) or contact your local sales office for support.

Appendix A - Application Program Description

Four Application Programs are included with the kit as described below. The control programs for the MAS 3507D and the DAC 3550A require a Windows 9x-PC system. The Application Programs for SmartMedia Card access named pdrv.exe and Flashimg.exe run under DOS, e.g. in a DOS-session of Windows 9x. Program installation is simply done by extracting the software to a dedicated directory. Using the Save-option will create a startup-file 'MASD.INI' located in the windows-directory.

MASD32_V098B.exe Application Program

This program provides access to all registers of MAS 3507D like monitoring the MPEG Status bits and provides the SineWave Generator download. Please note to power up the board **BEFORE** inserting the female 9pin connector of the cable to the I²C-connector (P2). Table 1 below gives a detailed description of the program menus, please refer to the listed sections and tables of the MAS 3507D Data Sheet (abbreviated DS) and to the Data Sheet addendum (abbreviated ADD) for details.

Menu	Submenu	Function	Notes
Main Window	Volume/Balance/ Mute/Bass/Treble and Prescaler including save and load option	Tone control of MAS 3507D	sets the Muting/Bypass Tone control, the Bass and Treble control and the Baseband volume matrix, please refer to DS- sections 3.4.2, 3.4.3 and 3.5.3
	File	Exit	exits the program exits after confirmation
Windows	Status Window	- MPEG status - PIO status	useful during MPEG decoding, please refer to DS-section 3.5 and ADD- section 4.2
	Tone Control	sets the Tone Control register and turns Tone Control on/off	please refer to DS-section 3.4.2 and table 3-8
	Configuration	- I ² S settings - PLL offset values	please refer to DS- sections 3.5.2.2 and 3.5.2.1 and ADD-section 5.2
	Start Up Configuration	monitoring of the PIO input pins PIO8, 4, 3, 2, 1 and 0	DS-Section 2.7.4 and ADD-section 2.1

Table 1 – MAS 3507D Application Program menus

Menu	Submenu	Function	Notes
Windows (continued)	MAS Access	access to I ² C- registers and to D0/D1 memory of MAS 3507D	please refer to DS-section 3.3 and ADD-section 4
	MAS Restart	resets the MAS 3507D	-
	Message Window	tracking of I ² C- commands	includes save option
Download/Run	none	download and run of *.mob-files (MAS Object Code-files)	opens a new window to select a *.mob-file e.g. the included sin1024.mob-file for the sine-generator, please refer to the application notes for details
Test	Parallel Port	forces I ² C-and Reset-lines to logic high or low levels	-
	Hardware Test	writes and reads back some MAS 3507D-registers	We recommend to run this test at the beginning to check the whole system
Help	About MASD	additional informations	-
	Help...	-	Not yet implemented

Table 1 – MAS 3507D Application Program menus (continued)

DAC3550A.exe Application Program

This program gives access to the I²C-registers of the DAC 3550A. Please note to power up the board **BEFORE** inserting the female 9pin connector of the cable to the I²C-connector (P2). Table 2 below describes the description of the program menus, please refer to the DAC 3550A Data Sheet for details. Using the Save-option will create a startup-file 'internet.INI' located in the windows-directory.

Menu	Submenu	Function	Notes
File	Exit	exits the program	exits without confirmation
Windows	Main	Volume/Balance and Configuration register	pops up at startup, also selectable sets the AVOL- register and the GCFG-register, please refer to section 3.5 If you run the program during SC4 decoding and encoding, please set the DAC off and select the AUX2 input for the line INPUTS and the AUX1 input for the MIC input Please confirm to use the write button
	Sample Rate	- I ² S configuration - Sample Rate selection	Please confirm to use the write button
Windows	Subaddress	sets the subaddress corresponding to the connections of the pins MCS1 and MCS2	Set to ADR3 in this application at the beginning Please confirm to use the save button
	DAC single telegram	access to I ² C-subregisters	-
Test	Open I ² C message window	tracking of I ² C-commands	includes save option
	Open I ² C message window	tracking of I ² C-commands	includes save option
Help	About	additional informations	infos about the program and the LPT port I/O-address

Table 2 – DAC 3550A Application Program menus

SmartMedia Card Flash access Application Programs

Please refer to the Section LPT communication above **before** running any SmartMedia Card Access Application Program. Both programs are DOS-based, to run them under Windows 9x, start a DOS-session by using the START-tab and browse to the directory where both programs are located.

- Creating the Flash image

The first step is to create an image which will be written to the SmartMedia Card. To create the image 5 files are necessary

- SC4 Encoder binary file (from MICRONAS, included)
- SC4 Decoder binary file (from MICRONAS, included)
- *.MP3 file (you can take any MP3 file)
- *.MP3 file (you can take any MP3 file)
- *.SC4 file (you can take any SC4 file)

The program Flashimg.exe will create the Flashimg.bin from the 5 files above. Its task is

- to put all files on the correct place in the Flash image file
- if the file is shorter than anticipated to fill the gap with 0xFF
- if the file is longer than anticipated place to short it to fit

The batch file image.bat demonstrates the use of the Flashimg.exe. The resulting image file is Flashimg.bin.

- Writing the image file to the SmartMedia

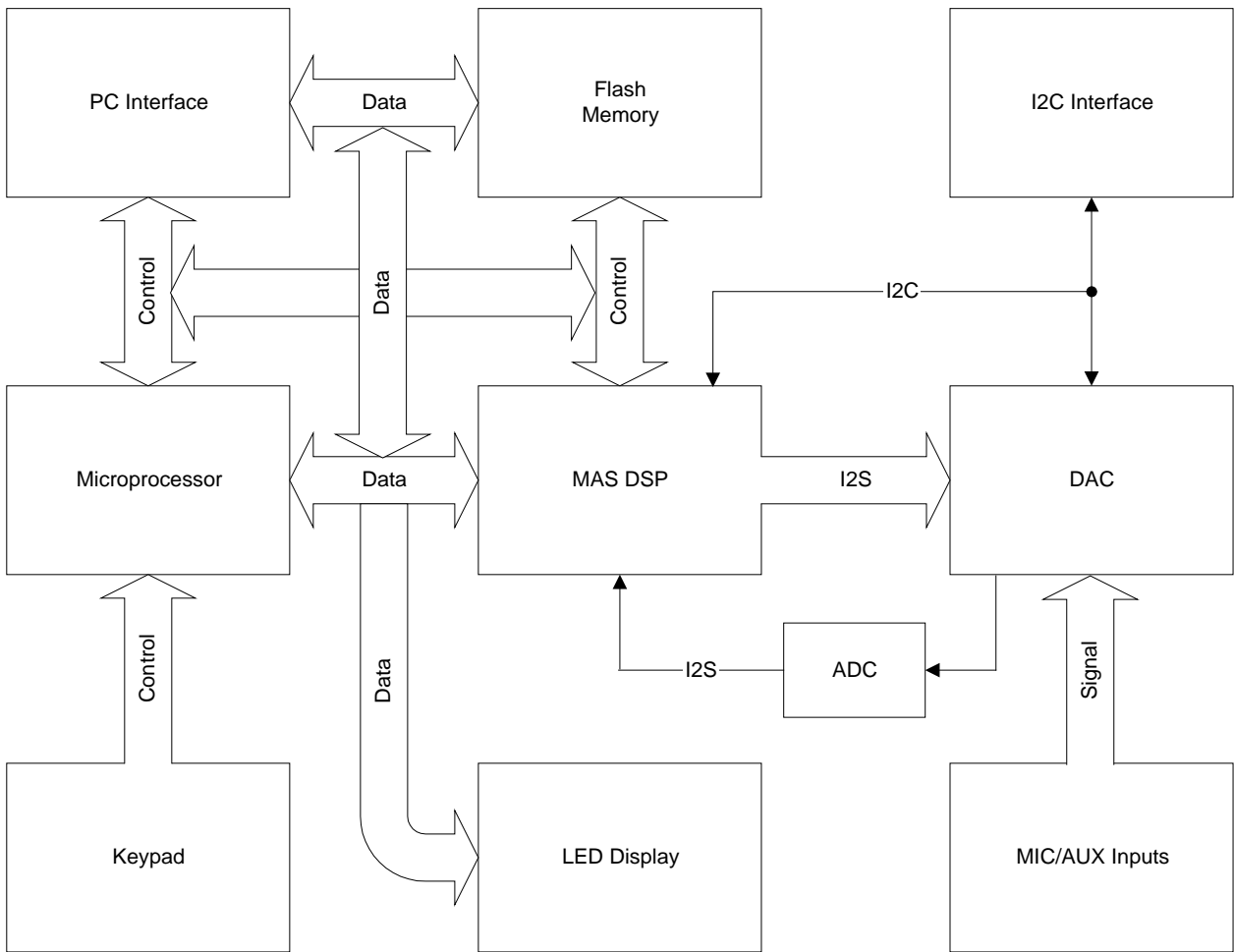
To write the image file to the SmartMedia Card use the pdrv.exe program. During writing the status byte will be displayed. If the communication with the SmartMedia Card is correct the 'status returned' value should be 0xc0.

w_smc.bat will write the file Flashimg.bin to the SmartMedia Card using the Parallel port address 0x278.

The reading of the SmartMedia Card is possible too. r_smc.bat is one example for it.

All options are explained by the 'help'-option, type 'pdrv /?' or 'flashimg -h' at the DOS-prompt.

Appendix B - Signal Flow Block Diagram



Appendix C - LED Functional Description

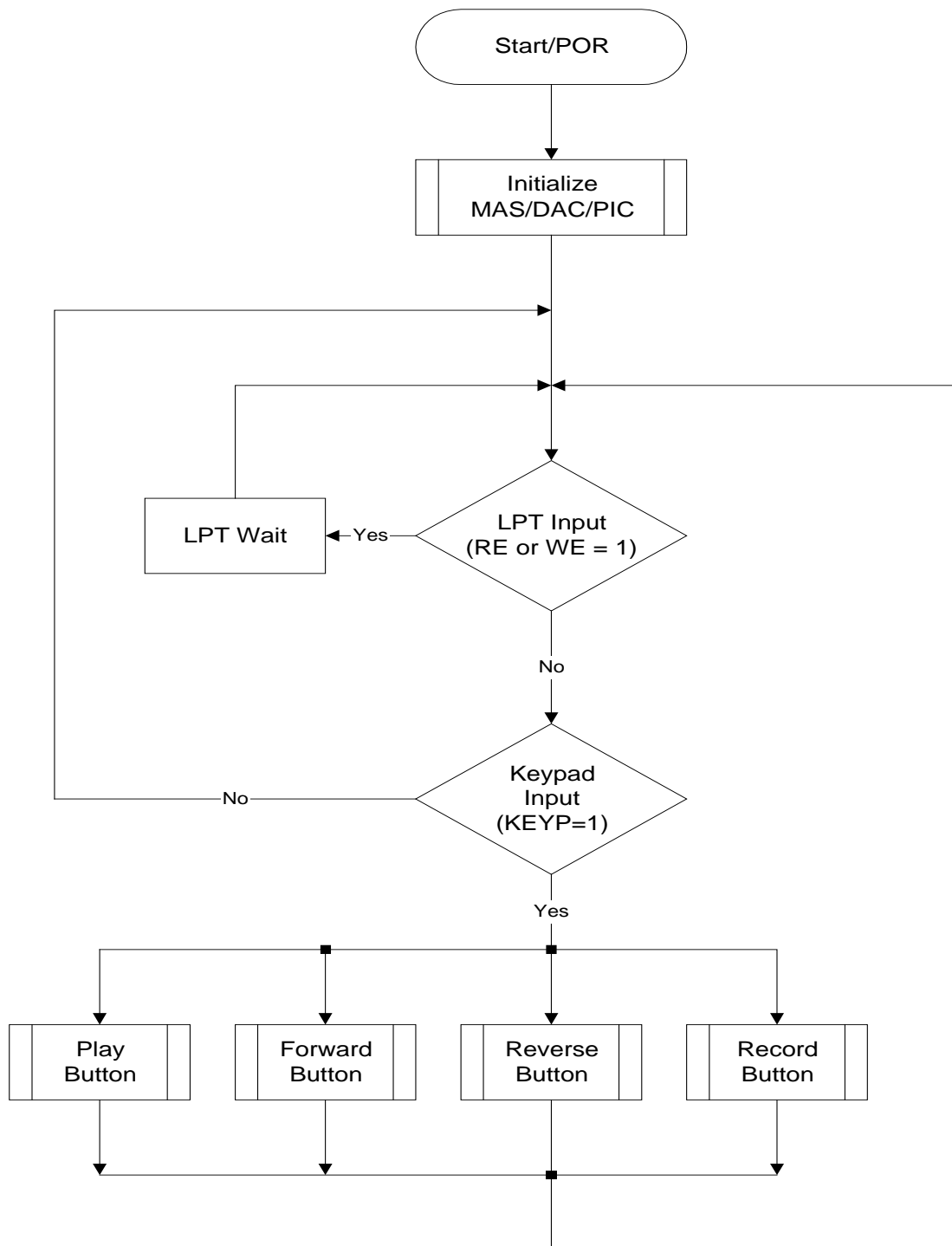
LED	Status	Function	Notes
ALL	OFF	Power Off	Low Power Mode current << 1 mA
D1	ON	Track 1 Memory Location Selected	MP3 Playback Reset Default State
D1	Flashes	Track 1 playback	MP3 Playback
D2	ON	Track 2 Memory Location Selected	
D2	Flashes	Track 2 playback	MP3 Playback
D3	ON	Track 3 Memory Location Selected	
D3	Flashes	Track 3 playback	SC4 Playback
D4	OFF	BASS Level at 0dB	Loops through 0, +6, -6, 0
D4	ON	BASS Level at +6 dB or -6 dB	Loops through 0, +6, -6, 0
D5	OFF	TREB Level at 0dB	Loops through 0, +6, -6, 0 MP3 Playback only
D5	ON	TREB Level at +6 dB or - 6 dB	Loops through 0, +6, -6, 0 MP3 Playback only
D6, D3	ON	SC4 Encoder SW Uploaded	VOL control active
D6,D3	D3 ON, D6 Flashes	SC4 Encoding in Process	VOL control active

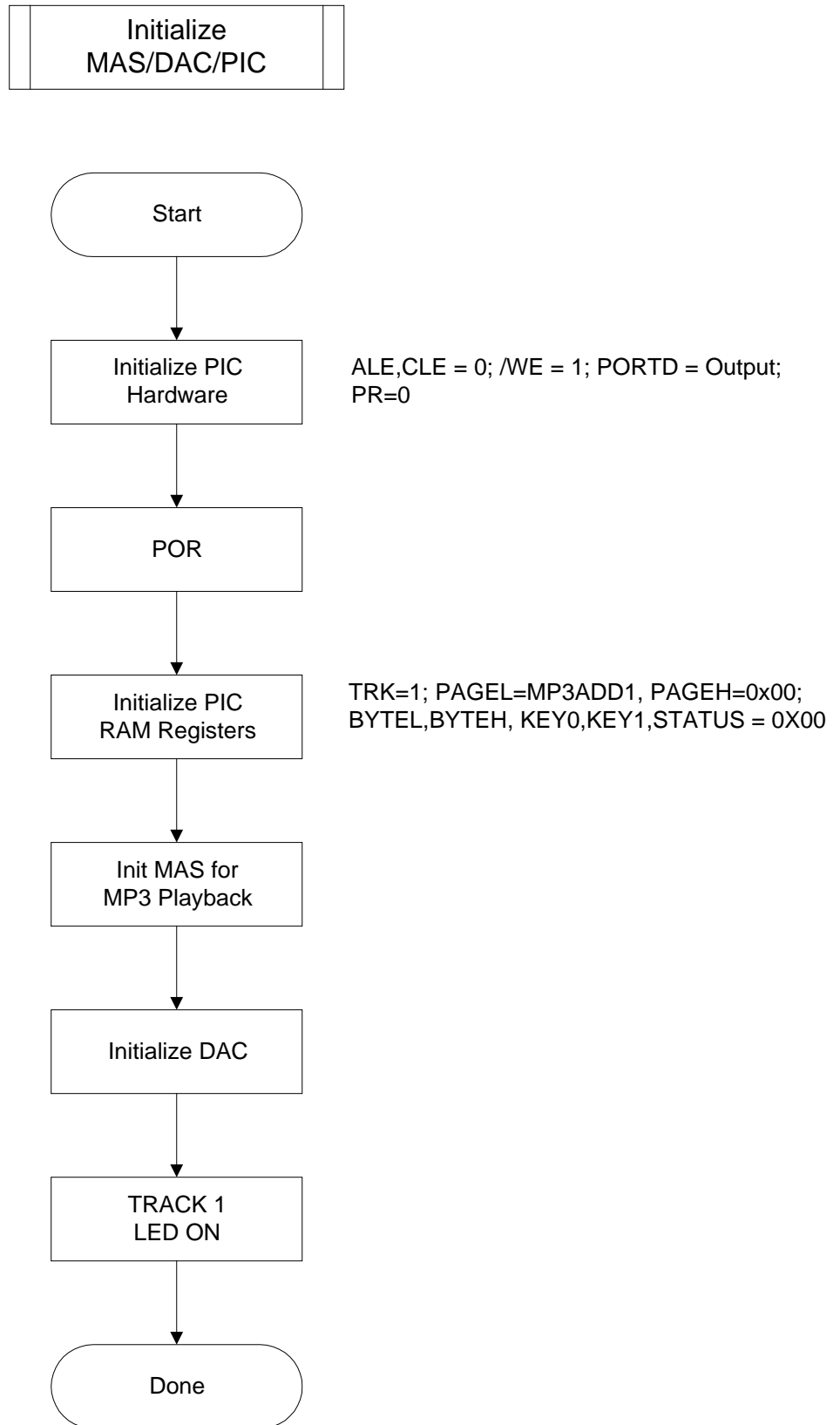
Please note:

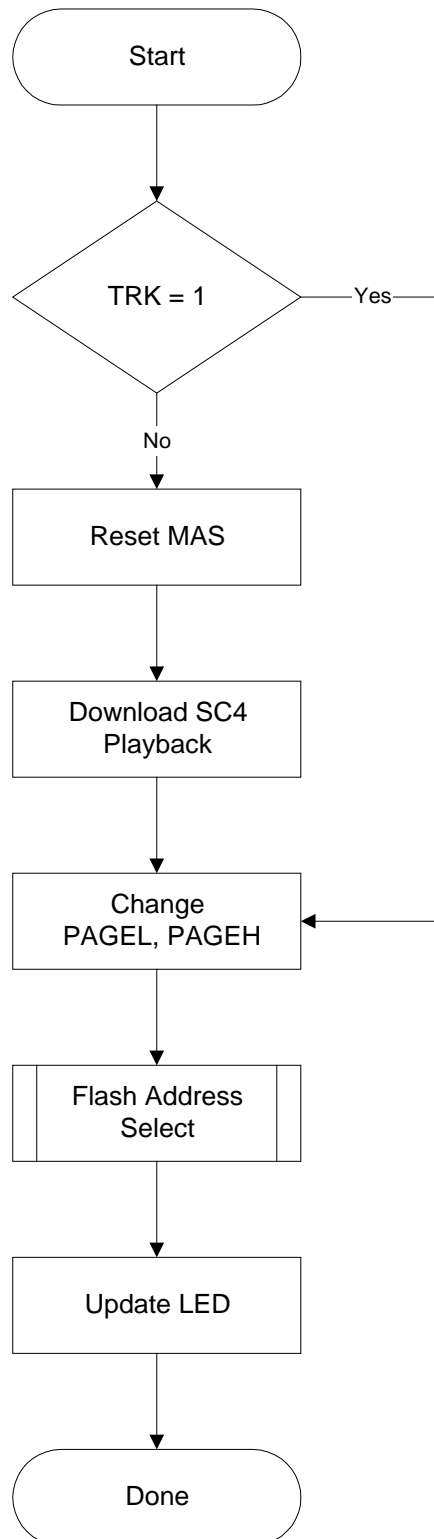
Any other LED combination is an invalid state. The board should be turned off and powered on for proper operation.

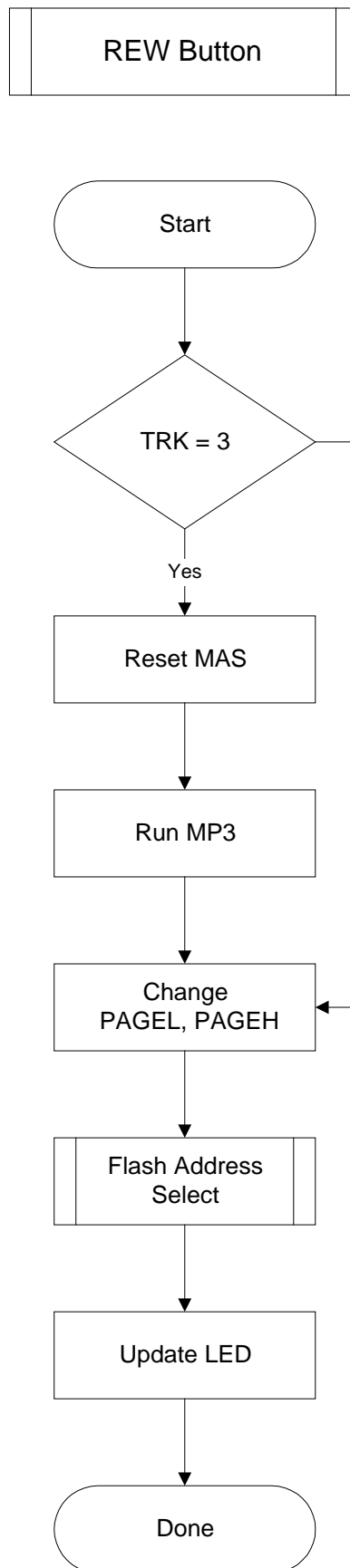
Appendix D - Firmware Flowcharts

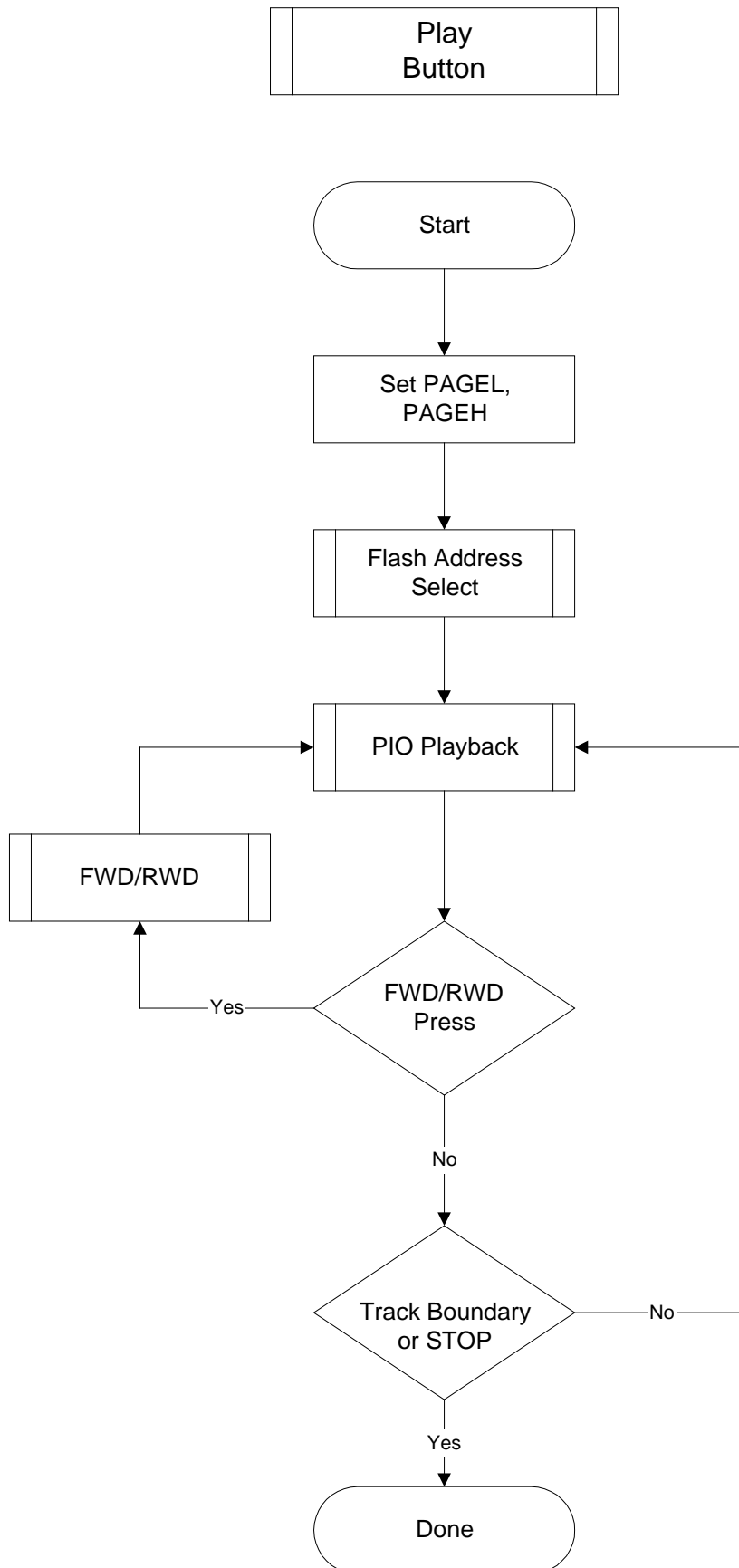
Micronas MASVoice Demo Board Flowchart
 Revision 4.30

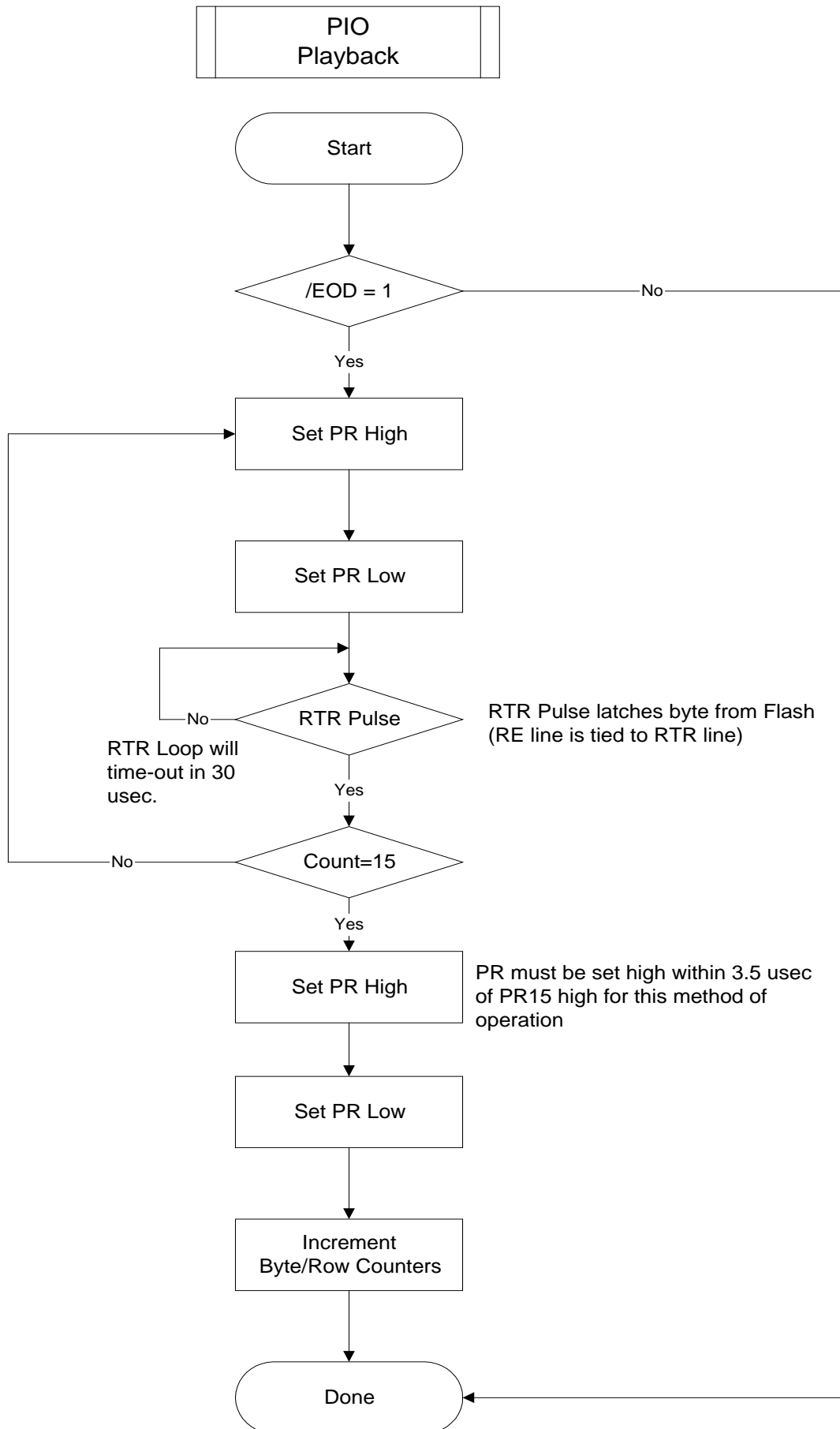


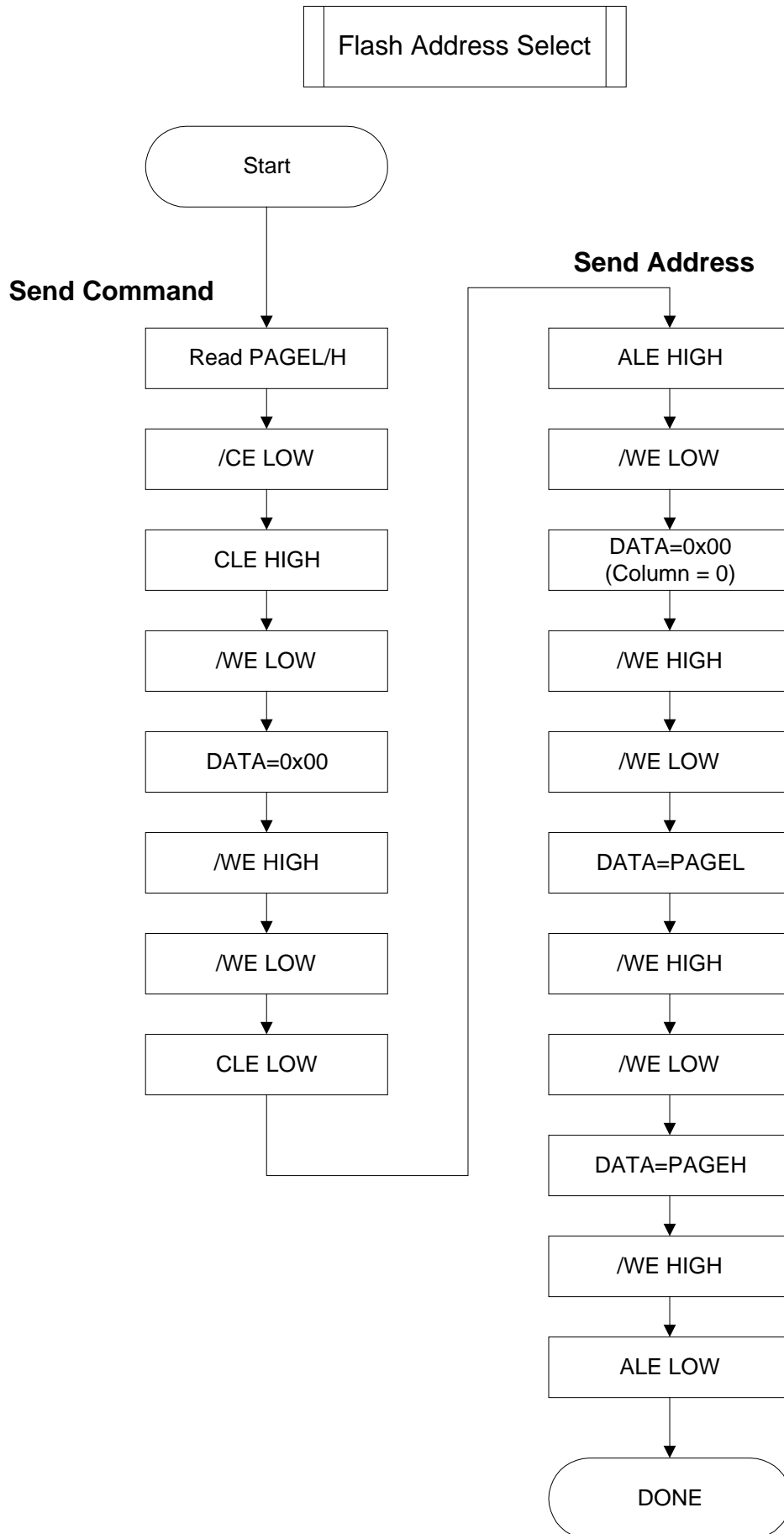


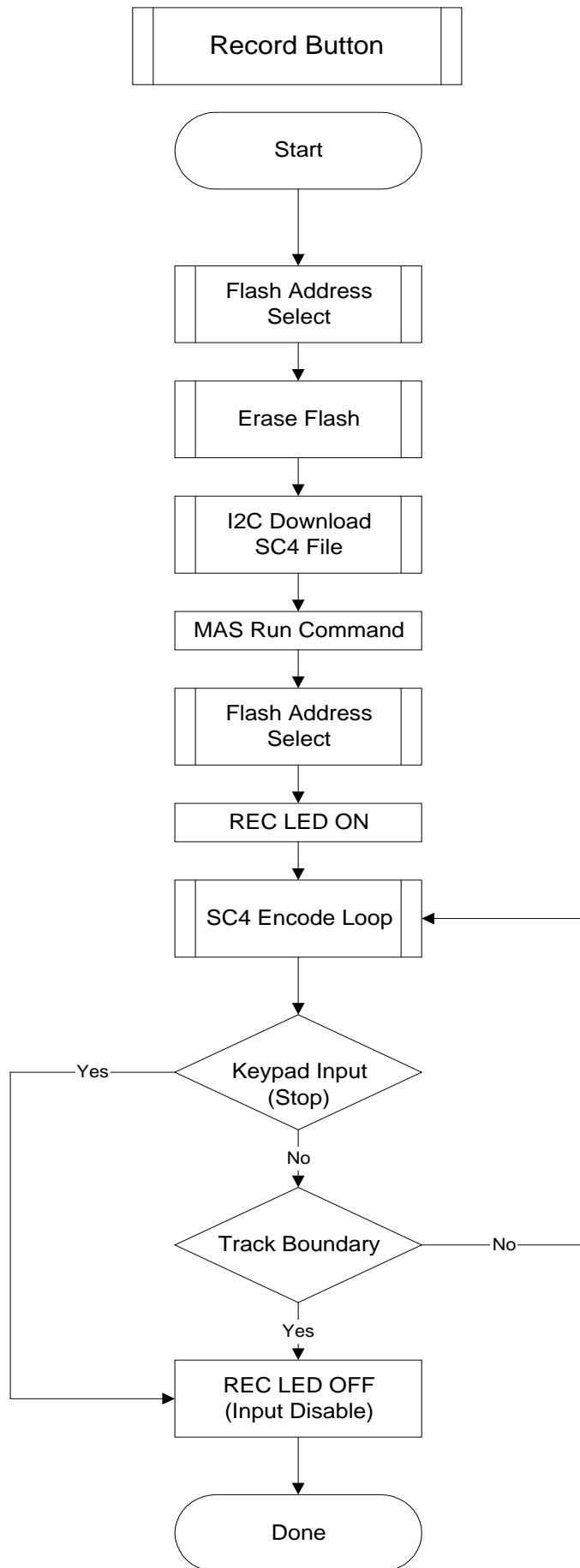


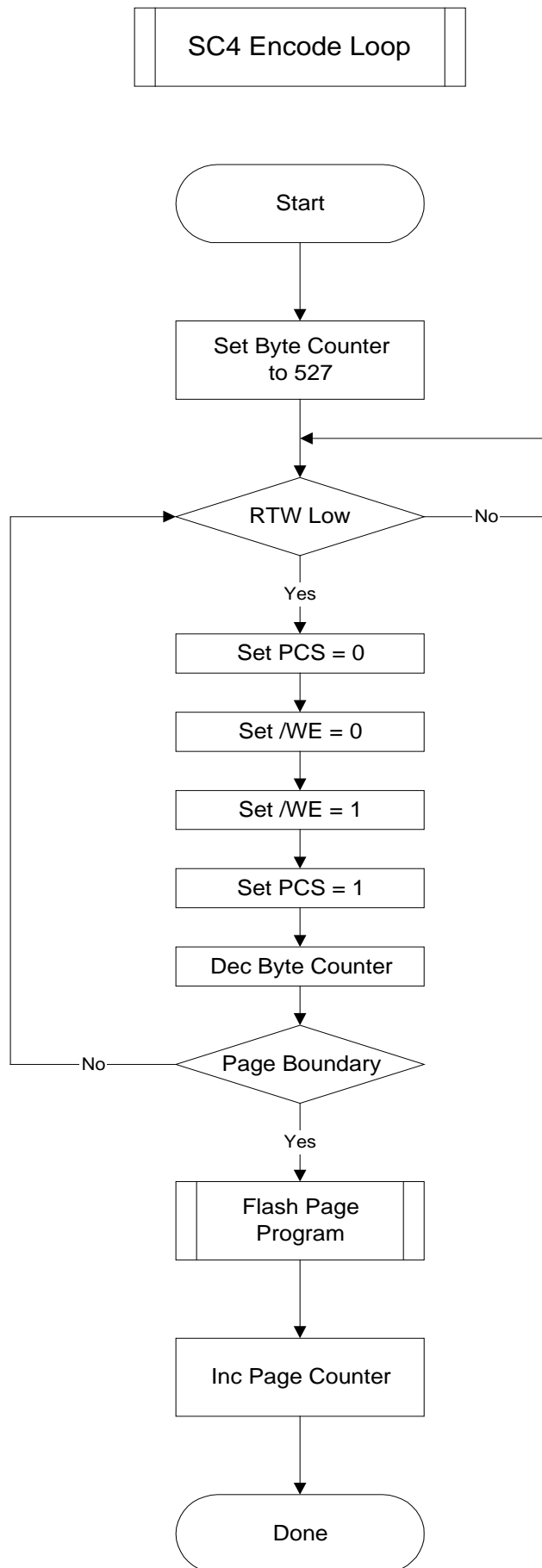


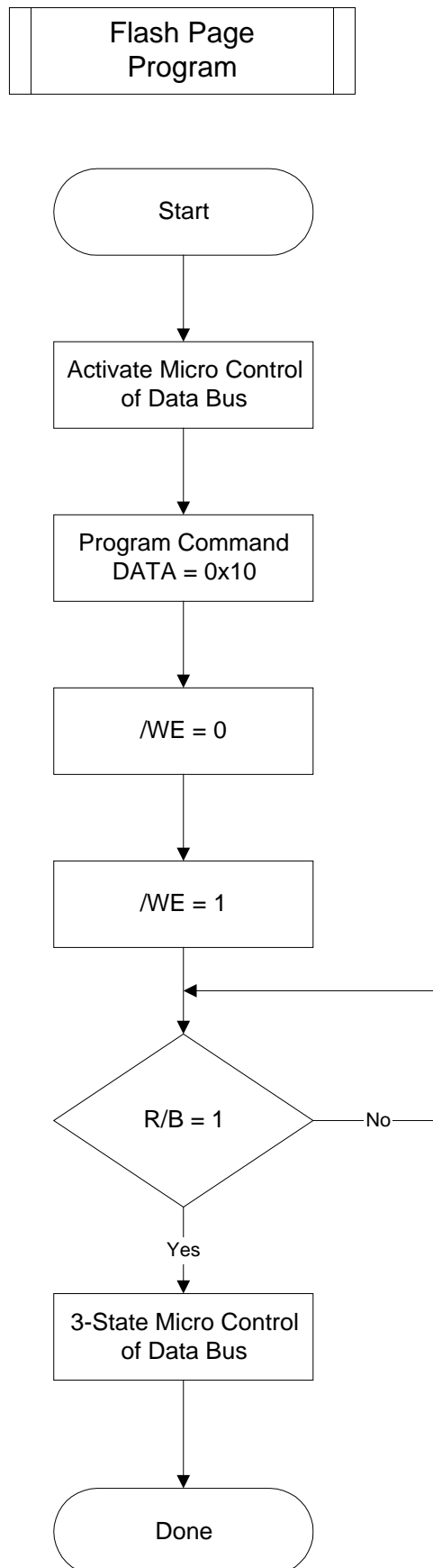


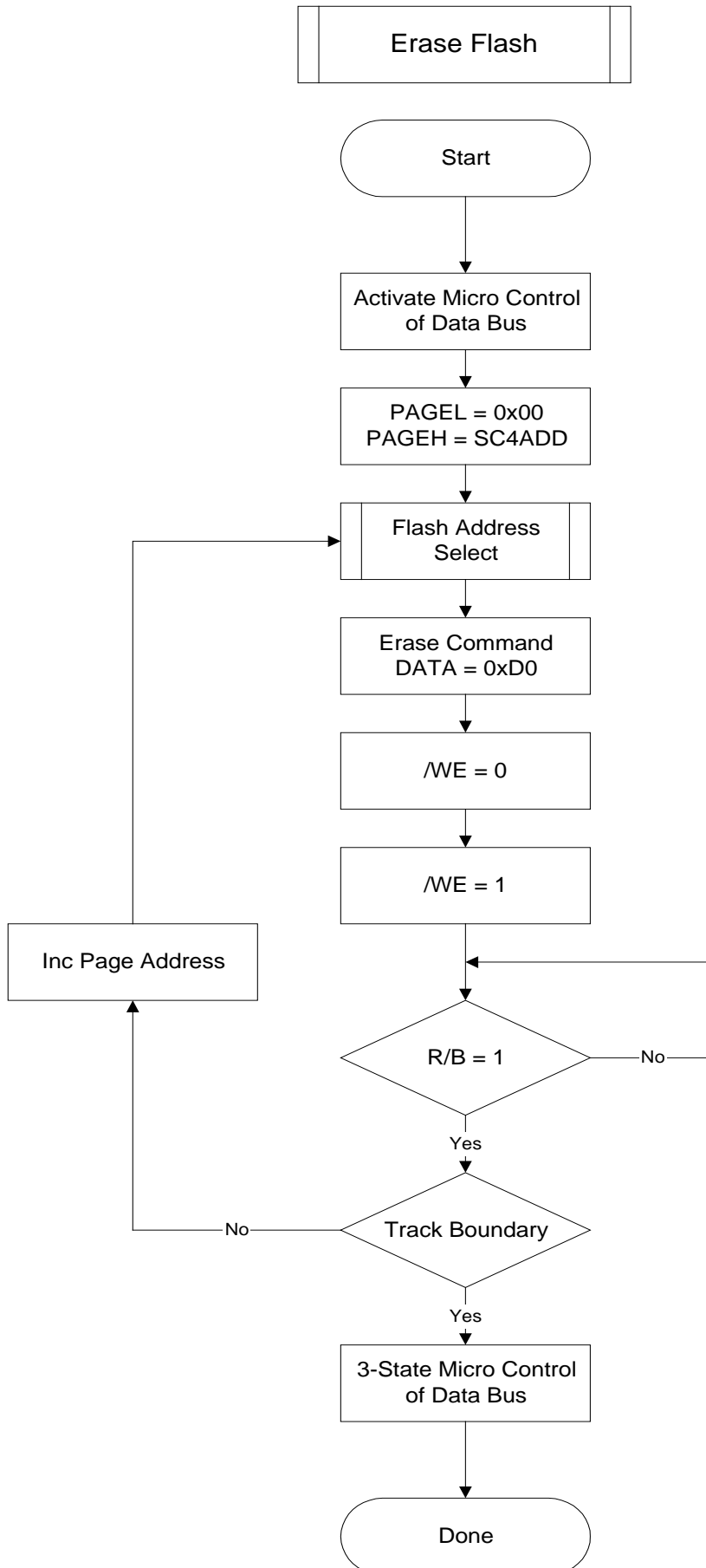












RAM Registers

KEY0	BASS	TREB	FWD	REW	PLAY	STOP	VOL+	VOL-
KEY1	BASS	TREB	FWD	REW	PLAY	STOP	VOL+	VOL-
STATUSM		RECEN			KEYP	EOF	PCBSY	PCREQ
LEDStatus		RECEN	RECLED	TREBLED	BASSLED	TRK3	TRK2	TRK1
BYTEL	B7	B6	B5	B4	B3	B2	B1	B0
BYTEH							B9	B8
PAGEL	P16	P15	P14	P13	P12	P11	P10	P9
PAGEH			P22	P21	P20	P19	P18	P17
VolumeR								
VolumeL								
TempVol								
BASS:1								
BASS:2								
BASS:3								
TREB:1								
TREB:2								
TREB:3								

Notes: 1.) STATUSM bit KEYP will only change when keys PLAY, REC, FWD, and REW have been pressed

Appendix E - contact addresses

- **For all issues regarding the PIC16C74 microcontroller, please contact**

**Microchip Technology Incorporated
2355 W. Chandler Blvd.
Chandler, AZ 85224
U.S.A**

internet <http://www.microchip.com/>

e-mail-address MP3@microchip.com

- **For all issues related to the MAS 3507D and the DAC 3550A, please contact**

MICRONAS Semiconductors Inc.

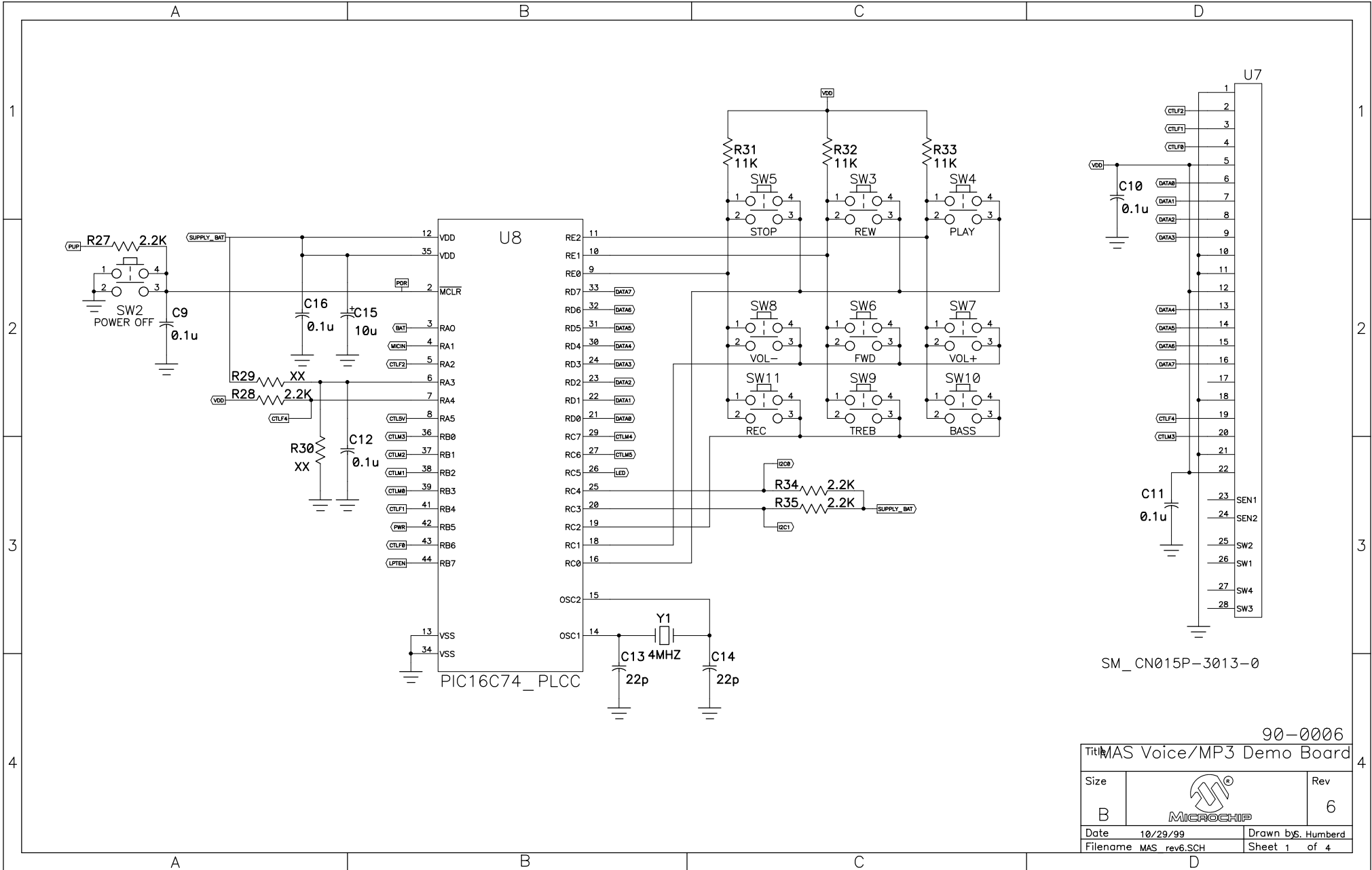
**2635 North First Street
Suite 101
San José, California 95134-2031
U.S.A.**

internet <http://www.micronas.com/>


Revision History

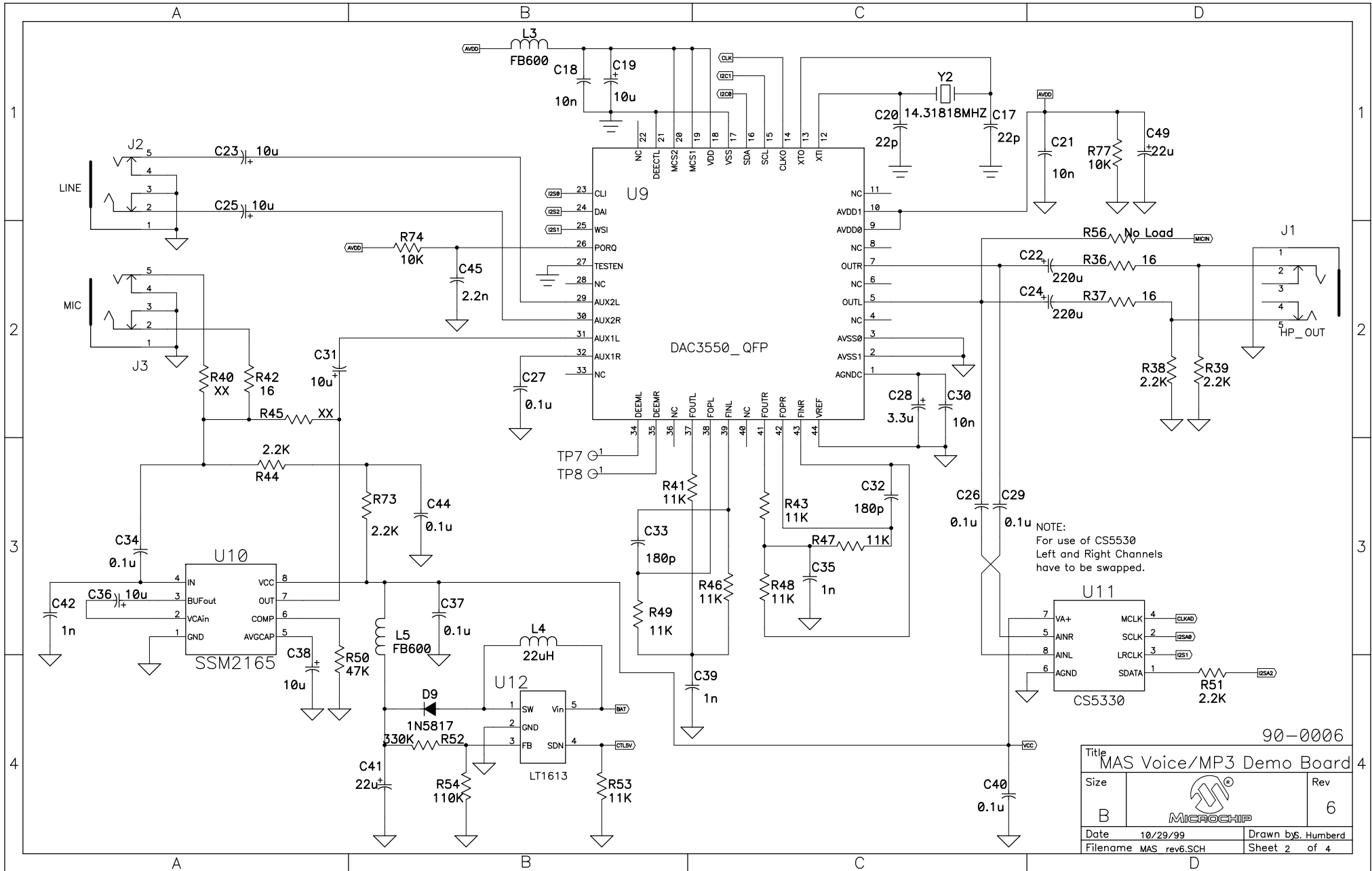
1.00 -	17 Sept 1999, Kris Klink
2.00 -	15 Feb 2000, Magnus Tölle

Appendix F – Circuit Board Schematics



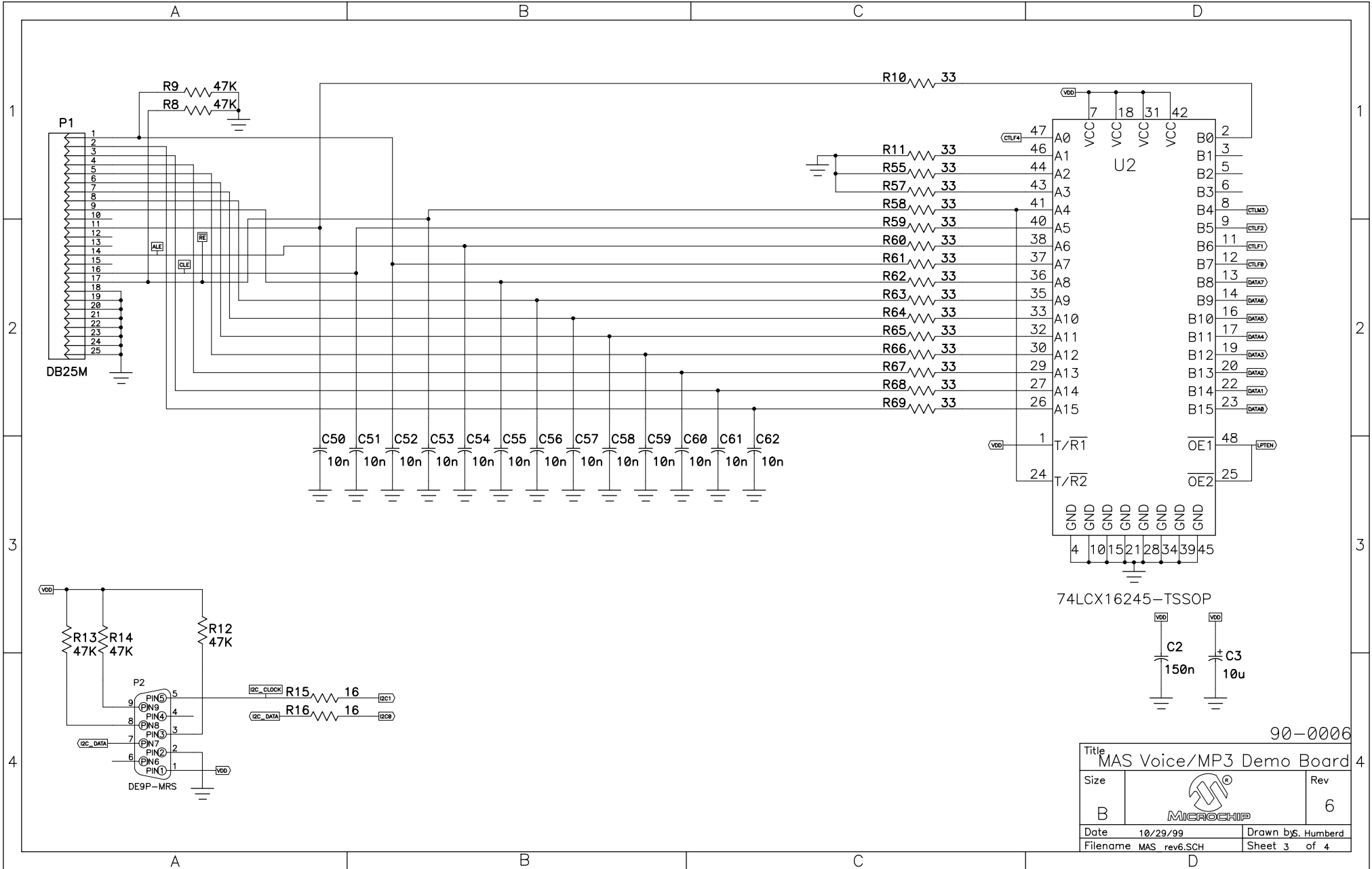
90-0006

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Filename: MAS_rev6.SCH	Sheet 1 of 4	




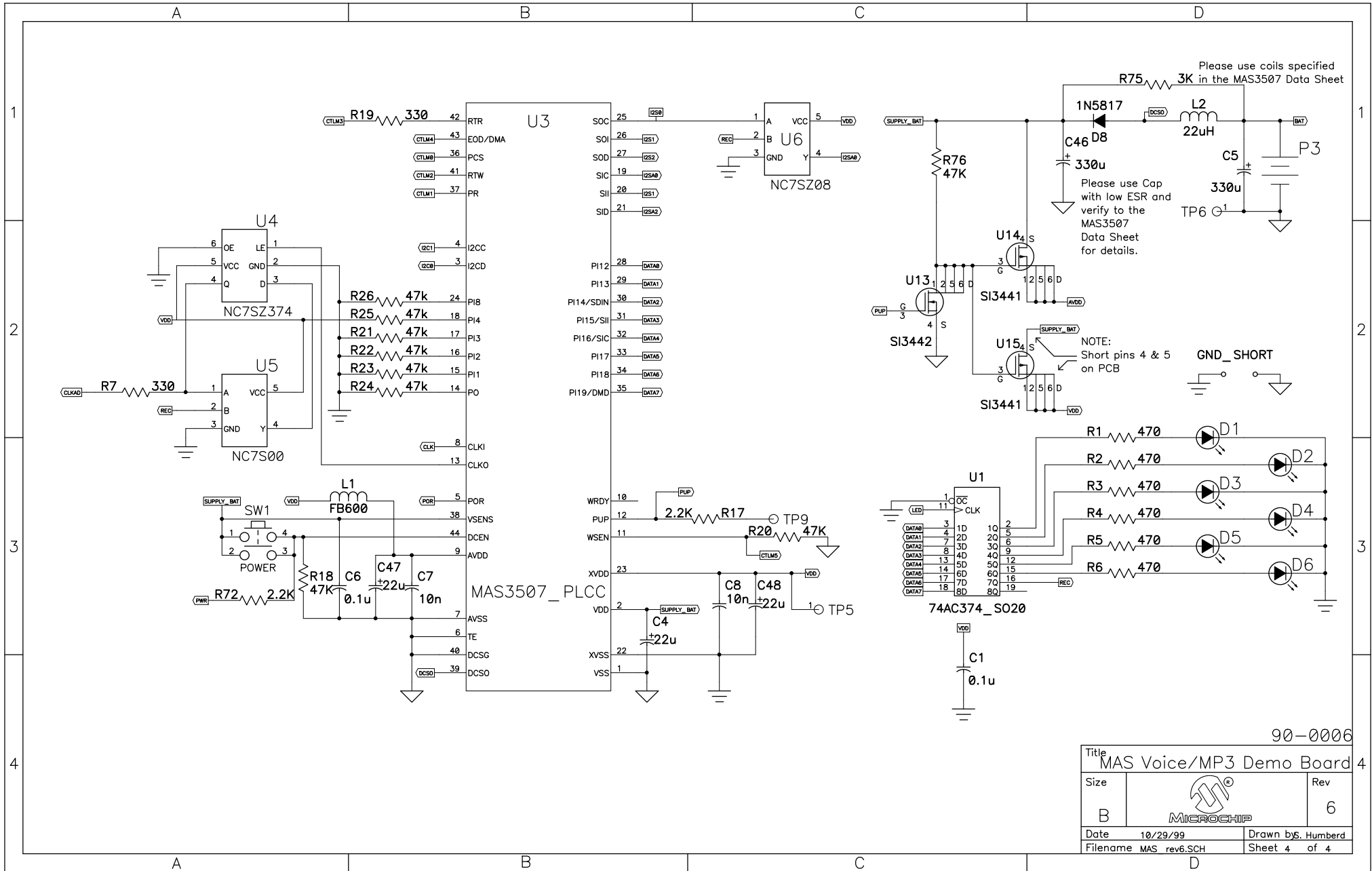
90-0006

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Filename MAS_rev6.SCH	Sheet 2 of 4	



90-0006

Title MAS Voice/MP3 Demo Board		
Size B	 MICROCHIP	Rev 6
Date 10/29/99	Drawn by: Humberd	
Filename MAS_rev6.SCH	Sheet 3 of 4	



90-0006

Title MAS Voice/MP3 Demo Board		
Size B		Rev 6
Date 10/29/99	Drawn by: Humberd	
Filename MAS_rev6.SCH	Sheet 4 of 4	