Targeting 56F8300 Demonstration Board

User Manual

56F800
16-bit Digital Signal Controllers

MC56F8300TUM
Rev. 4
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About This Book

This manual describes the applications for the 56F8300 Demonstration Board.

Audience

This document targets software developers using the 56F8300 Demonstration Board.

Organization

- **Chapter 1, Introduction**—provides a brief overview of this document
- **Chapter 2, 56F8300 Demonstration Board Applications**—describes the available demonstrations for the 56F8300 Demonstration Board
- **Appendix A, Targeting 56F8300 Demonstration Board Schematics** —contains the schematics of the 56F8300 Demonstration Board

Suggested Reading

We recommend that you have a copy of the following references:

- *56F8323 Technical Data,* MC56F8323
- *56F8300 Peripheral User Manual,* MC56F8300UM
- *Inside CodeWarrior: Core Tools*

Conventions

This document uses the following notational conventions:

Typeface, Symbol or Term	Meaning	Examples
`Courier Monospaced Type`	Code examples	`//Process command for line flash`
Italic	Directory names, project names, calls, functions, statements, procedures, routines, arguments, file names, applications, variables, directives, code snippets in text	...and contains these core directories: *applications* contains applications software... ...CodeWarrior project, *3des.mcp* is... ...the *pConfig* argument.... ...defined in the C header file, *aec.h*....
Bold	Reference sources, paths, emphasis	...refer to the **56F8300 Peripheral User Manual**....
Blue Text	Linkable on-line	...refer to Chapter 7, License....
Number	Any number is considered a positive value, unless preceded by a minus symbol to signify a negative value	3V -10 DES^{-1}
ALL CAPITAL LETTERS	# defines/ defined constants	# define INCLUDE_STACK_CHECK
Brackets [...]	Function keys	...by pressing function key [F7]
Quotation marks, “...”	Returned messages	...the message, “Test Passed” is displayed.... ...if unsuccessful for any reason, it will return “NULL”...

Definitions, Acronyms, and Abbreviations

The following list defines the acronyms and abbreviations used in this document. As this template develops, this list will be generated from the document. As we develop more group resources, these acronyms will be easily defined from a common acronym dictionary. Please note that while the acronyms are in solid caps, terms in the definition should be initial capped ONLY IF they are trademarked names or proper nouns.

ADC	Analog-to-Digital Converter
FFT	Fast Fourier Transform
FIR	Filter Interval Register
GPIO	General Purpose Input/Output
ISR	Interrupt Service Request

References

The following sources were used to produce this book:

1. *56F8300 Peripheral User Manual,* MC56F8300UM
2. *56F8300 Demonstration Board User's Manual,* MC56F8300DBUM
3. *DSP56800E Reference Manual,* DSP56F800ERM
4. *56F8323 Technical Data,* MC56F8323
5. *56800/E Accelerated Development System Resource Pak* CD-ROM (available from the Literature Distribution Center)

Chapter 1
Introduction

1.1 Overview

The 56F8300 Demonstration Board is a low-cost board that allows a user to execute preprogrammed demonstrations, as well as to develop his own applications using free CodeWarrior tools. The 56F8300 Demonstration Board consists of a 60 MIPs 56F8323 controller; a microphone attached to the ADC; a speaker; an E-field sensor; two buttons attached to external interrupts; and 10 LEDs. Pads have also been included on the board so a user can access all of the 56F8323's peripherals. The Demonstration Board does not have an external crystal, so the 56F8323 must use its internal oscillator.

For more information about developing software for this demonstration board, please refer to the **56F8300 Peripheral User Manual** and **56F8323 Technical Data**.

The software examples and source code for examples discussed in this document are available on the "*56800/E Accelerated Development System Resource Pak*" CD-ROM, which can be ordered from Motorola's Literature Distribution Center.

All example projects on the CD utilize Processor Expert™ (PE) The example projects Suspend PE within CodeWarrior to save the PE state of the working projects. To enable code design with PE within these projects, the following step is needed:

- Within CodeWarrior under *Processor Expert*, select *Code Design*. See **Figure 1-1**. This will enable Processor Expert for that project and allow a user to make modifications to the project with PE.

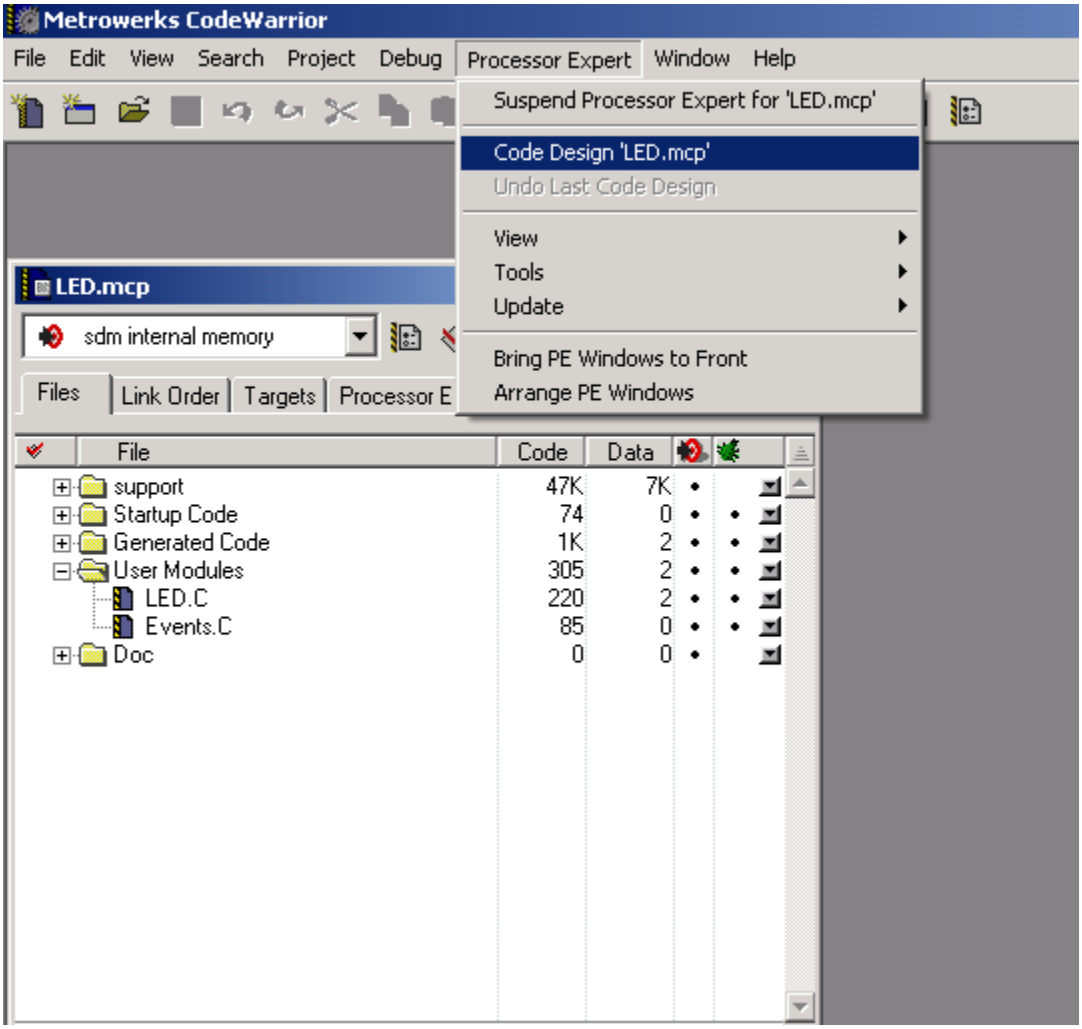

Figure 1-1. Select *Code Design*

Chapter 2
56F8300 Demonstration Board Applications

2.1 Applications

The following applications have been provided by Freescale to easily demonstrate some of the features of the 56F8300 Series of controllers.

Applications developed for this demonstration board were not designed for the 56F8100 devices. The 56F8300 demonstration board does, however, fully support 56F8100 software development.

2.1.1 Voice Recorder Demonstration

This demonstration exercises the ADC, TIMER, and GPIO in the 56F8323 processor. The demonstration allows a user to record and play back seven seconds of voice. In addition, the Voice Recorder Demonstration illustrates how the 56F8300 Series of controllers can be utilized to:

6. Sample seven seconds of voice via the on-chip ADC peripheral and a microphone
7. Filter incoming samples with the FIR filter
8. Calculate the FFT of incoming voice samples and display frequency spectrum via LEDs
9. Encode incoming samples with the G.711 vocoder
10. Write encoded samples to the on-chip flash
11. Read encoded samples from the on-chip flash
12. Decode samples with the G.711 vocoder
13. Output voice samples via the on-chip timer (which generates PWM signal) to the speaker

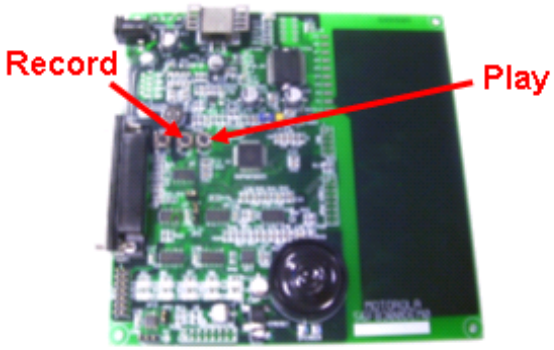

Figure 2-1. Voice Recorder Demo Button Usage

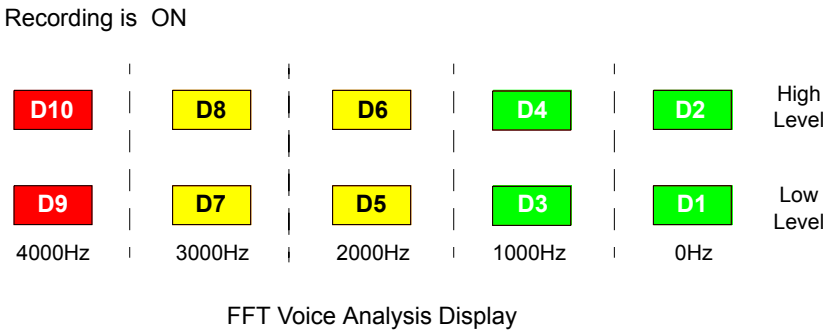

Figure 2-2. Voice Recorder Demo LED Usage

2.1.1.1 Set-up for Voice Recorder Demonstration

Demonstration Board Jumper Settings:

Use default settings as shown in the **56F8300 Demonstration Board User's Manual**.

2.1.1.2 Procedure for Voice Recorder Demonstration

- Install CodeWarrior project from the Resource Pak CD
- Build and download the project; when the debugger reaches *main()*, it will stop
- Select *Run* in the debugger to continue executing the demo
- The IRQA button will be used to **START** recording voice; see **Figure 2-1**
- The first row of five LEDs (D1, D3, D5, D7, and D9) will turn "ON" and "OFF", showing the frequency spectrum of the incoming signal.; see **Figure 2-2**
- Red LED D10 "ON" signifies that recording can start
- Red LED D10 "OFF" signifies that recording has stopped
  - The **SW2** button will be used to play back the recorded voice; see **Figure 2-1**
- The **RESET** button will reset the demo application

2.1.2 E-field Demonstration

This demonstration uses the on-board MC33794 E-Field Sensor as an input control for on-chip generated audio tones, a CANNED message, and LED display. The application will utilize the on-chip ADC module to monitor the MC33794 chip's E1 sensor. Approaching the on-board E1 sensor pad will activate three tones, at 400Hz, 1KHz, and 2KHz. When a user touches the E1 pad sensor, a CANNED message, "**ALERT**", will be output. All tones and the CANNED message will be generated and output by the 56F8323 processor. LEDs will also be activated by the processor according to proximity to the E1 sensor pad.

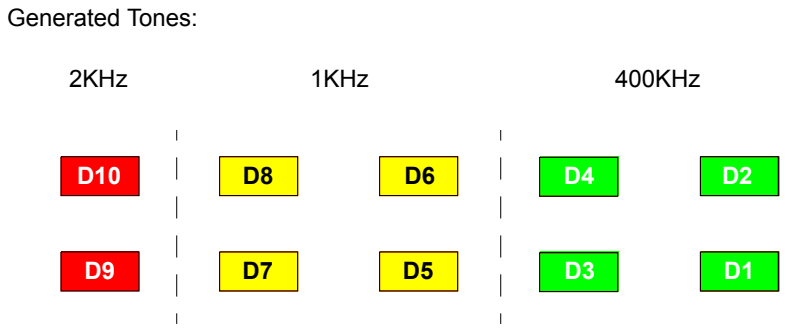

Figure 2-3. E-Field Demo LED usage

2.1.2.1 Set-up for E-field Demonstration

Demonstration Board Jumper Settings:

Use default settings as shown in the **56F8300 Demonstration Board User's Manual**.

2.1.2.2 Procedure for E-field Demonstration

- Install CodeWarrior project from the Resource Pak CD
- Build and download the project; when the debugger reaches *main()*, it will stop
- Set the 56F8300 Demonstration Board on a flat surface
- Select *Run* in the debugger to continue executing the demonstration
- The 56F8300 Demonstration Board will then calibrate the E-Sensor's surroundings
  - The calibration will start with all LEDs on and gradually they will all turn off, at which point, calibration is complete
  - Tones will also be generated during the calibration process
- Once the application is running, the application changes the ON/OFF state of the LEDs and outputs one of three tones, depending upon proximity to E1 sensor pad
  - A CANNED message, "**ALERT**", will be output when the E1 sensor pad is touched
- The **RESET** button will reset the demo application

2.1.3 Temperature Sensor Demonstration

This demonstration exercises the Temperature Sensor, ADC, and GPIO in the 56F8323 processor.

The demo application samples the ADC input, ANA7, which is attached internally to the on-chip Temperature Sensor. These samples are compared against a running dynamic threshold and a pair of corresponding LEDs will be turned on. As the temperature in the processor increases, the LED pairs, starting at D1/D2, will turn on until the last LED pair, D9/D10, is turned on . At this point, the LED pair will roll over and start again at D1/D2. The reverse will happen when the temperature of the processor decreases. See **Figure 2-4**.

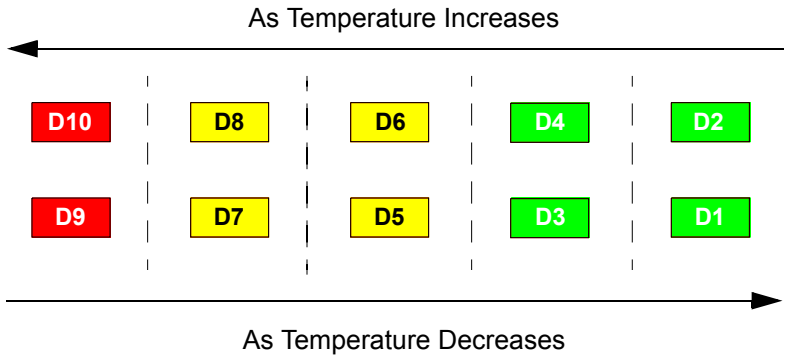

Figure 2-4. Temperature Sensor Demo LED usage

The temperature of the processor can be changed in many ways:

- Heating the processor externally with a heat gun
- Cooling the processor externally with cooling spray
- Putting a finger on the processor
- Pressing the IRQA button on the 56F8300 Demonstration Board

In the initial state of the demo application, all peripheral clocks are enabled and the ADC Low-Power Mode (LPM) is disabled. By pressing the IRQA button, a user can toggle between this state and a state where all peripheral clocks, except ADC and Timer A, are turned off, and the ADC LPM is enabled.

Demonstration Board Jumper Settings:

Use default settings as shown in the **56F8300 Demonstration Board User's Manual**.

2.1.3.1 Procedure for Temperature Sensor Demonstration

- Install CodeWarrior project from the Resource Pak CD
- Build and download the project; when the debugger reaches *main()*, it will stop
- Select *Run* in the debugger to continue executing the demonstration
- The application starts with all peripheral clocks enabled and the ADC Low-Power Mode (LPM) disabled.
  - By pressing the IRQA button, a user can alter this internal configuration, and thus the internal temperature of the processor, in the following ways:
    1. Pressing the IRQA button after startup enables the LPM of the ADC and all peripheral clocks, except for the ADC and Timer A, are disabled
    2. Pressing the IRQA again disables the LPM of the ADC and re-enables all of the peripheral clocks; the application is back to its initial state
- Pressing the **RESET** button will reset the demo application

2.1.4 CPU Utilization Demonstration

This demonstration utilizes an RTOS, MicroC/OS-II by Jean J. Labrosse, to demonstrate CPU utilization at different processor speeds.

The application starts out running at 60MHz and 60 MIPs, with 10 tasks running concurrently. Each task utilizes six MIPs of the processor. This correlates to **full** CPU utilization at start-up. Each task has an unique "priority" associated with it. Task 1 has the highest associated priority and Task 10 has the lowest priority associated with it. There is also an LED for each task which is toggled each time the task is run. At start-up, each task has the necessary bandwidth to complete its six MIPs worth of tasks. As a result, 10 LEDs will be in an "ON" state; see **Figure 2-5**.

The application allows a user to change the processor speed and thus the corresponding MIPs by the IRQA button. After start-up, pressing the IRQA button drops the processor speed to 30MHz and 30 MIPs. At this point, the user will see that only the tasks with the top 5 priorities have enough bandwidth to complete six MIPs worth of tasks; the tasks with the lower five priorities do not. Pressing the IRQA button again drops the processor speed to 20MHz and 20 MIPs and the user will see that only the top three priority tasks will have enough bandwidth to complete their six MIPs worth of tasks. Pressing the IRQA button again returns the application to its original state of 60MHz and 60 MIPs with 10 LEDs "ON".

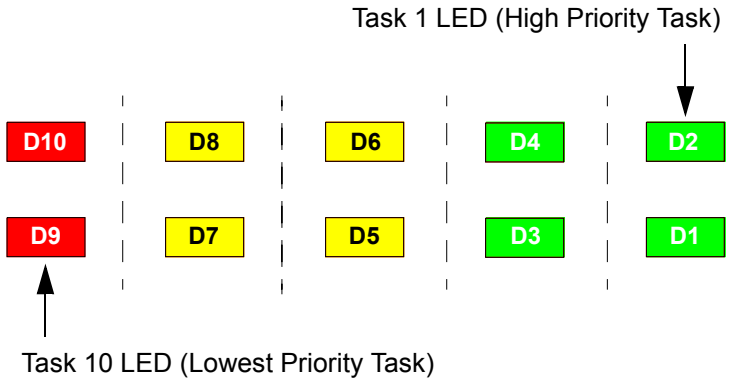

Figure 2-5. CPU Utilization LED usage

Demonstration Board Jumper Settings:

Use default settings as shown in the **56F8300 Demonstration Board User's Manual**.

2.1.4.1 Procedure for CPU Utilization Demonstration

- Install CodeWarrior project from the Resource Pak CD
- Under *Edit/Preferences*, select *Preferences*
  - Under *Build Settings/Build before running*, select *Never*; see **Figure 2-6**
    - This will then use the existing .elf (executable) file for the project
- Select *Run* in the debugger to continue executing the demonstration
- The application starts, running at 60MHz and 60 MIPs, with all 10 LEDs "ON"
- By pressing the IRQA button, a user can change the processor's speed and, thus, its MIPs, in the following ways:
  1. Pressing the IRQA button after start-up drops the processor's speed to 30MHz and 30 MIPs; only 5 LEDs will be in a constant "ON" state
  2. Pressing the IRQA button again drops the processor speed to 20MHz and 20 MIPs; only three LEDs will be in a constant "ON" state
  3. Pressing the IRQA button again returns the application to its initial state
- The **RESET** button will reset the demo application

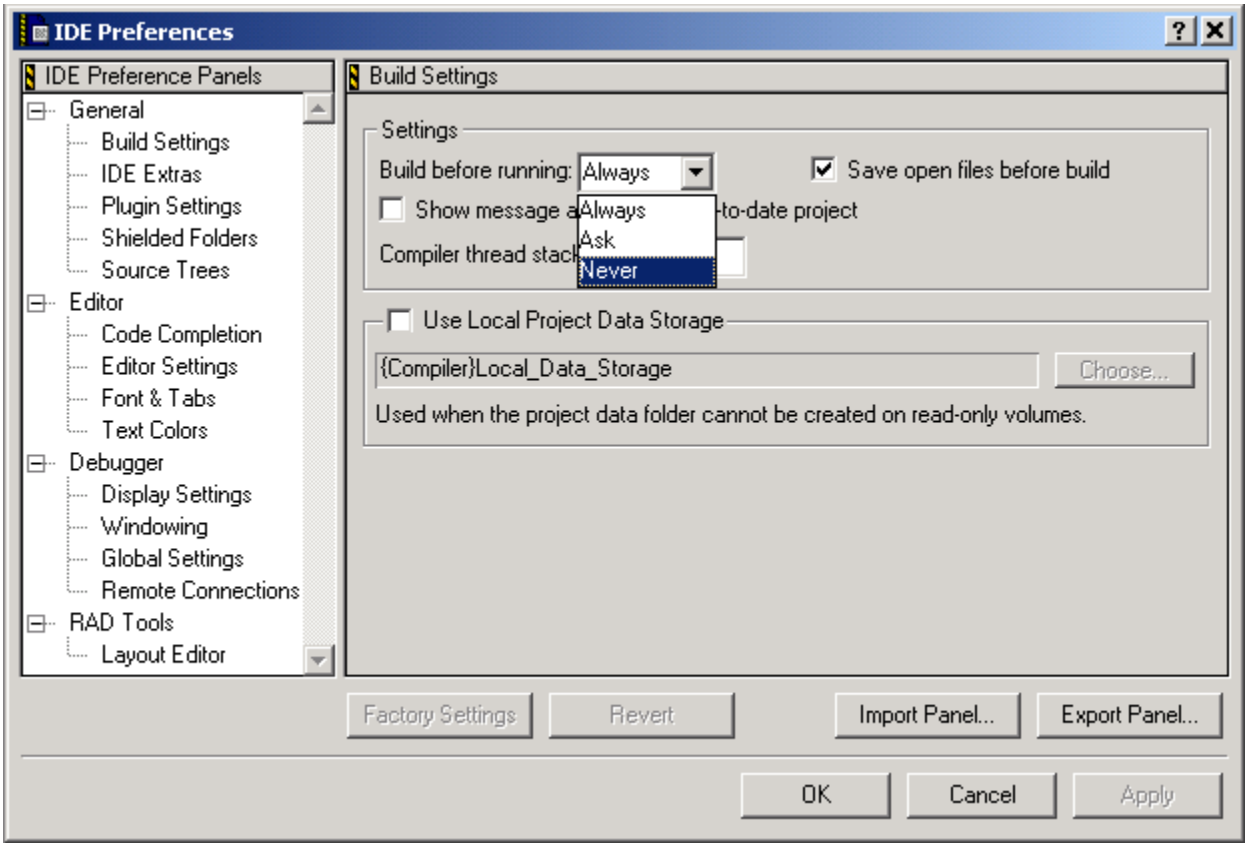

Figure 2-6. Editing Preferences

To rebuild the .elf (executable) file, the build setting within CodeWarrior must be changed from *Never* to *Always* and MicroC/OS-II source code must be added to the project. MicroC/OS-II source code can be purchased at this URL: **http://ucos-ii.com/**.

2.1.5 LED Demonstration

The LED Demonstration illustrates the use of five channels of the Quad Timer. The first timer goes off on a Compare1, which starts the second timer. The second timer goes off on Compare 2, which starts the third timer. The third timer goes off on Compare 3, which starts the fourth timer, the fourth timer goes off on Compare4, which starts the fifth timer. The fifth timer goes off on Compare 5, which starts the first timer. Each column of LEDs reflects the status of a corresponding timer and each timer is set to run at .5 second intervals.

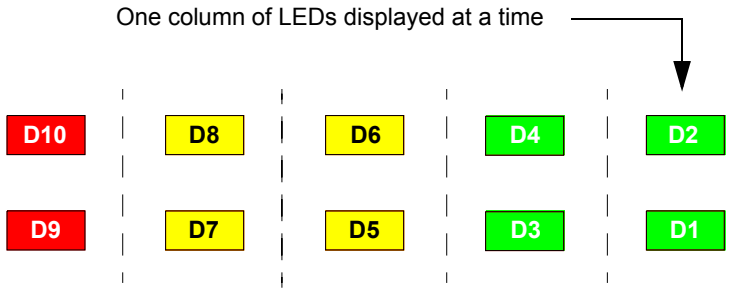

Figure 2-7. LED Demo LED usage

2.1.5.1 Set-up for LED Demonstration

Demonstration Board Jumper Settings:

Use default settings as shown in the **56F8300 Demonstration Board User's Manual**.

2.1.5.2 Procedure for LED Demonstration

- Install CodeWarrior project from the Resource Pak CD
- Build and download the project; when the debugger reaches *main()*, it will stop
- Select *Run* in the debugger to continue executing the test
- At this point, the five columns of LEDs will turn on and off sequentially
- The RESET button will reset the demo application

2.1.6 Fast Interrupt Demonstration

The Fast Interrupt Demonstration illustrates the processing time saved when using a Fast Interrupt over a Normal Interrupt. For one second, a timer interrupt will occur every 10ms and will transfer a word from a modulo buffer to another buffer in RAM, using only registers available to the Fast Interrupt's automatic context switching. Results will then be printed to a Code Warrior console window.

2.1.6.1 Set-up for Fast Interrupt Demonstration

Demonstration Board Jumper Settings:

Use default settings as shown in the **56F8300 Demonstration Board User's Manual**.

2.1.6.2 Procedure for Fast Interrupt Demonstration

- Install CodeWarrior project from the Resource Pak CD
- Build and download the project; when the debugger reaches *main()*, it will stop
- Select *Run* in the debugger to continue executing the test
- At this point, a console window will display the following information:
  - Number of Idle Ticks in one second with "No Interrupts"
  - Number of Idle Ticks in one second with "Normal Interrupts" and associated overhead
  - Number of Idle Ticks in one second with "Fast Interrupts" and associated overhead
  - How much more efficient the Fast Interrupt is than the Normal Interrupt

Appendix A
Targeting 56F8300 Demonstration Board Schematics

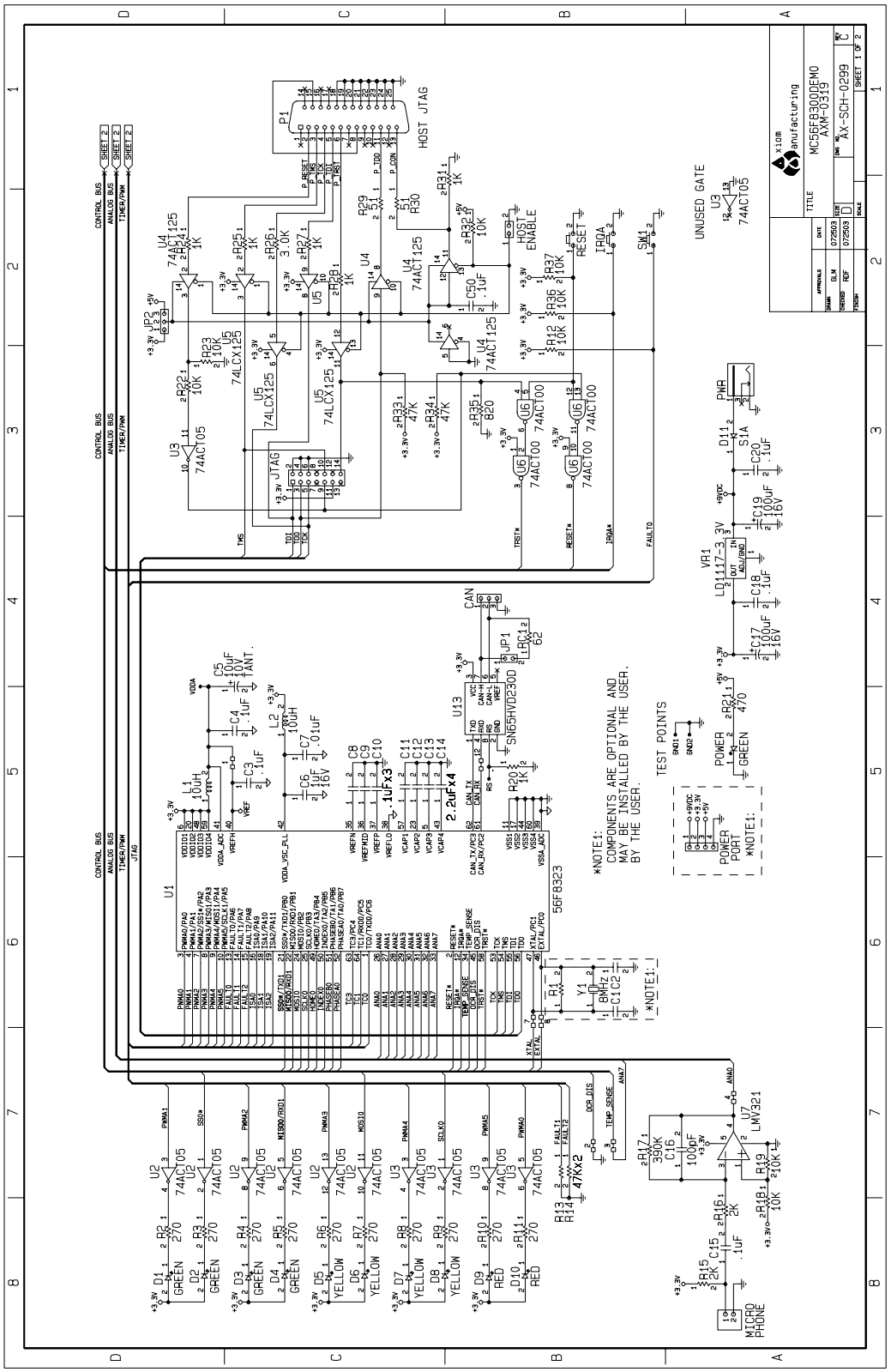

Figure A-1. Targeting 56F8300 Demonstration Board

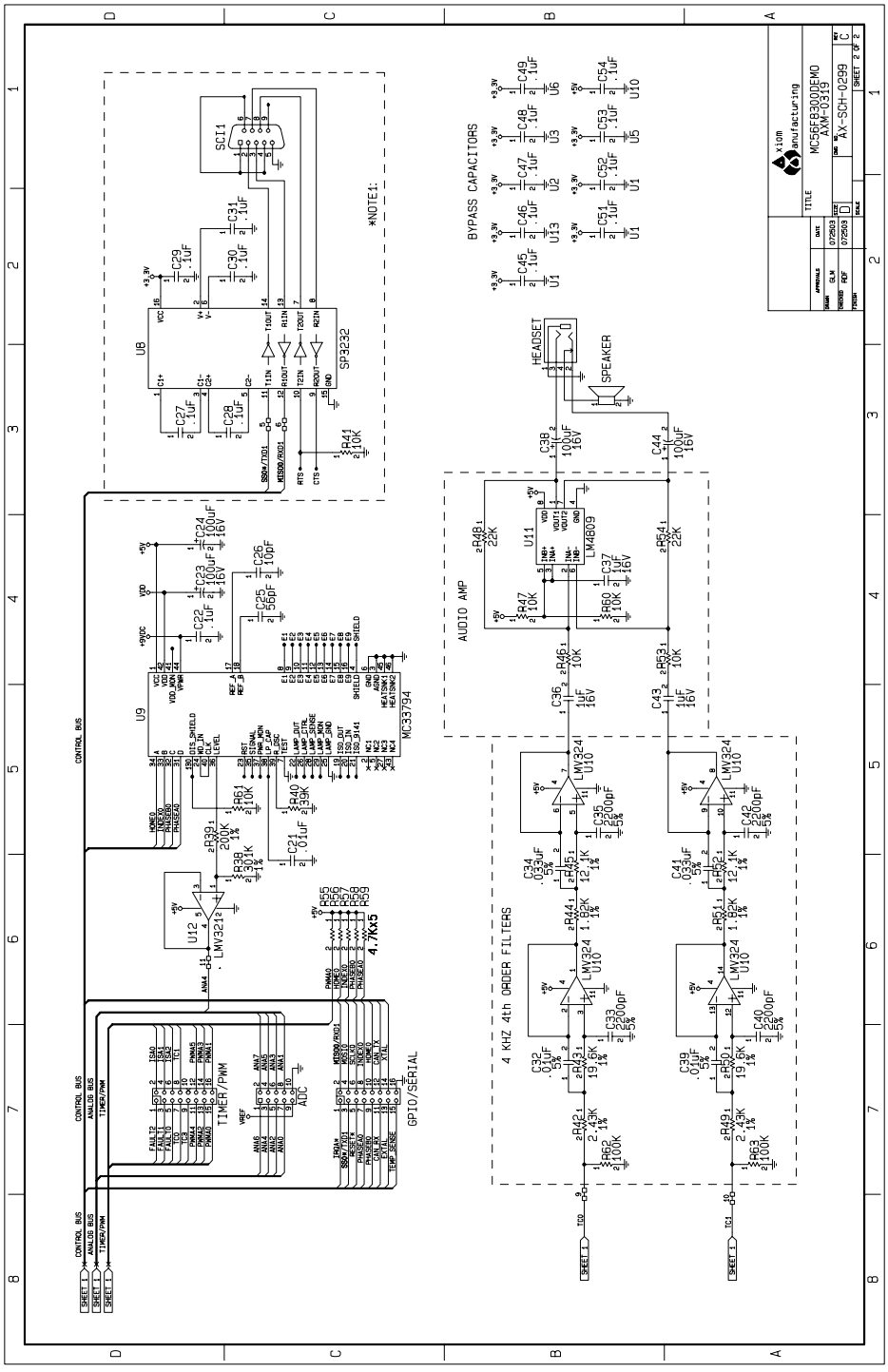

Figure A-2. Targeting 56F8300 Demonstration Board

Targeting 56F8300 Demonstration Board Schematics, Rev. 4

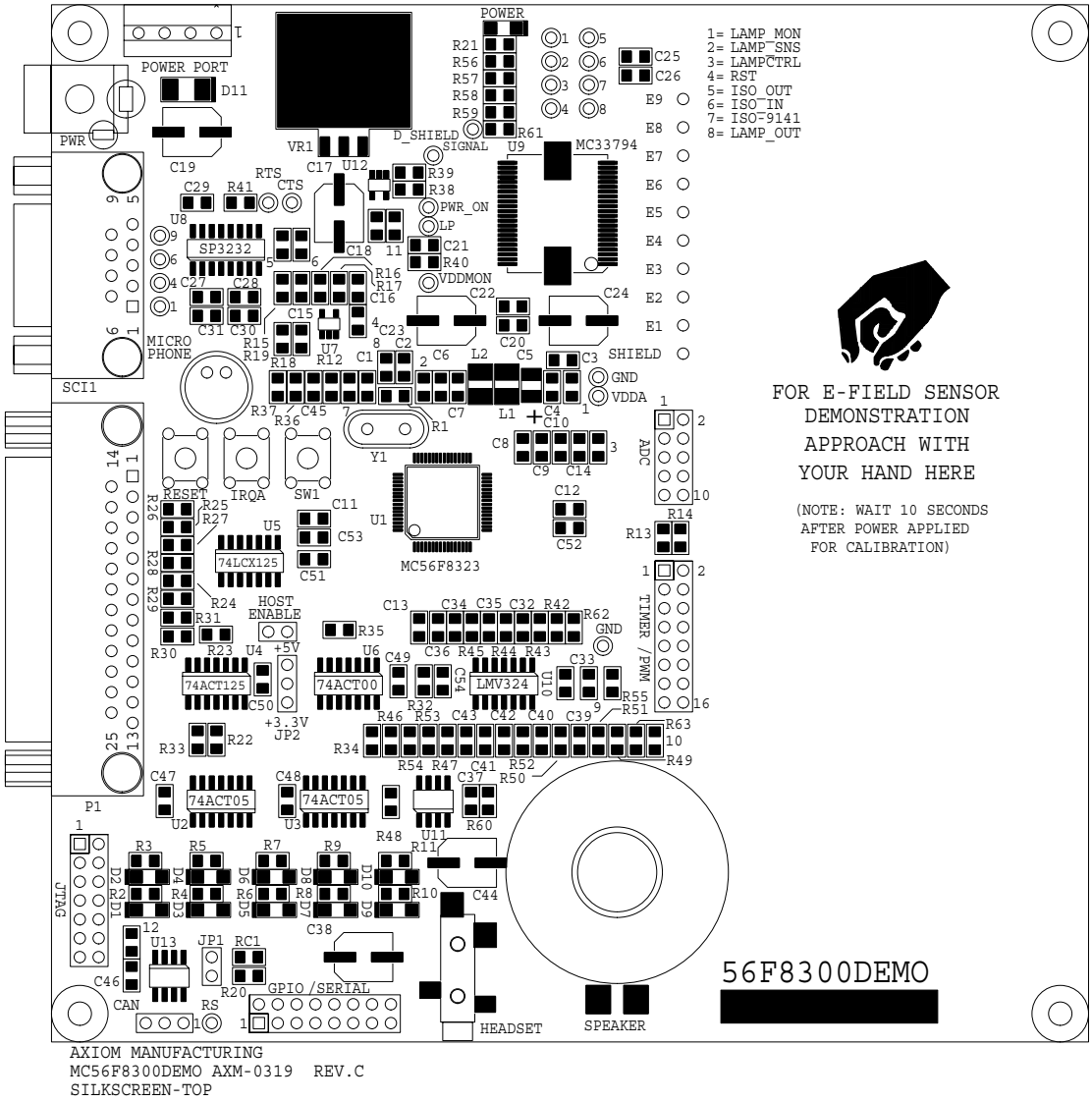

Figure A-3. MC56F8300 Demo Board

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