

# 56F8013

## Demonstration Board User Guide

**56F8000**  
**16-bit Digital Signal Controllers**

MC56F8013DEBUG  
Rev. 0  
3/2005

[freescale.com](http://freescale.com)





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# Preface

This manual describes the hardware on the 56F8013 Demonstration Board in detail.

## Audience

This document is intended for application developers who are creating software for devices using the Freescale 56F8013 part or a member of the 56F8000 family that is compatible with this part.

## Organization

This manual is organized into two chapters and two appendices.

- **Chapter 1, Introduction**, provides an overview of the Demo board and its features.
- **Chapter 2, Technical Summary**, describes the 56F8013 Demonstration Board hardware in detail.
- **Appendix A, 56F8013 Demonstration Board Schematics**, contains the schematics of the 56F8013 Demonstration Board.
- **Appendix B, 56F8013 Demonstration Board Bill of Material**, provides a list of the materials used on the 56F8013 Demonstration Board.

## Suggested Reading

More documentation on the 56F8013 Demonstration Board and the 56F8013 Demo kit may be found at URL:

**[www.freescale.com](http://www.freescale.com)**

# Notation Conventions

This manual uses the following notational conventions:

Term or Value	Symbol	Examples	Exceptions
Active High Signals (Logic One)	No special symbol attached to the signal name	A0 CLKO	
Active Low Signals (Logic Zero)	Noted with an overbar in text and in most figures	$\overline{WE}$ OE	In schematic drawings, Active Low Signals may be noted by a backslash: /WE
Hexadecimal Values	Begin with a "\$" symbol	\$0FF0 \$80	
Decimal Values	No special symbol attached to the number	10 34	
Binary Values	Begin with the letter "b" attached to the number	b1010 b0011	
Numbers	Considered positive unless specifically noted as a negative value	5 -10	Voltage is often shown as positive: +3.3V
Blue Text	Linkable on-line	...refer to <a href="#">Chapter 7, License</a>	
Bold	Reference sources, paths, emphasis	...see: <a href="http://www.freescale.com/">http://www.freescale.com/</a>	

## Definitions, Acronyms, and Abbreviations

Definitions, acronyms and abbreviations for terms used in this document are defined below for reference.

<b>56F8013</b>	Digital signal controller with motor control peripherals
<b>A/D</b>	Analog-to-Digital; a method of converting Analog signals to Digital values
<b>ADC</b>	Analog-to-Digital Converter; a peripheral on the 56F8013 part
<b>DSC</b>	Digital Signal Controller
<b>EOnCE</b>	Enhanced On-Chip Emulation; a debug bus and port which enables a designer to create a low-cost hardware interface for a professional-quality debug environment
<b>Demo Board</b>	Demonstration Board; a hardware platform which allows a customer to evaluate the silicon and develop his application
<b>GPIO</b>	General Purpose Input and Output port on Freescale's family of digital signal controllers; does not share pin functionality with any other peripheral on the chip and can only be set as an input, output, or level-sensitive interrupt input
<b>IC</b>	Integrated Circuit
<b>JTAG</b>	Joint Test Action Group; a bus protocol/interface used for test and debug
<b>LED</b>	Light Emitting Diode
<b>LQFP</b>	Low-profile Quad Flat Package
<b>OnCE™</b>	On-Chip Emulation, a debug bus and port created to allow a means for low-cost hardware to provide a professional-quality debug environment
<b>PCB</b>	Printed Circuit Board
<b>PWM</b>	Pulse Width Modulation
<b>SCI</b>	Serial Communications Interface; a peripheral on Freescale's family of digital signal controllers
<b>SPI</b>	Serial Peripheral Interface; a peripheral on Freescale's family of digital signal controllers

## References

The following sources were referenced to produce this manual:

- [1] *DSP56800E Reference Manual*, DSP56800ERM, Freescale Semiconductor, Inc.
- [2] *56F8000 Peripheral Reference Manual*, MC56F8000RM, Freescale Semiconductor, Inc.
- [3] *56F8013 Technical Data*, MC56F8013, Freescale Semiconductor, Inc.

# Chapter 1

## Introduction

The 56F8013 Demonstration Board is used to demonstrate the abilities of the 56F8013 digital signal controller and to provide a hardware tool allowing the development of applications.

The 56F8013 Demonstration Board is an evaluation module board that includes a 56F8013 part, RS-232 interface, user LEDs, user pushbutton switches and a daughter card connector. The daughter card connector allows signal monitoring and expandability of user features.

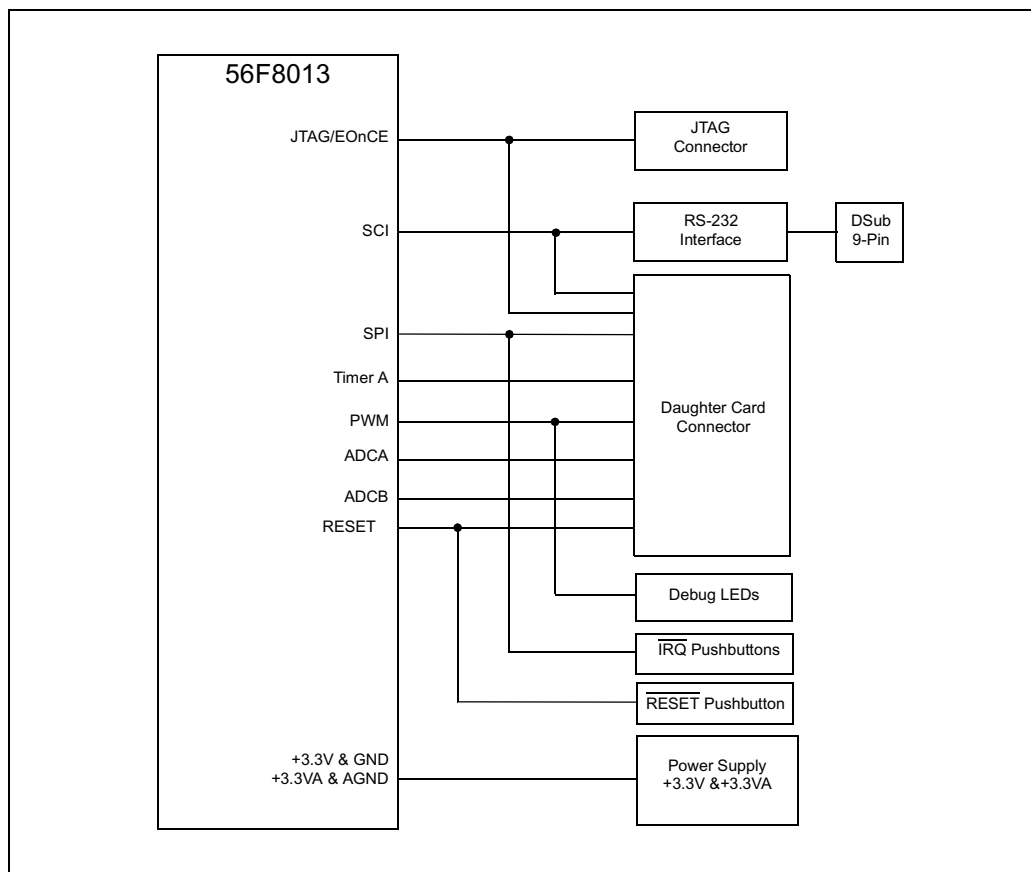
The 56F8013 Demonstration Board is designed for the following purposes:

- Allowing new users to become familiar with the features of the 56800E architecture. The tools and examples provided with the 56F8013 Demonstration Board facilitate evaluation of the feature set and the benefits of the family.
- Serving as a platform for real-time software development. The tool suite enables the user to develop and simulate routines, download the software to on-chip memory, run it, and debug it using a debugger via the JTAG/Enhanced OnCE (EOnCE) port. The breakpoint features of the EOnCE port enable the user to easily specify complex break conditions and to execute user-developed software at full speed until the break conditions are satisfied. The ability to examine and modify all user-accessible registers, memory and peripherals through the EOnCE port greatly facilitates the task of the developer.
- Serving as a platform for hardware development. The hardware platform enables the user to connect external hardware peripherals. The on-board peripherals can be disabled, providing the user with the ability to reassign any and all of the processor's peripherals. The EOnCE port's unobtrusive design means that all memory on the board and on the processor is available to the user.

### 1.1 56F8013 Demonstration Board Architecture

The 56F8013 Demonstration Board facilitates the evaluation of various features present in the 56F8013 part. The 56F8013 Demonstration Board can be used to develop real-time software and hardware products. The 56F8013 Demonstration Board provides the features necessary for a

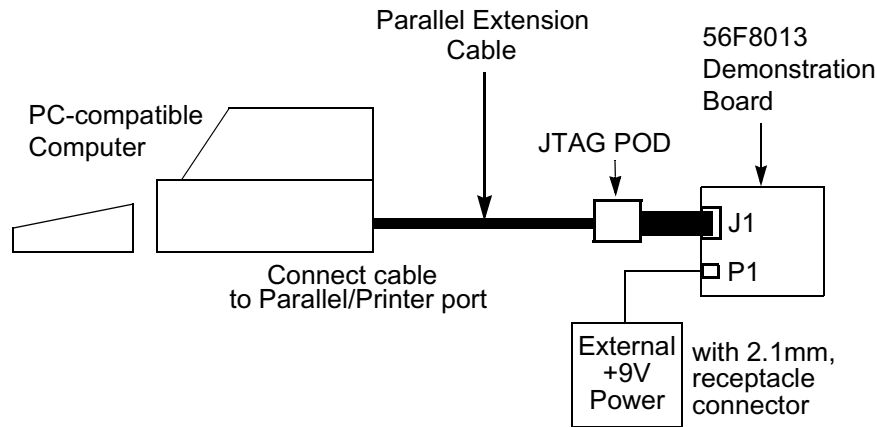
user to write and debug software, demonstrate the functionality of that software and interface with the user's application-specific device(s). The 56F8013 Demonstration Board is flexible enough to allow a user to fully exploit the 56F8013's features to optimize the performance of his product, as shown in [Figure 1-1](#).



**Figure 1-1. Block Diagram of the 56F8013 Demonstration Board**

## 1.2 56F8013 Demonstration Board Connections

An interconnection diagram is shown in [Figure 1-2](#) for connecting the PC and the external +9.0V DC power supply to the 56F8013 Demonstration Board.



**Figure 1-2. Connecting the 56F8013 Demonstration Board Cables**

Perform the following steps to connect the 56F8013 Demonstration Board cables:

1. Connect the parallel extension cable to the parallel port of the host computer.
2. Connect the other end of the parallel extension cable to the JTAG interface POD. Connect the ribbon cable from the JTAG interface POD to J1, shown in [Figure 1-2](#), on the 56F8013 Demonstration Board. This provides the connection which allows the host computer to control the board.
3. Make sure that the external +9V DC, 450mA power supply is not plugged into a +120V AC power source.
4. Connect the 2.1mm output power plug from the external power supply into P1, shown in [Figure 1-2](#), on the 56F8013 Demonstration Board.
5. Apply power to the external power supply. The green Power-ON LED, LED7, will illuminate when power is correctly applied.





# Chapter 2

## Technical Summary

The 56F8013 Demonstration Board is designed as a versatile development card using the 56F8013 processor, allowing the creation of real-time software and hardware products to support a new generation of applications in servo and motor control, digital and wireless messaging, digital answering machines, feature phones, modems, and digital cameras. The power of the 16-bit 56F8013 processor, combined with the on-board RS-232 interface and daughter card connector, makes the 56F8013 Demonstration Board ideal for developing and implementing many motor control algorithms, as well as for learning the architecture and instruction set of the 56F8013 processor.

The main features of the 56F8013 Demonstration Board, with board and schematic reference designators, include:

- 56F8013, a 16-bit +3.3V digital signal controller operating at 60MHz [U1]
- Joint Test Action Group (JTAG) port interface connector, for an external debug Host Target Interface [J1]
- RS-232 interface, for easy connection to a host processor [U2 and P3]
- Daughter Card connector, to allow the user to connect his own PWM, ADC, SCI, SPI or GPIO-compatible peripheral to the digital signal controller [P2]
- On-board power regulation provided from an external +9V DC-supplied power input [P1]
- Light Emitting Diode (LED) power indicator [LED7]
- Six on-board real-time user debugging LEDs [LED1-6]
- Manual RESET push-button [S3]
- Manual interrupt #1 push-button [S1]
- Manual interrupt #2 push-button [S2]

## 2.1 56F8013

The 56F8013 Demonstration Board uses a Freescale 56F8013 part, designated as U1 on the board and in the schematics. This part will operate at a maximum external bus speed of 60MHz. A full description of the 56F8013, including functionality and user information, is provided in these documents:

- *56F8013 Technical Data Sheet*, (MC56F8013): Electrical and timing specifications, pin descriptions, device specific peripheral information and package descriptions
- *56F8000 Peripheral Reference Manual*, (MC56F8000RM): Detailed description of peripherals of the 56F8000 family of devices
- *DSP56800E Reference Manual*, (DSP56800ERM): Detailed description of the 56800E family architecture, 16-bit core processor, and the instruction set

Refer to these documents for detailed information about chip functionality and operation. They can be found on this URL:

[www.freescale.com](http://www.freescale.com)

## 2.2 RS-232 Serial Communications

The 56F8013 Demonstration Board provides an RS-232 interface by the use of an RS-232 level converter, Sipex SP3220EUCY, designated as U2. Refer to the RS-232 schematic details in [Appendix A](#). The RS-232 level converter transitions the SCI port's +3.3V signal levels to RS-232-compatible signal levels and connects to the host's serial port via connector P3. The SCI ports signals, GPIOB6 and GPIOB7, can be disconnected from the RS-232 level converter by cutting the JP1 and JP2 jumpers on the board. The pin-out of connector P2 is shown in [Table 2-1](#).

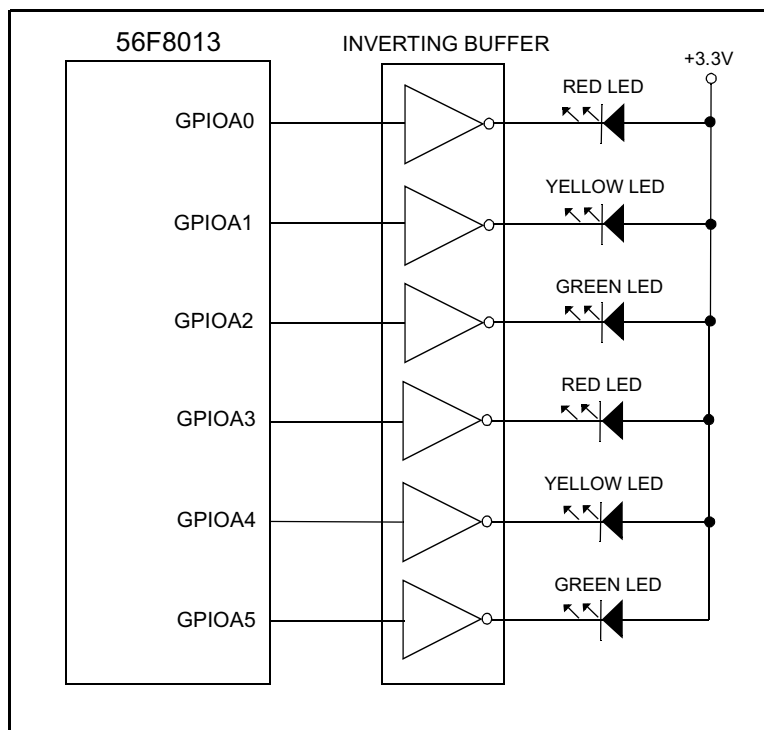
**Table 2-1. RS-232 Serial Connector Description**

P3			
Pin #	Signal	Pin #	Signal
1	Jumper to 6 & 4	6	Jumper to 1 & 4
2	TXD	7	NC
3	RXD	8	NC
4	Jumper to 1 & 6	9	NC
5	GND		

## 2.3 Debug LEDs

Six on-board Light-Emitting Diodes, (LEDs), are provided to allow real-time debugging for user programs. These LEDs will allow the programmer to monitor program execution without having to stop the program during debugging; refer to [Figure 2-1](#). [Table 2-2](#) describes the control of each LED.

Setting GPIOA0, GPIOA1, GPIOA2, GPIOA3, GPIOA4, or GPIOA5 to a Logic One value will turn on the associated LED.



**Figure 2-1. Diagram of the Debug LED Interface**

**Table 2-2. LED Control**

User LED	Controlled by	
	Color	Signal
LED1	RED	GPIO Port A, Bit 0
LED2	YELLOW	GPIO Port A, Bit 1
LED3	GREEN	GPIO Port A, Bit 2
LED4	RED	GPIO Port A, Bit 3
LED5	YELLOW	GPIO Port A, Bit 4
LED6	GREEN	GPIO Port A, Bit 5

## 2.4 Debug Support

A JTAG connector, J1, on the 56F8013 Demonstration Board allows the connection of an external Host Target Interface for downloading programs and working with the 56F8013's registers. This connector is used to communicate with an external Host Target Interface, which passes information and data back and forth with a host processor running a debugger program.

**Table 2-3** shows the pin-out for this connector.

## 2.5 External Interrupts

Two on-board push-button switches are provided for external interrupt generation, as shown in **Figure 2-2**. S1 allows the user to generate a hardware interrupt, IRQ #1, using GPIO Port B, Bit 2. S2 allows the user to generate a hardware interrupt, IRQ #2, using GPIO Port B, Bit 3. These two switches allow the user to generate interrupts for his user-specific programs.

Alternately, the user can use GPIO Port B, Bit 4 for IRQ #1. To accomplish this, cut the trace at JP3 pins 1 and 2 and solder a jumper between JP3 pins 2 and 3. Also, the user can use GPIO Port B, Bit 5 for IRQ #2. To accomplish this, cut the trace at JP4 pins 1 and 2 and solder a jumper between JP4 pins 2 and 3.

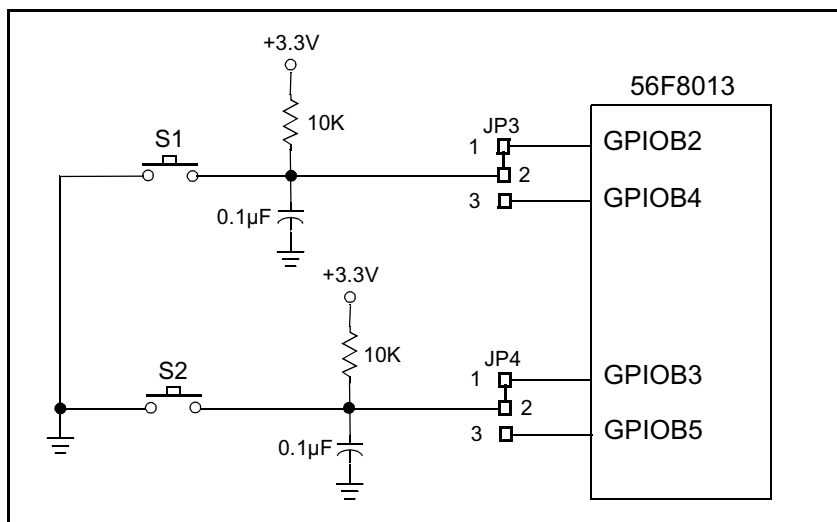


Figure 2-2. Schematic Diagram of the User Interrupt Interface

## 2.6 Reset

Logic is provided on the 56F8013 to generate an internal Power-On RESET. Additional reset logic is provided to support the RESET signal from the JTAG connector and the user RESET push-button, S3; refer to the schematics in [Appendix A](#).

## 2.7 Power Supply

The main power input to the 56F8013 Demonstration Board, +9V DC at 450mA, is through a 2.1mm coax power jack, P1. This input power passes through a reverse power-blocking diode to provide a DC supply input for the +3.3V voltage regulator, U3. A 450mA power supply is provided with the 56F8013 Demonstration Board; however, less than 200mA is required by the Demo Board. The remaining current is available for custom control applications when connected to the daughter card connector. The 56F8013 Demonstration Board provides +3.3V DC voltage regulation for the processor, ADC, JTAG interface and supporting logic; refer to schematics in [Appendix A](#). Additional voltage regulation logic provides a low-noise +3.3V DC voltage to the processor's A/D peripheral. Power applied to the 56F8013 Demonstration Board is indicated with a Power-ON LED, referenced as LED7.

## 2.8 Daughter Card Connector

The 56F8013 Demonstration Board contains a daughter card connector, P2, which contains the processor's peripheral port signals. The daughter card connector is used to connect a daughter card or a user-specific daughter card to the processor's peripheral port signals. The daughter card connector is a 40-pin 0.1" pitch connector with signals for RESET, SPI, SCI, PWM, ADC and GPIO ports. **Table 2-3** shows the daughter card connector's signal-to-pin assignments.

**Table 2-3. Daughter Card Connector Description**

P2			
Pin #	Signal	Pin #	Signal
1	+3.3V	2	NC
3	GND	4	GPIOA7 / $\overline{\text{RESET}}$ / V <sub>PP</sub>
5	GPIOB7 / TXD / SCL	6	NC
7	GPIOB6 / RXD / SDA / CLKIN	8	NC
9	GPIOA0 / PWM0	10	GPIOC0 / ANA0
11	GPIOA1 / PWM1	12	GPIOC1 / ANA1
13	GPIOB4 / T0 / CLK0	14	GPIOC2 / V <sub>REFH</sub> / ANA2
15	GPIOB5 / T1 / FAULT3	16	NC
17	GPIOB3 / MOSI / T3	18	GPIOC4 / ANB0
19	GPIOB2 / MISO / T2	20	GPIOC5 / ANB1
21	GPIOB0 / SCLK / SCL	22	GPIOC6 / V <sub>REFL</sub> / ANB2
23	GPIOB1 / $\overline{\text{SS}}$ / SDA	24	NC
25	GIOD0 / TDI	26	GPIOB1 / $\overline{\text{SS}}$ / SDA
27	GIOD1 / TDO	28	GPIOB0 / SCLK / SCL
29	GIOD2 / TCK	30	GPIOA2 / PWM2
31	GIOD3 / TMS	32	GPIOA3 / PWM3
33	GPIOA6 / FAULT0	34	GPIOA4 / PWM4 / FAULT1 / T2
35	NC	36	GPIOA5 / PWM5 / FAULT2 / T3
37	NC	38	NC
39	NC	40	NC

## 2.9 Test Points

The 56F8013 Demonstration Board board has two test points:

- +3.3V, TP1
- Digital Ground (GND), TP2

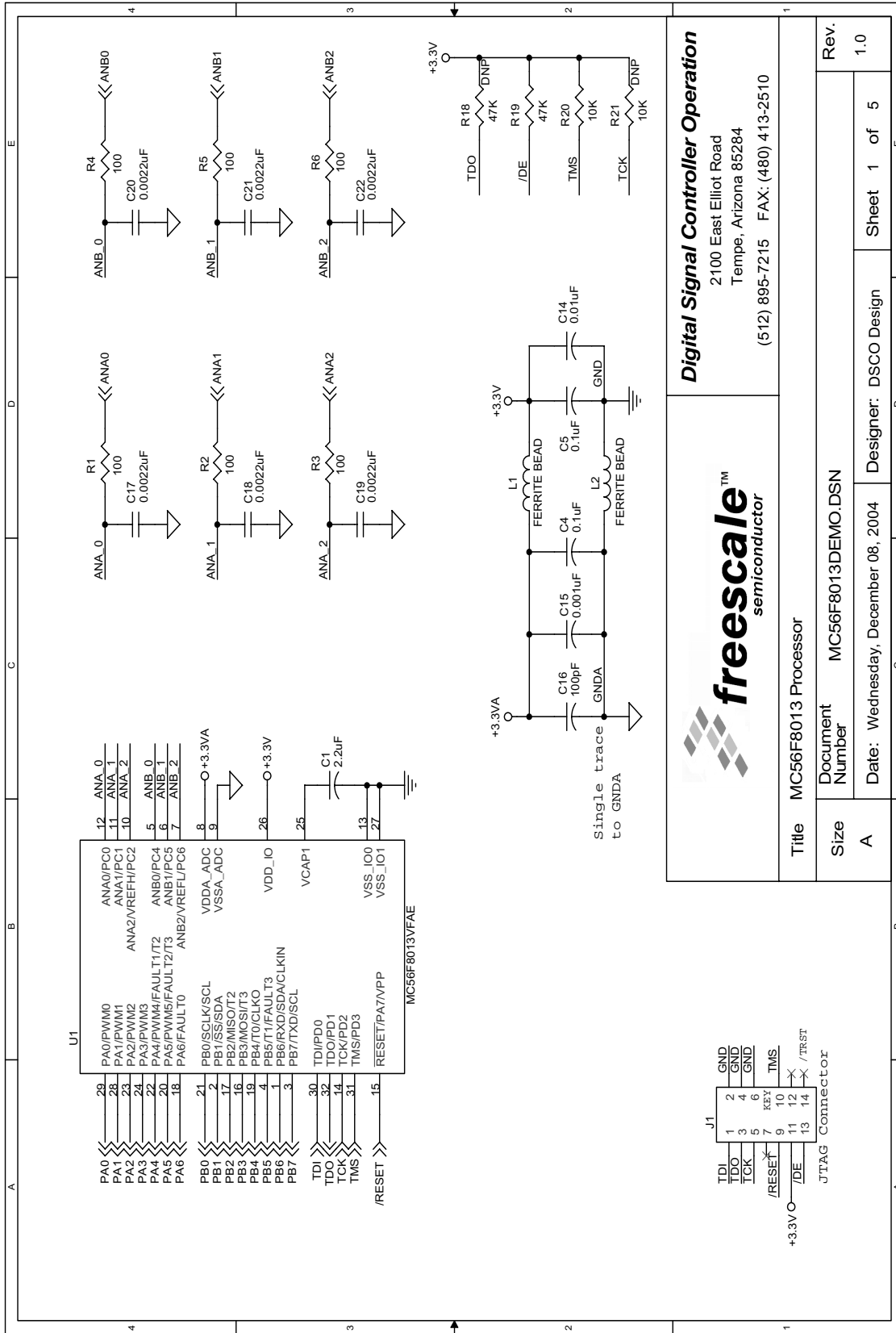






# **Appendix A**

## **56F8013 Demonstration Board Schematics**

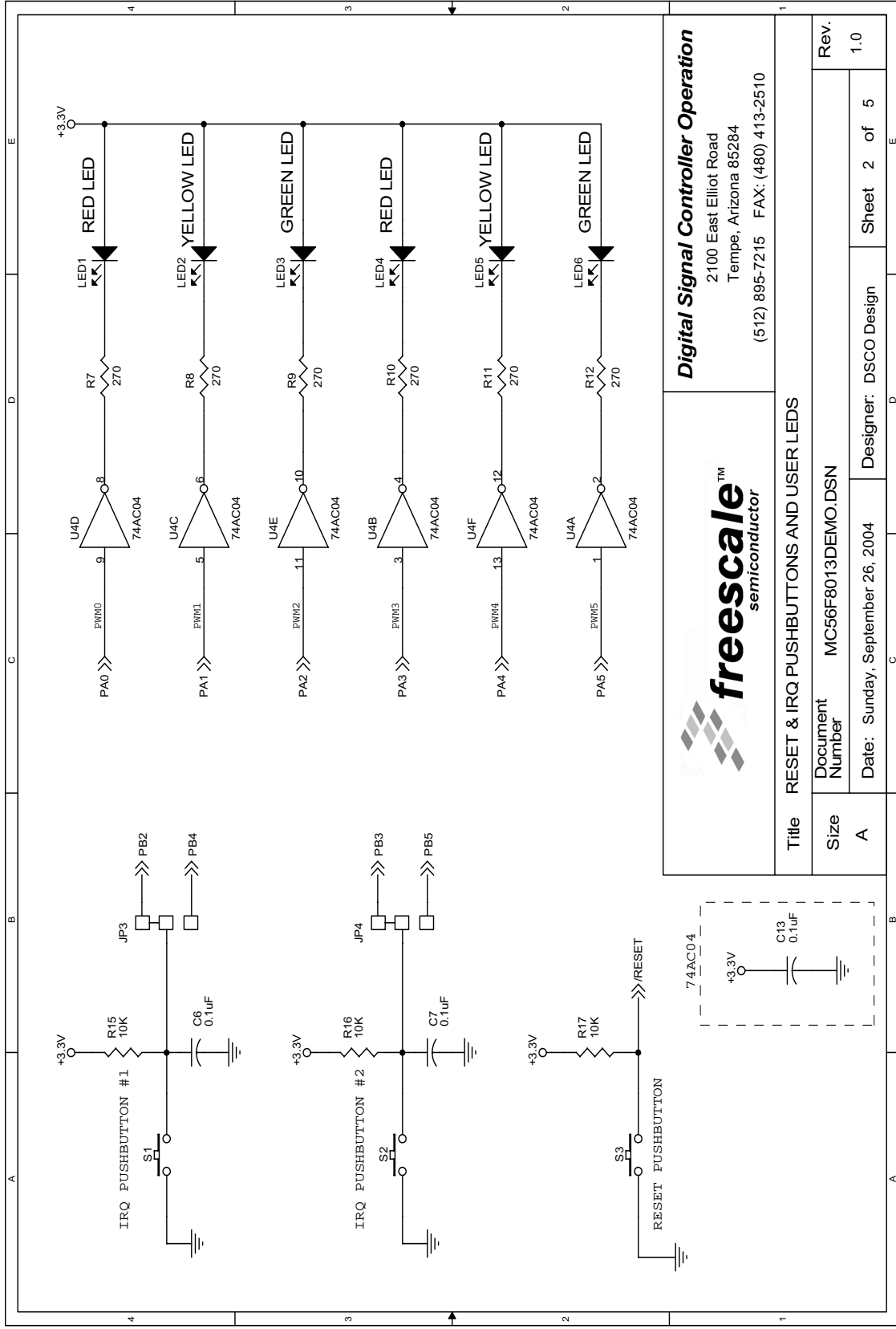


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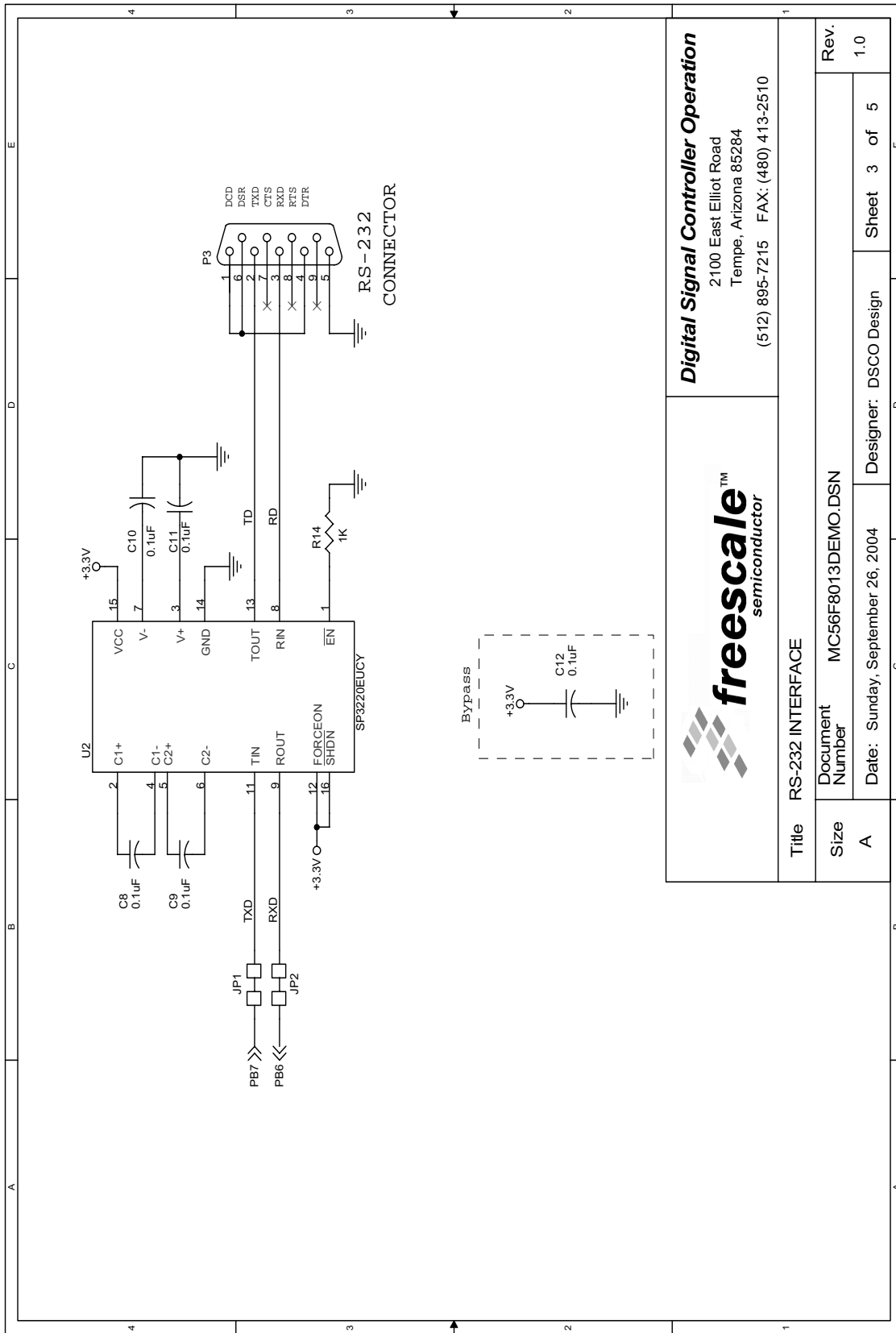
Title		MC56F8013 Processor	
Size	A	Document Number	MC56F8013DEMO.DSN
Date:	Wednesday, December 08, 2004	Designer:	DSCO Design
Sheet 1 of 5		Rev. 1.0	


**Figure A-1. MC56F8013 PROCESSOR**



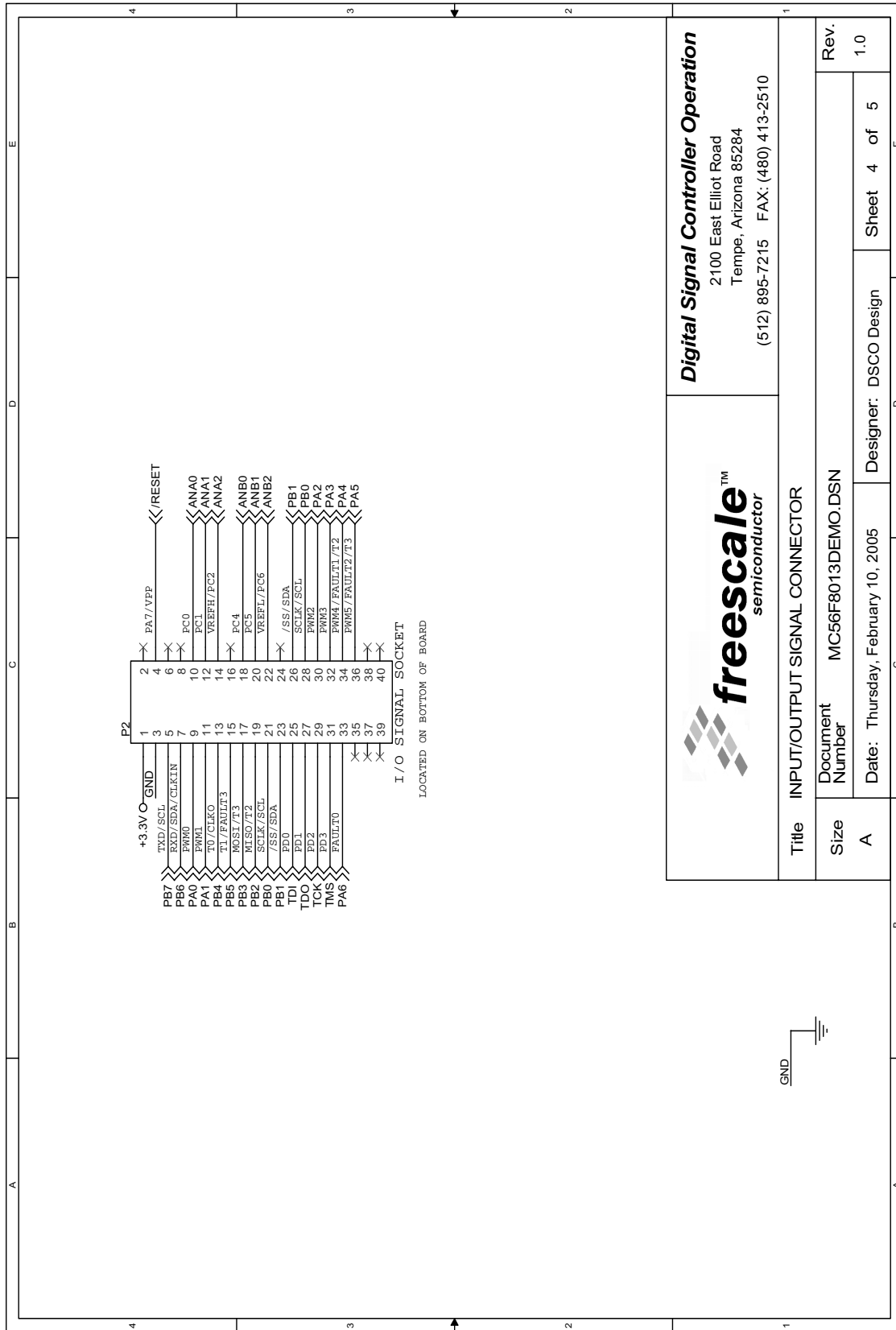
		<b>Digital Signal Controller Operation</b> 2100 East Elliot Road Tempe, Arizona 85284 (512) 895-7215 FAX: (480) 413-2510	
		<b>Title</b> RESET & IRQ PUSHBUTTONS AND USER LEDs	<b>Rev.</b> 1.0
<b>Document Number</b> MC56F8013DEMO.DSN	<b>Date:</b> Sunday, September 26, 2004	<b>Designer:</b> DSCO Design	<b>Sheet</b> 2 of 5

Figure A-2. RESET & IRQ Pushbuttons and User LEDs



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		Title RS-232 INTERFACE	
Size	A	Document Number	MC56F8013DEMO.DSN
Date:	Sunday, September 26, 2004	Designer:	DSCO Design
Sheet	3 of 5	Rev.	1.0

**Figure A-3. RS-232 Interface**

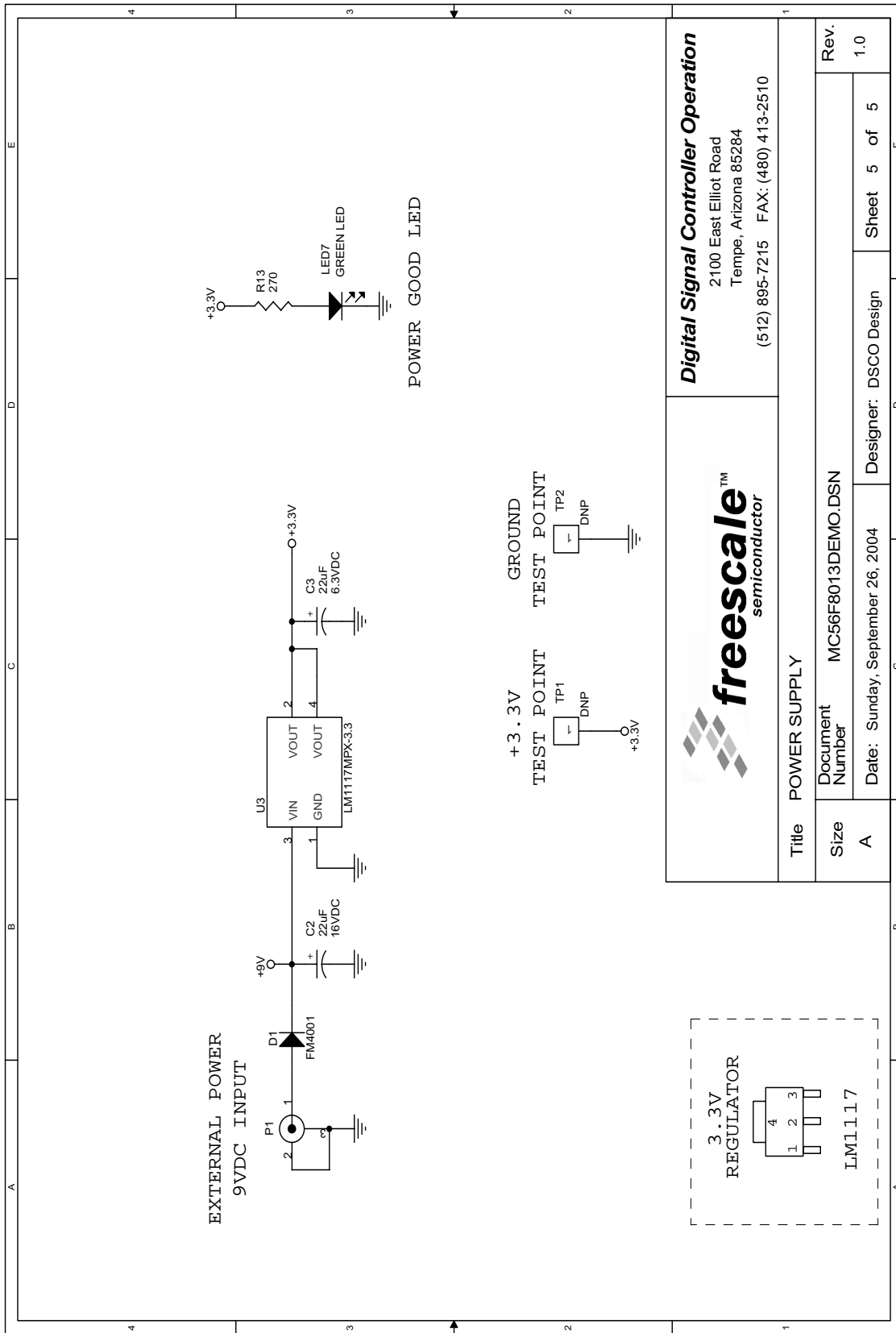


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Title		INPUT/OUTPUT SIGNAL CONNECTOR	
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Sheet	4 of 5	Rev.	1.0

**Figure A-4. Input / Output Signal Connector**



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Title: POWER SUPPLY		Rev.:
Size: A	Document Number: MC56F8013DEMO.DSN	1.0
Date: Sunday, September 26, 2004	Designer: DSCO Design	Sheet 5 of 5

**Figure A-5. Power Supply**

# Appendix B

## 56F8013 Demonstration Board

### Bill of Material

Qty	Description	Ref. Designators	Vendor Part #
<b>Integrated Circuits</b>			
1	MC56F8013	U1	Freescale, MC56F8013VFAE
1	RS-232 Transceiver	U2	Sipex, SP3220EUCY
1	+3.3V Voltage Regulator	U3	National Semi, LM1117MPX-3.3
1	74AC04	U4	ON Semiconductor, MC74AC04AD
<b>Resistors</b>			
6	100 $\Omega$ , 0603	R1 — R6	SMEC, RC73L2X101JT
7	270 $\Omega$ , 0603	R7 — R13	SMEC, RC73L2X271JT
1	1K $\Omega$ , 0603	R14	SMEC, RC73L2X102JT
4	10K $\Omega$ , 0603	R15 — R17, R20	SMEC, RC73L2X103JT
0	47K $\Omega$ , 0603	R18 (Optional)	SMEC, RC73L2X473JT
1	47K $\Omega$ , 0603	R19	SMEC, RC73L2X473JT
0	10K $\Omega$ , 0603	R21 (Optional)	SMEC, RC73L2X103JT
<b>Inductors</b>			
2	Ferrite Bead, 0604	L1 — L2	SMEC, FCB0603-1000HNT
<b>LEDs</b>			
2	Red LED, 1206	LED1, LED4	Hewlett-Packard, HSMS-C650
2	Yellow LED, 1206	LED2, LED5	Hewlett-Packard, HSMY-C650
2	Green LED, 1206	LED3, LED6, LED7	Hewlett-Packard, HSMG-C650

Qty	Description	Ref. Designators	Vendor Part #
<b>Diode</b>			
1	S2B-FM401, SMA	D1	Vishay, DL4001DICT
<b>Capacitors</b>			
1	2.2 $\mu$ F, +25V DC, 0805 (Low ESR)	C1	TAIYO YUDEN, CELMK212BJ225MG-T
1	22 $\mu$ F, +16V DC, EIA-B	C2	SMEC, TCC22K16B
1	22 $\mu$ F, +6.3V DC, EIA-A	C3	SMEC, TCC22M6.3A
10	0.1 $\mu$ F, 0603	C4 — C13	SMEC, MCCA104K1NR-T1
1	0.01 $\mu$ F, 0603	C14	SMEC, MCCA103K1NR-T1
1	0.001 $\mu$ F, 0603	C15	SMEC, MCCA102K1NRT
1	100pF, 0603	C16	SMEC, MCCA101K1NRT
6	0.0022 $\mu$ F, 0603	C17 — C22	SMEC, MCCA222K1NRT
<b>Test Points</b>			
0	+3.3V Test Point	TP1 (Optional)	KEYSTONE, 5000, RED
0	GND Test Point	TP2 (Optional)	KEYSTONE, 5001, BLACK
<b>Connectors</b>			
1	2.1mm coax Power Connector	P1	Switchcraft, RAPC-722
1	Daughter Card Connector	P2	SAMTEC, SSM-120-L-DV-LC
1	DE9S Connector	P3	AMPHENOL, 617-C009S-AJ120
1	7x2 JTAG Header	J1	SAMTEC, TSW-107-07-S-D
<b>Switches</b>			
3	SPST Pushbutton	S1 — S3	Panasonic, EVQ-PAD05R
<b>Miscellaneous</b>			
2	Stand-off Post, 4-40		Aluminum 0.25" Hex Female, 0.375"
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