TEXAS INSTRUMENTS

MSC1200EVM

Precision ADC with 8051 Microcontroller and Flash Memory

Evaluation Module

User's Guide

May 2004

Data Acquisition Products

SBAU098

IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, modifications, enhancements, improvements, and other changes to its products and services at any time and to discontinue any product or service without notice. Customers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All products are sold subject to TI's terms and conditions of sale supplied at the time of order acknowledgment.

TI warrants performance of its hardware products to the specifications applicable at the time of sale in accordance with TI's standard warranty. Testing and other quality control techniques are used to the extent TI deems necessary to support this warranty. Except where mandated by government requirements, testing of all parameters of each product is not necessarily performed.

TI assumes no liability for applications assistance or customer product design. Customers are responsible for their products and applications using TI components. To minimize the risks associated with customer products and applications, customers should provide adequate design and operating safeguards.

TI does not warrant or represent that any license, either express or implied, is granted under any TI patent right, copyright, mask work right, or other TI intellectual property right relating to any combination, machine, or process in which TI products or services are used. Information published by TI regarding third-party products or services does not constitute a license from TI to use such products or services or a warranty or endorsement thereof. Use of such information may require a license from a third party under the patents or other intellectual property of the third party, or a license from TI under the patents or other intellectual property of TI.

Reproduction of information in TI data books or data sheets is permissible only if reproduction is without alteration and is accompanied by all associated warranties, conditions, limitations, and notices. Reproduction of this information with alteration is an unfair and deceptive business practice. TI is not responsible or liable for such altered documentation.

Resale of TI products or services with statements different from or beyond the parameters stated by TI for that product or service voids all express and any implied warranties for the associated TI product or service and is an unfair and deceptive business practice. TI is not responsible or liable for any such statements.

Following are URLs where you can obtain information on other Texas Instruments products and application solutions:

Products		**Applications**	
Amplifiers	amplifier.ti.com	Audio	www.ti.com/audio
Data Converters	dataconverter.ti.com	Automotive	www.ti.com/automotive
DSP	dsp.ti.com	Broadband	www.ti.com/broadband
Interface	interface.ti.com	Digital Control	www.ti.com/digitalcontrol
Logic	logic.ti.com	Military	www.ti.com/military
Power Mgmt	power.ti.com	Optical Networking	www.ti.com/opticalnetwork
Microcontrollers	microcontroller.ti.com	Security	www.ti.com/security
		Telephony	www.ti.com/telephony
		Video & Imaging	www.ti.com/video
		Wireless	www.ti.com/wireless

Mailing Address: Texas Instruments
Post Office Box 655303 Dallas, Texas 75265

EVM IMPORTANT NOTICE

Texas Instruments (TI) provides the enclosed product(s) under the following conditions:

This evaluation kit being sold by TI is intended for use for **ENGINEERING DEVELOPMENT OR EVALUATION PURPOSES ONLY** and is not considered by TI to be fit for commercial use. As such, the goods being provided may not be complete in terms of required design-, marketing-, and/or manufacturing-related protective considerations, including product safety measures typically found in the end product incorporating the goods. As a prototype, this product does not fall within the scope of the European Union directive on electromagnetic compatibility and therefore may not meet the technical requirements of the directive.

Should this evaluation kit not meet the specifications indicated in the EVM User's Guide, the kit may be returned within 30 days from the date of delivery for a full refund. THE FOREGOING WARRANTY IS THE EXCLUSIVE WARRANTY MADE BY SELLER TO BUYER AND IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED, IMPLIED, OR STATUTORY, INCLUDING ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR ANY PARTICULAR PURPOSE.

The user assumes all responsibility and liability for proper and safe handling of the goods. Further, the user indemnifies TI from all claims arising from the handling or use of the goods. Please be aware that the products received may not be regulatory compliant or agency certified (FCC, UL, CE, etc.). Due to the open construction of the product, it is the user's responsibility to take any and all appropriate precautions with regard to electrostatic discharge.

EXCEPT TO THE EXTENT OF THE INDEMNITY SET FORTH ABOVE, NEITHER PARTY SHALL BE LIABLE TO THE OTHER FOR ANY INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES.

TI currently deals with a variety of customers for products, and therefore our arrangement with the user **is not exclusive**.

TI assumes **no liability for applications assistance, customer product design, software performance, or infringement of patents or services described herein**.

Please read the EVM User's Guide and, specifically, the EVM Warnings and Restrictions notice in the EVM User's Guide prior to handling the product. This notice contains important safety information about temperatures and voltages. For further safety concerns, please contact the TI application engineer.

Persons handling the product must have electronics training and observe good laboratory practice standards.

No license is granted under any patent right or other intellectual property right of TI covering or relating to any machine, process, or combination in which such TI products or services might be or are used.

Mailing Address:

Texas Instruments
Post Office Box 655303
Dallas, Texas 75265

EVM WARNINGS AND RESTRICTIONS

It is important to operate this EVM within the specified input and output ranges described in the EVM User's Guide.

Exceeding the specified input range may cause unexpected operation and/or irreversible damage to the EVM. If there are questions concerning the input range, please contact a TI field representative prior to connecting the input power.

Applying loads outside of the specified output range may result in unintended operation and/or possible permanent damage to the EVM. Please consult the EVM User's Guide prior to connecting any load to the EVM output. If there is uncertainty as to the load specification, please contact a TI field representative.

During normal operation, some circuit components may have case temperatures greater than 60°C. The EVM is designed to operate properly with certain components above 60°C as long as the input and output ranges are maintained. These components include but are not limited to linear regulators, switching transistors, pass transistors, and current sense resistors. These types of devices can be identified using the EVM schematic located in the EVM User's Guide. When placing measurement probes near these devices during operation, please be aware that these devices may be very warm to the touch.

Mailing Address:

Texas Instruments
Post Office Box 655303
Dallas, Texas 75265

Preface

Read This First

About This Manual

This manual describes the function and operation of the MSC1200EVM evaluation module. Throughout this document, the abbreviation EVM and the term *evaluation module* are synonymous with the MSC1200EVM. This manual will help you quickly set up the EVM and its accompanying software, so that you can rapidly test and evaluate the MSC1200. A complete circuit description, as well as schematic diagram and bill of materials, is included.

How to Use This Manual

This manual begins with an introductory chapter which describes the evaluation module and what it can do. If you are ready to set things up and start testing, we suggest you read at least the first two chapters. These sections introduce you to the board and how to configure it for testing the device. Later chapters go into more detail on the EVM design and how to access its many features.

Information About Cautions and Warnings

This book contains cautions.

CAUTION

This is an example of a caution statement.

A caution statement describes a situation that could potentially damage your software or equipment.

The information in a caution is provided for your protection. Please read each caution carefully.

Related Documentation From Texas Instruments

The following documents provide information regarding Texas Instruments integrated circuits used in the assembly of the MSC1200EVM. These documents are available from the TI web site. The last character of the literature number corresponds to the document revision, which is current at the time of the writing of this User's Guide. To obtain a copy of the following TI document, visit our website at http://www.ti.com/ or call the Texas Instruments Literature Response Center at (800) 477−8924 or the Product Information Center at (972) 644−5580. When ordering, identify the document by both title and literature number.

Data sheet	Literature number
MSC1200	SBAS289A
REG102NA−5, REG102NA−3.3	SBVS024E
TUSB3410VF	SLLS519C
MAX3243CPWR	SLLS350
TPS3837L30DBVT,TPS3838L30DBVT	SLVS292
DAC8531E	SBAS192
ADS8325IBDGKT	SBAS226A
SN74AHC1G07DBVR	SCES296N

If You Need Assistance

If you have questions regarding either the use of this evaluation module, the information contained in the accompanying documentation, or other TI data converter evaluation modules or devices, please contact the Texas Instruments Product Information Center at (972) 644−5580 or visit the TI web site at www.ti.com. Additionally, you may contact the data converter applications team at dataconvapps@list.ti.com. Include the product name in the subject heading.

FCC Warning

This equipment is intended for use in a laboratory test environment only. It generates, uses, and can radiate radio frequency energy and has not been tested for compliance with the limits of computing devices pursuant to subpart J of part 15 of FCC rules, which are designed to provide reasonable protection against radio frequency interference. Operation of this equipment in other environments may cause interference with radio communications, in which case the user at his own expense will be required to take whatever measures may be required to correct this interference.

Trademarks

All trademarks are the property of their respective owners.

Contents

Figures

Tables

Chapter 1

Introduction

This chapter provides an overview of the MSC1200EVM evaluation module and software.

1.1 MSC1200 Characteristics

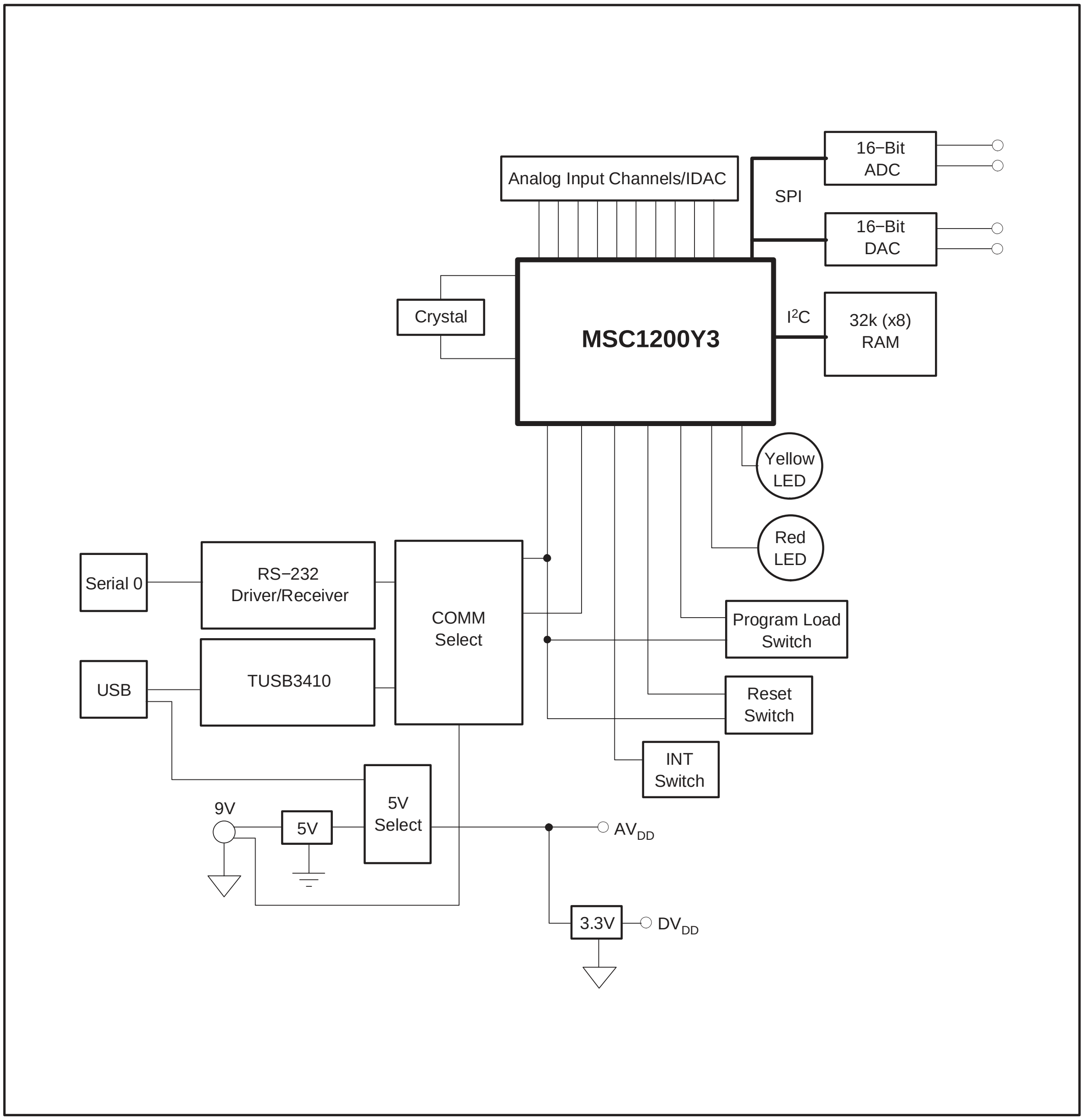
The MSC1200 is a precision 24-bit delta-sigma (ΔΣ) analog-to-digital converter with an 8051 microcontroller and up to 8K of flash memory. It has eight fully differential or single-ended analog input channels. The delta-sigma architecture employed in the MSC1200 enables the device to achieve 22 bits of effective resolution (0.45ppm RMS noise) at a data rate of 10Hz. It can be programmed for other data rates up to 1 kHz that have lower effective resolution. In addition to the standard 8051 peripherals and functions, the MSC1200 includes a 32-bit accumulator, basic SPI/I^2C interface, 16-bit PWM output, 4/8K data flash memory, 1,280 bytes of data RAM, UART and dual DPTR registers.

The MSC1200 has an enhanced 8051 core which only requires four clock cycles per machine cycle. It has extra timers as well as watchdog, brownout and low voltage detect circuits. Additionally, it features power management control and hardware breakpoint registers.

1.2 EVM System Overview

A block diagram of the MSC1200 evaluation module is shown in Figure 1−1.

Figure 1−1. MSC1200EVM Overview



During normal operation, programs are developed on the PC and then downloaded into the MSC1200 for execution. The primary development environment is Raisonance for assembly and C language programming. There is also a Basic interpreter available from MDL−Labs.

1.3 Analog Inputs/Outputs

Analog input is supplied through the 11-way screw terminal block J4. The nine analog inputs (AN0−7, AINCOM) are connected to the MSC1200 through a 100Ω resistor. There is also a terminal block for AGND (GND). The inputs have only the 100Ω resistor to protect against overvoltage.

1.4 Power Requirements

When the MSC1200EVM uses J3 (RS232) connector for communications, power (5.5V to 15V) must be supplied to J2 (and pins 2-3 of JMP1) for proper operation.

A 9V wall mount power supply is included with the MSC1200EVM to provide this power.

When using USB communications, power is provided from the USB connector (J1) and pins 1-2 are connected on JMP1.

1.5 Host Computer Requirements

The Keil or Raisonance software development environments are designed to run on a PC running any Windows platform (Windows 9x/NT/2K/XP).

Minimum operating system requirements are:

- ❑ IBM-compatible 486 PC or higher
- ❑ 64MB RAM
- ❑ 20MB available hard disk space
- ❑ CD-ROM drive
- ❑ Available RS232 or USB serial port

Chapter 2

Getting Started

This chapter will guide you through unpacking the EVM and setting it up so you can begin using it immediately.

Topic **Page**

2.1 Unpacking the EVM

After unpacking the MSC1200EVM kit, verify that you have received all of the items listed here:

- ❑ MSC1200EVM board
- ❑ 9V wall mount power supply
- ❑ 9-pin D-sub male-female 2m serial cable
- ❑ 2m A-B USB cable
- ❑ Software CD-ROM
- ❑ This user guide

If any of these items are missing, contact Texas Instruments to receive replacements.

2.2 Default Configuration

Although much of the MSC1200EVM operation is controlled by the host PC, some configuration must be done directly on the board, using ten jumpers (shorting blocks). The MSC1200EVM is configured at the factory as described in Table 2−1:

Table 2−1. Factory Jumper Settings

Jumper Identifier	Description	Default Setting
JMP1	5V power supply source (USB)	1−2
JMP2	Digital power supply select (5V)	2−3
JMP4	IDAC 1K Load Resistor	1−2
JMP5	AV_{DD} Power Source (EVM)	1−2
JMP6	AINCOM to AGND Connection	1−2
JMP7	Red LED enable	1−2
JMP8	Yellow LED enable	1−2
JMP9	SPI/I^2C Select (SPI)	1−3, 2−4
JMP10	SPI/I^2C Clock Source	1−2

For more information about the jumpers, see section 3−1.

2.3 Quick Start

Once the MSC1200EVM has been unpacked from its shipping container, and you have verified that the board is configured as shown in Table 1, it can be powered on and tested.

There are two options for supplying power to the EVM: via a USB connection through the host computer, or from an external wall mount power adapter.

2.3.1 USB Connection

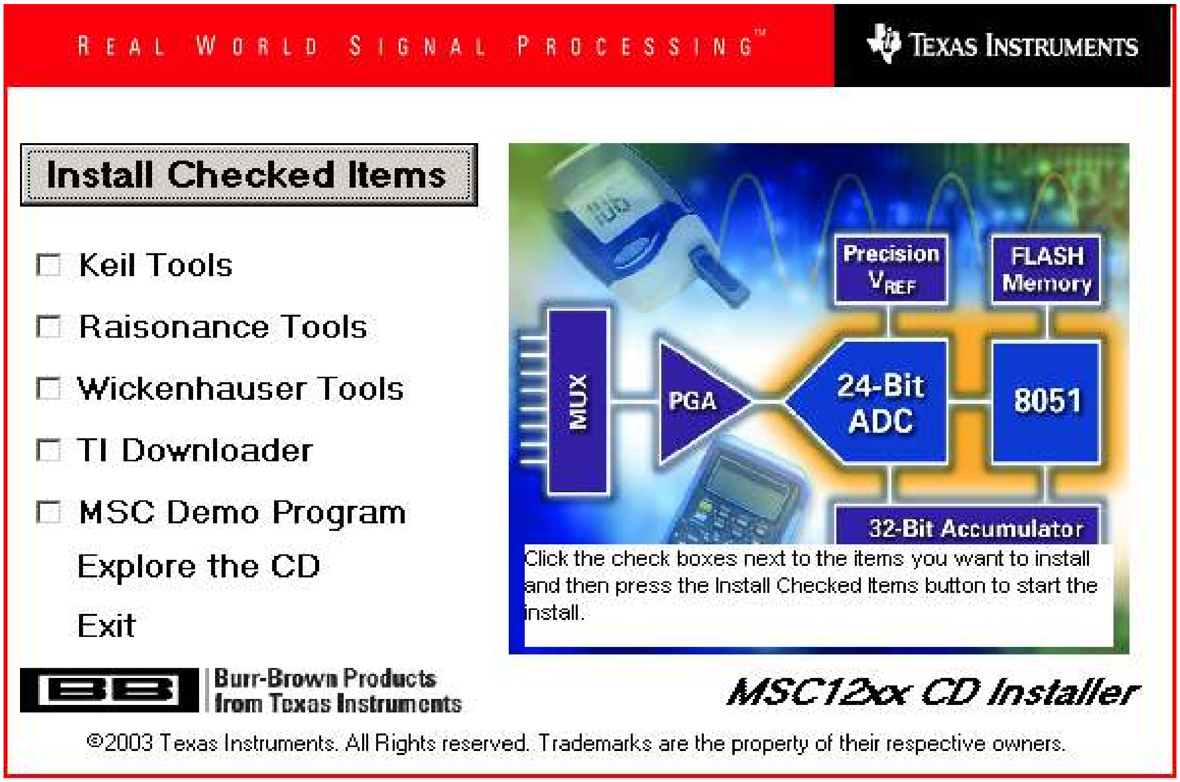
Connect the board to the host PC using the supplied USB serial cable. When the board is properly powered on, the green *power good* LED near the power USB connector will glow brightly.

2.3.2 Wall Power Connection

Connect the board to the host PC using the supplied 9-pin serial cable. Then power on the board by plugging the wall power adapter into a suitable AC power source and plugging the barrel plug into the barrel jack on the MSC1200EVM. (You do not have to connect the serial cable first; it is also acceptable to apply power to the board first.) When the board is properly powered on, the two green *power good* indicator lamps near the power connectors will glow brightly.

Place the CD-ROM into the PC’s CD−ROM drive. You should then see the installation screen shown in Figure 2−1.

Figure 2−1. Installation Screen

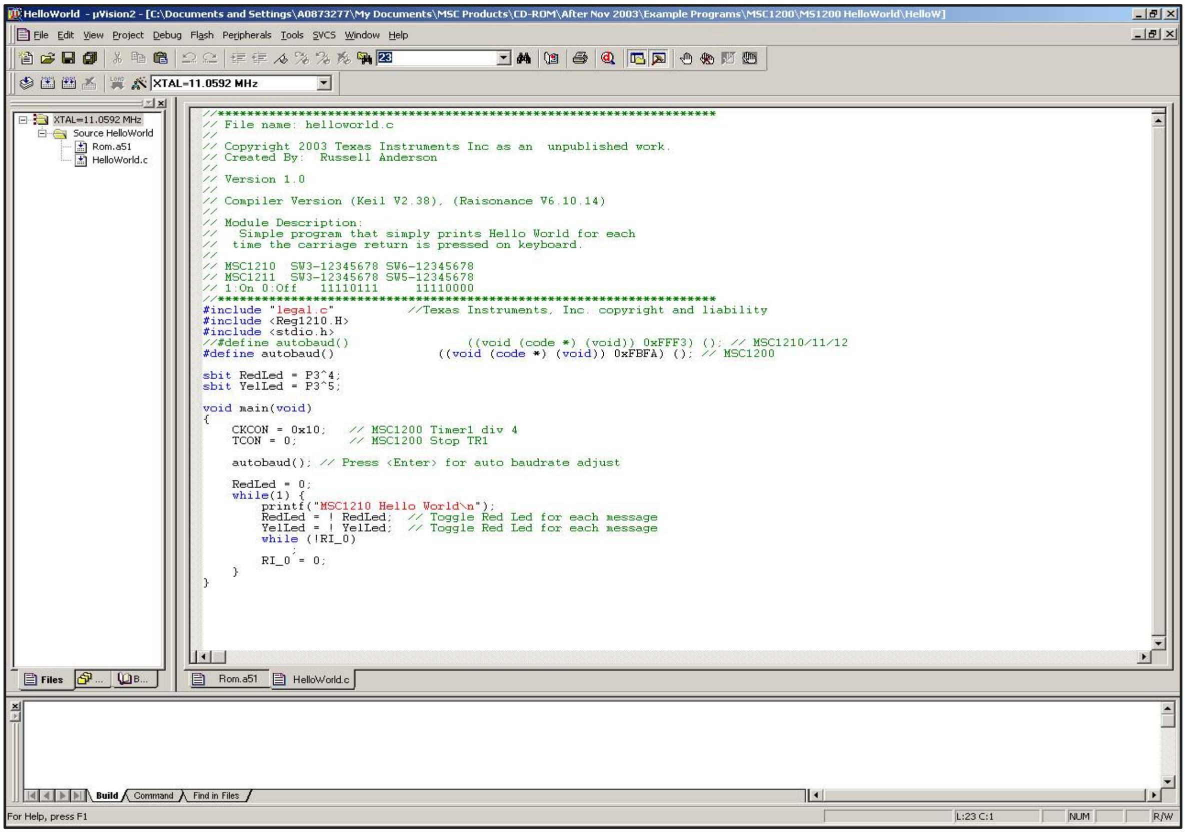


Select the tools that you want to install. Keil, Raisonance and Wickenhauser are all C compilers. The Keil and Raisonance tools include a complete IDE with debug support. The TI Downloader is used to load the compiled HEX file into the MSC1200EVM.

Install any of the compilers that you wish to use. Also, choose the TI Downloader. (Note: If you are running Windows NT or Windows 2000, you will need administrator privileges to install the software.) Follow the instructions displayed by the installer. When the software is installed, you can select, *Explore the CD*. You can also find some example programs in the **\Example Programs\MSC1200** directory.

Once the programs have been successfully installed, they can be executed. If you examine the **HelloWorld** project when the Keil uVision2 development system is run, it will display a title screen; you will see a message like that displayed in Figure 2−2.

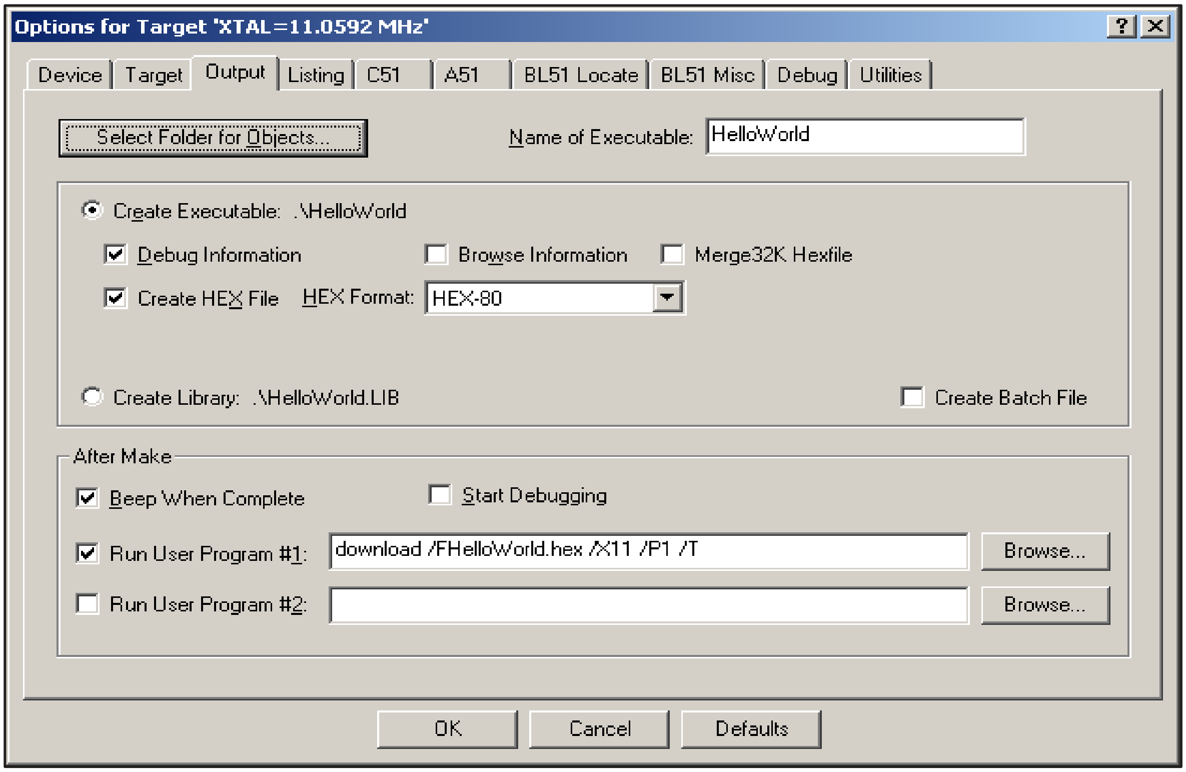
Figure 2−2. Keil uVision2 Display Screen



Refer to the Keil documentation and Help menus for more information about how to interact with the Keil software environment. When a program is compiled, it can be immediately downloaded into the MSC1200EVM by using the TI download utility program.

In the Project Menu, select **Options for target '. . . '** Then select the **output** tab. You will see a screen like the one shown in Figure 2−3.

Figure 2−3. Options for Target Output Display Screen



Check the box to **Create HEX File** and **Run User Program #1**. Then enter the download command with its parameters in the window. The download.exe file will need to be in the current directory or the Windows path.

All operands should immediately follow the switch character with no spaces except between options; for example:

download.exe /Fconv.hex /B9600 /P1

If the filename, crystal frequency or port are not included, then a screen will prompt for the values.

/Ffile hex file, #H in the Keil environment will substitute the hex file (required)

/Xfreq MSC1200 Xtal Clock frequency (required)

/Pport PC Comm port 1, 2, 3 or 4 (required)

/Bbaud Download baud rate (standard rates), otherwise − computed from /Xfreq

/H If this flag is present, the configuration bytes will be erased

/Tbaud This flag requests a terminal window after download; can specify baud.

/D Debug mode. Displays a terminal window of the command interactions.

/Epages Specify a partial erase of the flash memory

Chapter 3

Operation

This chapter describes each function of the MSC1200EVM, as well as how to use the accompanying software to program and use the MSC1200.

Topic **Page**

3.1 Jumpers

Table 3−2 shows a detailed summary of each jumper on the EVM.

Table 3−1. Jumper Function Reference

Reference Designator	Setting/Pin	Function	Default	Subsection (Information)
JMP1	1 to 2	5V is supplied by USB	1−2	
	2 to 3	5V is supplied by U1 from J2		
JMP2	1 to 2	3.3V DV_{DD}	2−3	Chapter 3.1.2
	2 to 3	5V DV_{DD}		
JMP3	1	AGND	Disconnected	Chapter 3.1.3
	2	$\overline{\text{RESET}}$ for U3 (TUSB3410)		
JMP4	1	R15—1K Resistor to AGND	1−2	Chapter 3.1.4
	2	IDAC		
JMP5	1	+5V	1−2	Chapter 3.1.5
	2	R18—10Ω to AV_{DD} (MSC1200)		
JMP6	1	AGND	1−2	Chapter 3.1.6
	2	AINCOM		
JMP7	1	P3.4/T0	1−2	Chapter 3.1.7
	2	LED D5 connected to R13 to DV_{DD}		
JMP8	1	P3.5/T1	1−2	Chapter 3.1.8
	2	LED D6 connected to R13 to DV_{DD}		
JMP9	1	D_{IN} U11 (DAC8531)	1−3, 2−4	Chapter 3.1.9
	2	D_{OUT} U13 (ADS8531)		
	3	P1.2/DOUT		
	4	P1.3/DIN		
	5	SDA U12 (MCP_24LC256)		
	6	SDA U12 (MCP_24LC256)		
JMP10	1	SCLK (U11), DCLK (U13)	1−2	Chapter 3.1.10
	2	P3.6/SCK		
	3	SCL (U12)		

3.1.1 JMP1: 5V Power Source Select

The MSC1200EVM can use either the USB or the voltage regulator U1 for the source of +5 volts. When the power is connected from the external 9V supply (wall mount) to J2, communications for the board are routed to the RS-232 signals associated with U4 (MAX3243). Shorting pins 1 and 2 connect a filtered version of the 5V power from the USB. Shorting pins 2−3 connect the 5V signal to the output of the voltage regulator U1.

3.1.2 JMP2: DV_{DD} Power Source Select

The MSC1200 has separate analog and digital power supplies. Use JMP2 to connect the desired voltage source for the digital power supply DV_{DD}. Shorting pins 1 and 2 connect the onboard 3.3V regulator; shorting pins 2−3 connect DV_{DD} to 5V.

3.1.3 JMP3: TUSB3410 $\overline{\text{RESET}}$ Pin

JMP3 provides a method to reset the TUSB3410. Shorting pin 1 to 2 will reset U3 (TUSB3410).

3.1.4 JMP4: Enable Voltage Output for IDAC

If a jumper is between pins 1 and 2 of JMP4, a 1K resistor is connected from the output of the IDAC to AGND. This provides a method to convert the current from the IDAC pin to a voltage.

3.1.5 JMP5: AV_{DD} Power

If a jumper is between pins 1 and 2 of JMP5. the 5V which is derived from either the USB or the regulator IC U1 will be filtered and used for the AV_{DD} power. If another source of AV_{DD} voltage is desired, then the jumper can be removed and the voltage applied to pin 2.

3.1.6 JMP6: AINCOM to AGND

By shorting the two pins of JMP6, the AINCOM signal will be connected to AGND.

3.1.7 JMP7: Red LED Enable

When this jumper is inserted, the Red LED D5 is connected to port pin 3.4. The other side of D5 is connected to a 220Ω resistor which connects to the DV_{DD} voltage. This 220Ω resistor provides the current limiting when the P3.4 is output as a low voltage.

3.1.8 JMP8: Yellow LED Enable

When this jumper is inserted, the Yellow LED D6 is connected to port pin 3.5. The other side of D6 is connected to a 220Ω resistor which connects to the DV_{DD} voltage. This 220Ω resistor provides the current limiting when the P3.5 is output as a low voltage.

3.1.9 JMP9: SPI/I2C Data Connection

This six pin jumper is provided to configure the data lines for SPI or I^2C control. With jumpers on pins 1−3 and 2−4, the data lines are configured for SPI communications with P1.2 and P1.3. With jumpers on 3−5 and 4−6, the DIN and DOUT lines are connected together for I^2C operation.

3.1.10 JMP10: SPI/I2C Clock Select

When pins 1−2 are connected, the clock signal (P3.6/SCK) is connected to the SPI devices. When pins 2−3 are connected, the clock signal is connected to the I^2C memory device.

3.2 Switch Configuration

3.2.1 INT Switch

Switch SW2 is a miniature pushbutton which, when pressed, shorts (through a 1K resistor) Port 3.2 to ground. This pin is the $\overline{INT0}$ pin and therefore can be set up to cause an interrupt when this pin goes low.

3.2.2 Reset Switch

Switch SW1 is a miniature pushbutton which, when pressed, forces the MSC1200 RST line high. When released, the MSC1200 will enter a reset cycle. If communication becomes disrupted between the host and the board, or the board is unresponsive, pressing RESET will return the system to normal operation.

3.2.3 PRG LD Switch

Switch SW3 is a miniature pushbutton which, when pressed, forces the MSC1200 RST line high. It also pulls the PSEN line low so that when released, the MCU will enter a reset cycle in the Program Load mode. Program execution will be from the on-chip ROM and it first starts by waiting for a carriage return so that it can perform an autobaud function. This mode is used to load a hex file into the flash memory for execution.

3.3 I/O Connectors and Signals

This section describes the various connectors on the MSC1200EVM.

3.3.1 J1: USB Type B Connector

This connector is available for use with the second UART in the MSC1200. Only the TD and RD lines are used. The DTR pin is connected to the DSR pin and the RTS pin is connected to the CTS pin.

In the RS-232 electrical specification, −5V to –15V on a line indicates a logic high (mark), and +5V to +15V indicates logic low (space). Line states are described here according to their logical states.

Table 3−2 describes the J1 USB port pinout configuration.

Table 3−2. J1: USB Port Pinout

Pin Number	Signal Name	USB Name	Direction (at board)	Function
1	GND	Power Ground	Input	Ground return for VCC power
2	D−	USB data pin Data−	Bidirectional	USB data
3	D+	USB data pin Data+	Bidirectional	USB data
4	VCC	+5V power	Input	+5V power (500mA max)

3.3.2 J2: Serial RS-232 Connector

The host PC communicates with the MSC1200EVM through this connector, which is a 9-pin female D-shell type, pinned out in the usual manner. Certain of the flow control lines are used for special purposes by the MSC1200EVM board; these are described in Table 3−3.

Table 3−3. J2: RS-232 Port Pinout

Pin Number	Signal Name	RS-232 Name	Direction (at board)	Function
1	DCD	Data Carrier Detect	Output	None
2	RD	Receive Data	Output	Serial data output to host PC
3	TD	Transmit Data	Input	Serial data input from host PC
4	DTR	Data Terminal Ready	Input	Connected to the reset circuit. A low to high transition on this line resets the MCU.
5	SG	Signal Ground	Power	Ground reference
6	DSR	Data Set Ready	Output	None
7	RTS	Request to Send	Input	Connected to PROG LOAD function. Used to enter serial programming mode. A high to low transition resets the MCU and put it into the serial programming mode.
8	CTS	Clear to Send	Output	None
9	RI	Ring Indicator	Output	None

In the RS-232 electrical specification, −5V to –15V on a line indicates a logic high (mark), and +5V to +15V indicates logic low (space). Line states are described here according to their logical states.

If a non-handshaking RS-232 cable is used—that is, one which connects only RD, TD, and signal ground—the board can still operate normally; however, it cannot be reset by the host PC, and bootstrap firmware upgrading cannot be performed through the serial port.

3.3.3 J2, JMP1, JMP2, JMP5: Power Connectors

The MSC1200EVM features a flexible power supply. Externally generated power, USB, the onboard regulator circuitry or the supplied wall mount adapter may all be used to supply power to the EVM. Furthermore, the separated analog and digital power supplies may be powered differently; for example, the analog power supply may be powered externally, and the digital power supply may use the on board regulator, at the same time. (This is configured using jumpers JMP2 and JMP5.)

The analog power AV_{DD} is always 5V from either the regulator U1 or from a filtered version of the USB power, although external power could be applied to pin 2 of JMP5 to provide any desired AV_{DD} voltage from 2.7V to 5.25V with the ground connected to TP1.

The digital power DV_{DD} is supplied from pin 2 of JMP2. If connected to pin 1, then DV_{DD} will be 3.3V from voltage regulator U2. If pin 2 is connected to pin 3, then DV_{DD} is the 5V at the input of U2. This 5V can come from either the output of U1 or USB; or, it could be supplied from an external supply voltage to the center pin of JMP1. Pin 2 of JMP2 could also be supplied from an external supply voltage with the ground connected to TP2.

CAUTION:

Be **very** careful when connecting external power supplies to JMP5, JMP2 and JMP1. These connectors are not protected against reversed polarity. If they are connected backwards (that is, with reversed polarity), it is likely that the MSC1200EVM will be permanently damaged.

Table 3−4 through Table 3−7 summarize the power options for the MSC1200EVM.

Table 3−4. J2: Unregulated Power Input Connector

Terminal Name	Function
Tip	Positive power supply input
Sleeve	Power ground

Table 3−5. JMP1: 5V Power Source Select

Terminal Name	Function
1	U1 voltage regulator output
2	5V for U2, AV_{DD} or DV_{DD}
3	USB power

Table 3−6. JMP2: DV_{DD} Power Source Select

Terminal Name	Function
1	3.3V from voltage regulator U2
2	DV_{DD}
3	5V from JMP1 pin 2

Table 3−7. JMP5: AV_{DD} Power

Terminal Name	Function
1	5V from JMP1 pin 2
2	AV_{DD} through R18 and (C27,C28)

3.3.4 J4: Analog Inputs, IDAC Output

Terminal block J4 is the main analog input to the MSC1200EVM. One terminals is provided for each of the 9 differential inputs on the MSC1200. Each terminal is connected to the MSC1200 through a 1K resistor.

Table 3−8 summarizes the analog inputs for the MSC1200EVM.

Table 3−8. J13: Analog Inputs

Terminal Number	Terminal Name	MSC1200 Pin Number	Function
1	AN0	24	Analog input 0
2	AN1	23	Analog input 1
3	AN2	22	Analog input 2
4	AN3	21	Analog input 3
5	AN4	20	Analog input 4
6	AN5	19	Analog input 5
7	AN6	18	Analog input 6
8	AN7	17	Analog input 7
9	AINCOM	12	Analog common
10	AGND	10, 11	Analog ground
11	IDAC	13	IDAC output

3.3.5 TP16: Reference Output/Input

The MSC1200EVM has an onboard 2.5V/1.25V bandgap reference. If a lower-noise reference source or a reference with a different voltage is desired, it can be connected to test point TP16. When using an external reference, the internal reference should be shut off (using ADCON0) since they use the same pin. C37 and C32 provide bypassing for the Reference Inputs.

3.3.6 TP1−6: Test Points

The test points (summarized in Table 3−9) can be used to monitor certain signals on the board.

Consult the MSC1200 datasheet for information on the signals connected directly to the MSC1200.

Table 3−9. TP1−6: Test Points

Test Point Designator	MSC1200 Pin Number	MSC1200 Pin Name	Function
TP1	10, 11	AGND	Analog ground
TP2	33, 34, 38	DGND	Digital ground
TP3	−	100kΩ Pull-up	Uncommitted
TP4	−	100kΩ Pull-up	Uncommitted
TP5	−	X1/CLKI	Clock input for TUSB3410
TP6	2	XIN	Clock input for MSC1200
TP7	17	AIN7	Analog input 7
TP8	18	AIN6	Analog input 6
TP9	19	AIN5	Analog input 5
TP10	20	AIN4	Analog input 4
TP11	21	AIN3	Analog input 3
TP12	22	AIN2	Analog input 2
TP13	23	AIN1	Analog input 1
TP14	24	AIN0	Analog input 0
TP15	5	RST	Reset
TP16	14	REFOUT/ REFIN+	Internal Reference Output or Positive Reference Input

3.4 Circuit Description

The MSC1200EVM combines the MSC1200 microcontroller, 24LC256 32Kx8 EEPROM, DAC8531, ADS8325, a 22.11842MHz crystal, support for one serial port, and other support circuits to aid in the evaluation of the MSC1200.

In addition, the TUSB3410 microcontroller is included so that the MSC1200 serial communications can come via either RS-232 or USB.

3.4.1 MSC1200

The MSC1200 (U3) is clocked by the internal oscillator or a 22.1184MHz crystal. Analog Inputs come from J4 through current-limiting resistors RA3.

Programs can be loaded into the 8K bytes of flash memory using the serial port (RS-232 or USB). The MSC1200 has 128 bytes of RAM on-chip.

For detailed information about the MSC1200, consult the MSC1200 product datasheet.

3.4.2 Programming and Host Communication

The Keil or Raisonance integrated software environments, combined with the TI Downloader program, provide a convenient system of program development, download and execution.

Full source code for the MSC1200EVM test firmware is included on the CD−ROM.

3.4.3 Power Supply

The board receives power through external power connectors J2, USB, or to the individual pins on JMP1, JMP2 or JMP5. If a wall power adaptor is plugged into J2, the USB communications is disabled.

Power supplied through J2 is regulated by voltage regulators U1 and U2, which provide +3.3V digital and +5V analog supplies. Power supplied through JMP1, JMP2 or JMP5 is not filtered; regulated power of the correct voltages must be supplied to these pins.

The board is laid out with separate analog and digital power supplies. Analog power is 5V and is supplied from regulator U1, USB, or external power connected to JMP1 or JMP5. 3.3V digital power is supplied from regulator U2 or JMP2. When the external power connector J2 is used, it supplies regulator U1, which then supplies regulator U2.

Chapter 4

Schematic and Layout

This chapter contains the schematic drawings, PCB layouts and bill of materials for the MSC1200EVM board.

Note:

Board layouts are not to scale. These are intended to show how the board is laid out; they are not intended to be used for manufacturing MSC12000EVM PCBs.

Topic **Page**

4.1 MSC1200 Schematics

Figure 4−1. Processor and Analog Inputs

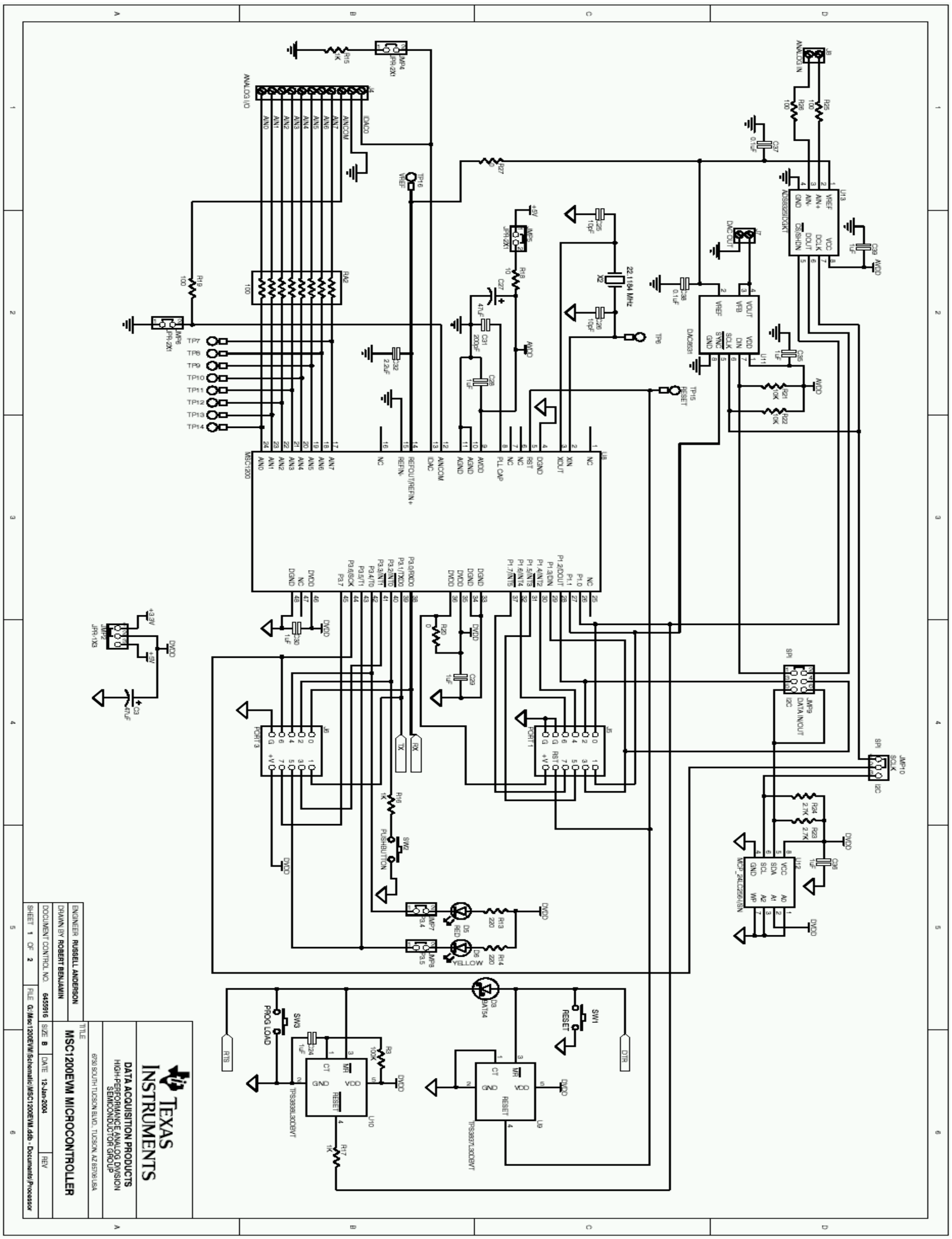
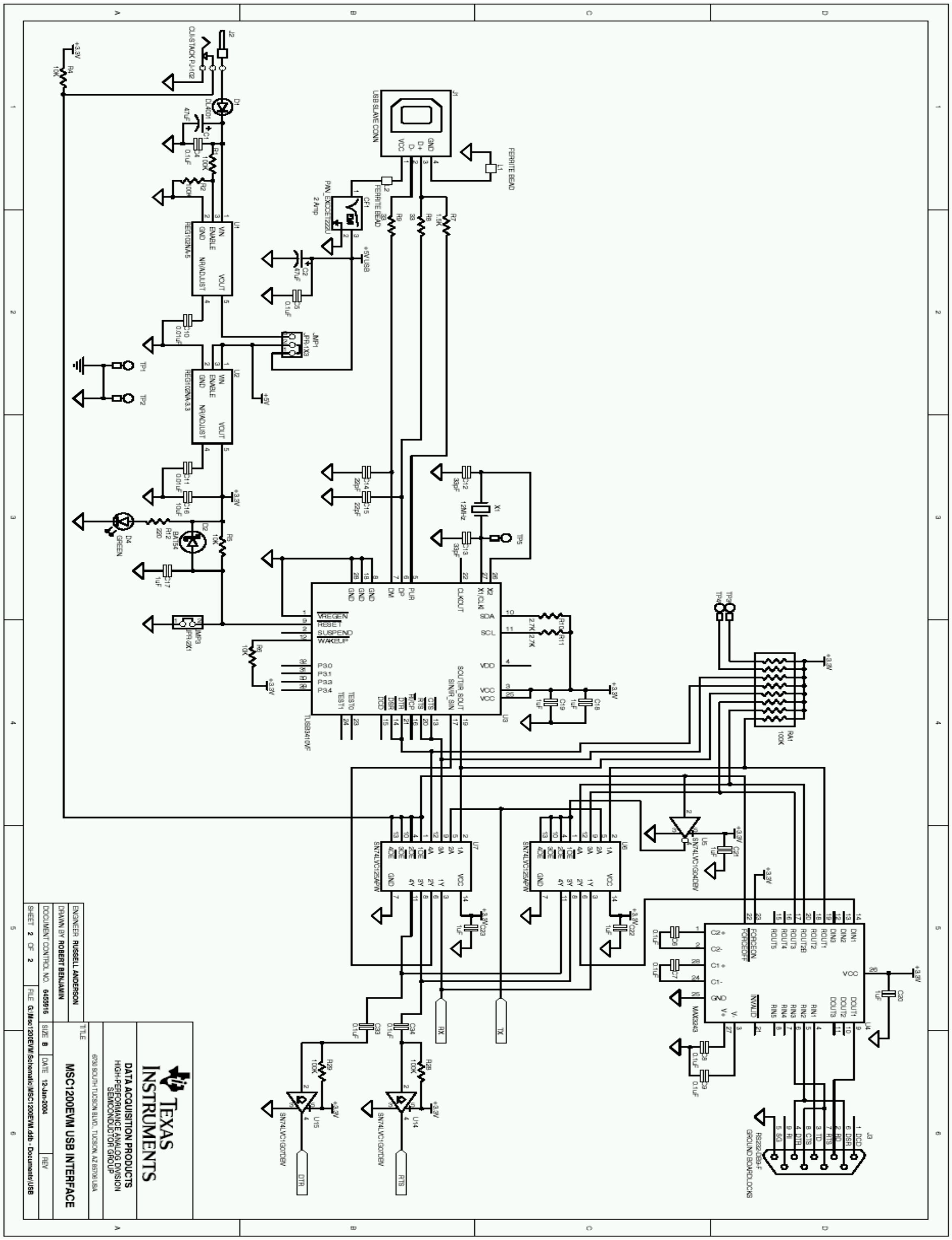
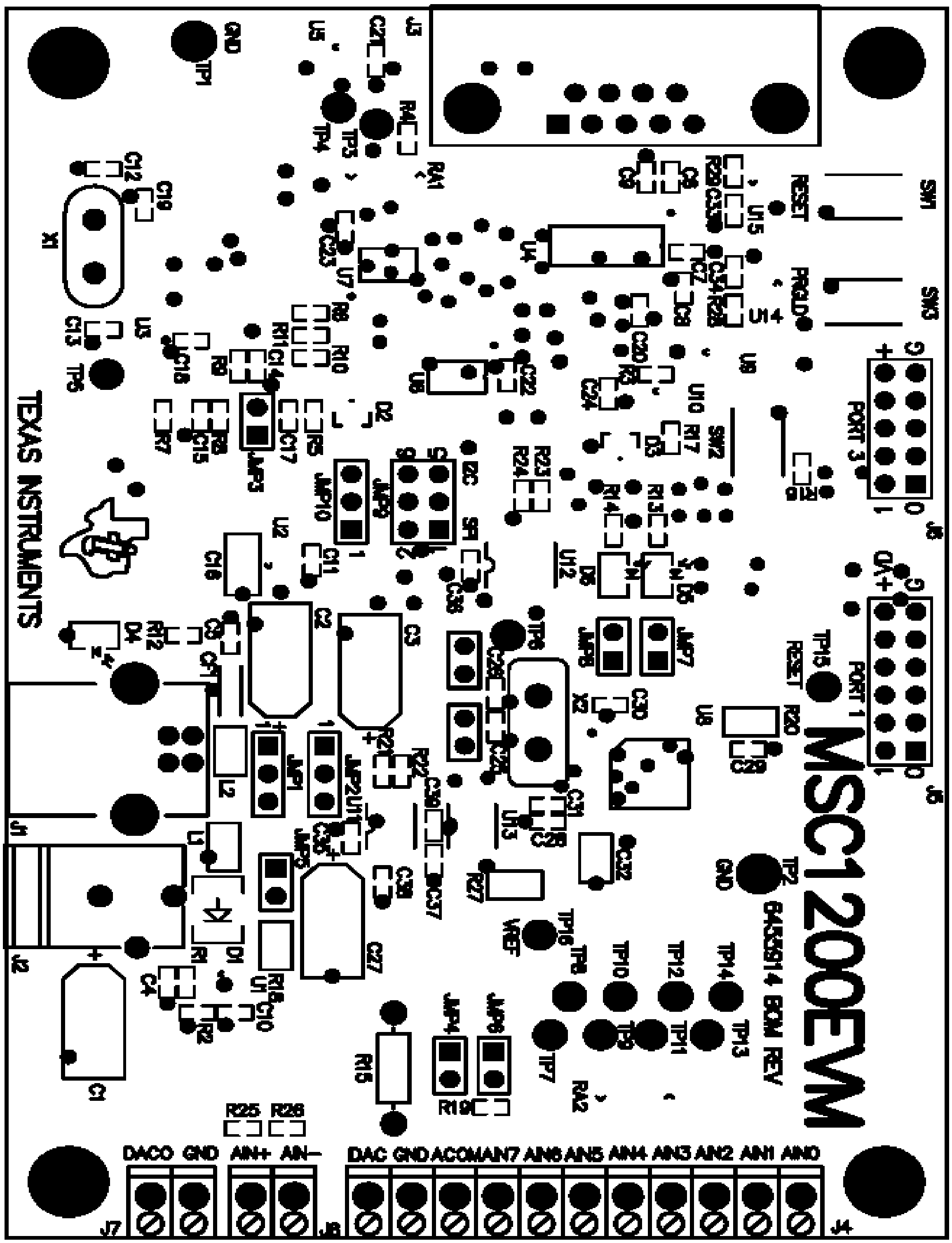


Figure 4−2. Power and Communications Selection



4.2 Component Locations

Figure 4−3. MSC1200EVM Layout



4.3 Bill of Materials

Table 4−1. Bill of Materials

Item No.	Quantity	Value	Reference Designator	Description	Vendor	Mfg Part Number
1	2	0R	R20, R27	1/8W 5% Chip Resistor	Panasonic	ERJ−6GEY0R00V
2	1	10R	R18	1/8W 5% Chip Resistor	Panasonic	ERJ−6GEYJ100V
3	2	33R	R8, R9	1/10W 5% Chip Resistor	Panasonic	ERJ−3GEYJ330V
4	3	100R	R19, R25, R26	1/10W 5% Chip Resistor	Panasonic	ERJ−3GEYJ330V
5	1	100R	RA2	1/16W 5% Chip Resistor Array	CTS Corporation	742C163101JTR
6	3	220R	R12, R13, R14	1/10W 5% Chip Resistor	Panasonic	ERJ−3GEYJ221V
7	2	1K	R16, R17	1/10W 5% Chip Resistor	Panasonic	ERJ−3GEYJ102V
8	1	1K	R15	1/4W 1% Axial Lead Resistor	Yageo	MFR−25FBF−1K0
9	1	1.5K	R7	1/10W 5% Chip Resistor	Panasonic	ERJ−3GEYJ152V
10	4	2.7K	R10, R11, R23, R24	1/10W 5% Chip Resistor	Panasonic	ERJ−3GEYJ272V
11	5	10K	R4, R5, R6, R21, R22	1/10W 5% Chip Resistor	Panasonic	ERJ−3GEYJ103V
12	5	100K	R1, R2, R3, R28, R29	1/10W 5% Chip Resistor	Panasonic	ERJ−3GEYJ104V
13	1	100K	RA1	1/16W 5% Chip Resistor Array	CTS Corporation	742C163104JTR
14	2	10pF	C25, C26	50V Ceramic Chip Capacitor, ±0.5pF, NPO	Panasonic	ECJ−1VC1H100D
15	2	22pF	C14, C15	50V Ceramic Chip Capacitor, ±0.5pF, NPO	Panasonic	ECJ−1VC1H220J
16	2	33pF	C12, C13	50V Ceramic Chip Capacitor, ±0.5pF, NPO	Panasonic	ECJ−1VC1H330J
17	1	220pF	C31	50V Ceramic Chip Capacitor, ±0.5pF, NPO	Panasonic	ECJ−1VC1H221J
18	2	0.01µF	C10, C11	50V Ceramic Chip Capacitor, ±10%, X7R	Panasonic	ECJ−1VB1H103K
19	10	0.1µF	C4, C5, C6, C7, C8, C9, C33, C34, C37, C38	25V Ceramic Chip Capacitor, ±10%, X7R	Panasonic	ECJ−1VB1H104K

Table 4−1. Bill of Materials (continued)

Item No.	Quantity	Value	Reference Designator	Description	Vendor	Mfg Part Number
20	14	1µF	C17, C18, C19, C20, C21, C22, C23, C24, C28, C29, C30, C35, C36, C39	6.3V Ceramic Chip Capacitor, ±10%, X5R	Panasonic	ECJ−1VB1H105K
21	1	2.2µF	C32	10V Ceramic Chip Capacitor, ±10%, X5R	Panasonic	ECJ−2FB1A225K
22	1	10µF	C16	6.3V Ceramic Chip Capacitor, ±10%,X5R	Panasonic	ECJ−3YB0J106K
23	4	47µF	C1, C2, C3, C27	16V Tantalum Chip Capacitor, ±10%	Kemet	T491D476K016AS
24	1		CF1	50V, 1A Diode	Panasonic	EXC−CET222U
25	1		D1	1/4W 1% Axial Lead Resistor	Micro Commercial Co.	DL4001
26	2		D2, D3	0V, 200mA Schottky Diode	Fairchild Semiconductor	BAT54
27	1		D4	Green LED	Lumex	SML−LX0603GW−TR
28	1		D5	Red LED	Lumex	SML−LX0603IW−TR
29	1		D6	Yellow LED	Lumex	SML−LX0603YW−TR
30	2		RA1	Ferrite Bead Core	Panasonic	EXC−ML20A390U
31	1	12MHz	L1, L2	Quartz Crystal	Citizen	HC49US12.000MABJ
32	1	22.1184 MHz	X1, X2	Quartz Crystal	Citizen	HC49US22.1184MABJ
33	1		U1	5V, 250mA, LDO Regulator	Texas Instruments	REG102NA−5
34	1		U2	3.3V, 250mA, LDO Regulator	Texas Instruments	REG102NA−3.3
35	14		U3	USB/ Serial Converter	Texas Instruments	TUSB3410VF

Table 4−1. Bill of Materials (continued)

Item No.	Quantity	Value	Reference Designator	Description	Vendor	Mfg Part Number
36	1		U4	RS-232 Transceiver	Texas Instruments	MAX3243CPWR
37	1		U5	Single IC Inverter	Texas Instruments	SN74LVC1G04DBVR
38	2		U6, U7	Quad Bus Buffer w/Tri-State Enable	Texas Instruments	SN74LVC125APW
39	1		U8	Precision ADC/DAC with 8051 Microcontroller	Texas Instruments	MSC1200Y3PFBT
40	1		U9	Supervisory Circuit, Reset High	Texas Instruments	TPS3837L30DBVT
41	2		U10	Supervisory Circuit, Reset Low	Texas Instruments	TPS3838L30DBVT
42	1		U11	16-Bit, Digital-Analog Converter	Texas Instruments	DAC8531E
43	1		U12	256K I2C EEPROM	Microchip	24LC256−I/SN
44	1		U13	16-Bit, Analog-to-Digital Converter	Texas Instruments	ADS8325IBDGKT
45	2		U14, U15	Single Gate, Open Drain Buffer	Texas Instruments	SN74LVC1G07DBVT
46	1		N/A	MSC1200 EVM PWB	Texas Instruments	6455915
47	1		J1	USB Type 'B' Socket	Mill-Max	897-30-004-90-000000
48	1		J2	2.5mm Power Jack	CUI Inc.	PJ-102B
49	1		J3	DB9 Right Angle Female Connector	AMP/ Tyco Electronics	747844-4
50	1		J4	11 Position Terminal Block, 3.5mm Spacing	On Shore Technology	ED555/11DS
51	2		J7, J8	2 Position Terminal Block, 3.5mm Spacing	On Shore Technology	ED555/2DS

Table 4−1. Bill of Materials (continued)

Item No.	Quantity	Value	Reference Designator	Description	Vendor	Mfg Part Number
52	1		J6	5 Position, Dual Row Header, 0.1in Spacing	Samtec	TSW-105-07-L-D
53	1		J5	6 Position, Dual Row Header, 0.1in Spacing	Samtec	TSW-106-07-L-D
54	3		JMP1, JMP2, JMP10	3 Position Jumper , 0.1in Spacing	Samtec	TSW-103-07-L-S
55	6		JMP3, JMP4, JMP5, JMP6, JMP7, JMP8	2 Position Jumper , 0.1in Spacing	Samtec	TSW-102-07-L-S
56	1		JMP9	3 Position, Dual Row Jumper , 0.1in Spacing	Samtec	TSW-103-07-L-D
57	3		SW1, SW2, SW3	Pushbutton Normally Open Switch	Panasonic	EVQ−PJU04K
58	2		TP1, TP2	Large Loop Test Point Terminal	Keystone Electronics	5011
59	Not Installed		TP3, TP4, TP5, TP6, TP7, TP8, TP9, TP10, TP11, TP12, TP13, TP14, TP15, TP16	Miniature Test Point Terminal	Keystone Electronics	5000
60	11		N/A	Shorting Jumper	Samtec	SNT-00-BK-TH
61	4		N/A	1/4in x .625 hex 4−40 Threaded Standoff	Keystone Electronics	1808
62	4		N/A	Pan Head Machine Screws 4−40 x 1/2in Phillips	Building Fasten- ers	PMS 440 0050 PH

Appendix

Certificate of Conformity

Wall Mount Power Supply

2000 14:14 VON -FRIWO SALES EXPORT +49-2532-81-112 T-170 P.003/004 F-587

FRIWO Gerätebau GmbH
Von-Liebig-Str. 11
D-48346 Ostbevern
Germany

FRIWO

CE-Konformitätserklärung
Declaration of Conformity

Wir, der Hersteller, erklären hiermit, daß das Produkt:
We, the manufacturer, hereby confirm, that the product:

Typ:	*Type:*	FW 7207/9
Zeichnungs-Nr.:	*Part-No.:*	15.0661.500-00
weitere Merkmale: *additional information:*		

mit der beiliegenden Beschreibung die Anforderungen der Niederspannungsrichtlinie 73/23/EWG, CE-Kennzeichnungsrichtlinie 93/68/EWG und der EMV-Richtlinien 89/336/EWG, 92/31/EWG erfüllt.
with the enclosed description fulfills the requirements of the Low Voltage Directive 73/23/EEC, CE Marking Standard 93/68/EEC and the regulations of the EMC Directives 89/336/EEC, 92/31/EEC.

Das Gerät entspricht der:
The unit corresponds to:

a) Niederspannungsrichtlinie
Low Voltage Directive

- ☐ EN 60742 9/95
- ☐ EN 60335 5/95
- ☒ EN 60950 9/94
- ☐ EN 60601 9/94

b) EMV-Richtlinie
EMC-Directive

- ☒ EN 50081-1 3/93
- ☐ EN 50081-2 3/94
- ☐ EN 50082-1 3/93
- ☒ EN 50082-2 2/96

Ausstelldatum:
Date of issue: 98-10-02

Quality Manager ppa. Busche

R & D Manager i.V. Dr. Ebert

checked: R & D Electr. Man. i. V. Schulz

FRIWO Gerätebau GmbH
Von-Liebig-Straße 11
48346 Ostbevern

Firmenstempel Company stamp