104-ADIO128, 104-AD128, and 104-AOB4/12 User's Guide

Manual PN: 931-0066-00-A
November 2002

kontron

www.kontron.com

Customer Service

Mailing Address:
Kontron - United States
14118 Stowe Drive
Poway, CA 92064 USA
Tel: 858-677-0877
Fax: 858-677-0895

Technical Support:
U.S. and Canadian Customers - 24 hours a day
Tel: 800-480-0044, option 1
Fax: 858-677-0898

International Customers - 9am to 4pm local time
Tel: (+49) 8165-77 112
Fax: (+49) 8165-77 110

Visit our site at:
www.kontron.com

Contents

Chapter 4
Connector Pin Assignments

Chapter 5
Programming

Chapter 6
Specifications

Appendix A
Debug Scripts

Safety Instructions

Contents

This page intentionally left blank.

Before You Begin

Before handling the 104-ADIO128 (AD128), read the instructions and safety guidelines on the following pages to prevent damage to the product and to ensure your own personal safety. Refer to the "Advisories" section in the Preface for advisory conventions used in this user's guide, including the distinction between Warnings, Cautions, Important Notes, and Notes.

- Always use caution when handling/operating the computer. Only qualified, experienced, authorized electronics service personnel should access the interior of the computer. The power supplies produce high voltages and energy hazards, which can cause bodily harm.
- Use extreme caution when installing or removing components. Refer to the installation instructions in this user's guide for precautions and procedures. If you have any questions, please contact Kontron Post-Sales Technical Support.

WARNING

High voltages are present inside the chassis when the unit's power cord is plugged into an electrical outlet. Turn off system power, turn off the power supply, and then disconnect the power cord from its source before removing the chassis cover. Turning off the system power switch does not remove power to components.

When Working Inside a Computer

Before taking covers off a computer, perform the following steps:

1) Turn off the computer and any peripherals.

2) Disconnect the computer and peripherals from their power sources or subsystems to prevent electric shock or system board damage. This does not apply when hot swapping parts.

3) Follow the guidelines provided in "Preventing Electrostatic Discharge" on the following page.

4) Disconnect any telephone or telecommunications lines from the computer.

In addition, take note of these safety guidelines when appropriate:

- To help avoid possible damage to system boards, wait five seconds after turning off the computer before removing a component, removing a system board, or disconnecting a peripheral device from the computer.

- When you disconnect a cable, pull on its connector or on its strain-relief loop, not on the cable itself. Some cables have a connector with locking tabs. If you are disconnecting this type of cable, press in on the locking tabs before disconnecting the cable. As you pull connectors apart, keep them evenly aligned to avoid bending any connector pins. Also, before connecting a cable, make sure both connectors are correctly oriented and aligned.

CAUTION

Do not attempt to service the system yourself except as explained in this user's guide. Follow installation and troubleshooting instructions closely.

Preventing Electrostatic Discharge

Static electricity can harm system boards. Perform service at an ESD workstation and follow proper ESD procedure to reduce the risk of damage to components. Kontron strongly encourages you to follow proper ESD procedure, which can include wrist straps and smocks, when servicing equipment.

You can also take the following steps to prevent damage from electrostatic discharge (ESD):

- When unpacking a static-sensitive component from its shipping carton, do not remove the component's antistatic packing material until you are ready to install the component in a computer. Just before unwrapping the antistatic packaging, be sure you are at an ESD workstation or grounded. This willl discharge any static electricity that may have built up in your body.
- When transporting a sensitive component, first place it in an antistatic container or packaging.
- Handle all sensitive components at an ESD workstation. If possible, use antistatic floor pads and workbench pads.
- Handle components and boards with care. Don't touch the components or contacts on a board. Hold a board by its edges or by its metal mounting bracket.
- Do not handle or store system boards near strong electrostatic, electromagnetic, magnetic, or radioactive fields.

This page intentionally left blank.

Preface

Contents

This page intentionally left blank.

How to Use This Guide

This guide is designed to be used as step-by-step instructions for installation, and as a reference for operation, troubleshooting, and upgrades.

Note: Additional technical information, BIOS updates, and drivers are available on our web site, *www.kontron.com*, under Technical Support.

The following is a summary of the chapter contents:

- **Chapter 1, Introduction,** provides a brief overview of the 104-ADIO128 (AD128) board and lists what's included in the box.
- **Chapter 2,Board Setup,** provides details for properly selecting jumper options and interrupt levels and describes address selection to properly configure the 104-ADIO128 (AD128) for your system requirements.
- **Chapter 3, Installation,** describes how to install the 104-ADIO128 (AD128) drivers to your system and how to install the 104-ADIO128 (AD128) board into an expansion connector on a PC/104 compatible card.
- **Chapter 4, Technical Description,** describes the technical details of the 104-ADIO128 (AD128) and provides connector pin assigments.
- **Chapter 5, Programming and Software,** provides advanced programming details for customizing the functionality of the 104-ADIO128 (AD128) and a description of the software utilities and sample programs provided with the 104-ADIO128 (AD128) on CD.
- **Chapter 6, Specifications,** provides details for isolated inputs, relay outputs, power requirements, and operating temperature specifications.

Customer Comments

If you have any difficulties using this user's guide, discover an error, or just want to provide some feedback, please send us a message using the online form under "Contact Us" on our web site (*www.kontron.com*) under "Technical Support." Detail any errors you find. We will correct the errors or problems as soon as possible and post the revised user's guide in our online Support Library. Thank you.

Note: You may also use the online form on our web site to submit comments or concerns about our products, or request technical support.

Advisory Conventions

Four types of advisories are used throughout the user's guides to provide helpful information or to alert you to the potential for hardware damage or personal injury. They are Notes, Cautions, and Warnings. The following is an example of each type of advisory. Use caution when servicing any electrical component.

Note: A note is used to make helpful information stand out.

Important: An important note indicates information that is important for you to know.

CAUTION

A CAUTION indicates potential damage to hardware and tells you how to avoid the problem.

WARNING

A WARNING indicates the potential for bodily harm and tells you how to avoid the problem.

Disclaimer: We have tried to identify all situations that may pose a warning or caution condition in this user's guide. However, Kontron does not claim to have covered all situations that might require the use of a Caution or Warning.

Unpacking

When unpacking, follow these steps:

1) After opening the box, save it and the packing material for possible future shipment.

2) Remove all items from the box. If any items listed on the purchase order are missing, notify Kontron customer service immediately.

3) Inspect the product for damage. If there is damage, notify Kontron customer service immediately. Refer to “Guarantee and Warranty Policy” for the return procedure.

Guarantee and Warranty Policy

Guarantee

A thirty day money-back guarantee is provided on all standard products sold. Special order products are covered by our Limited Warranty, *however they may not be returned for refund or credit. EPROMs, RAM, Flash EPROMs or other forms of solid electronic media are not returnable for credit - but for replacement* only. An extended warranty is available. Consult the factory.

Refunds

In order to receive a refund on a product for the purchase price, the product must not have been damaged by the customer or by the common carrier chosen by the customer to return the goods and the product must be returned complete (meaning all user's guides, software, cables, etc.) within 30 days of receipt and in an as-new and resalable condition. The "Return Procedure" must be followed to assure a prompt refund.

Restocking Charges

Product returned *after* 30 days, and *before* 60 days, of the purchase will be subject to a minimum 20% restocking charge and charges for any damaged or missing parts. Products not returned within 60 days of purchase, or products which are not in an as-new and resalable condition, are not eligible for a credit return and will be returned to the customer.

Limited Warranty

Effective April 1, 1998, all products carry a 2-year limited warranty. Within 2 years of purchase, Kontron will repair or replace, at our option, any defective product. Kontron will service the warranty for all standard catalog products for the first two years from the date of shipment. Please note: The 2-year warranty may not apply to special promotion items. Please consult the factory for warranty verification.

The limited warranty is void if the product has been subjected to alteration, neglect, misuse, or abuse; if any repairs have been attempted by anyone other than Kontron or its authorized agent; or if the failure is caused by accident, acts of God, or other causes beyond the control of Kontron or the manufacturer. Neglect, misuse, and abuse shall include any installation, operation, or maintenance of the product other than in accordance with the user's guide.

No agent, dealer, distributor, service company, or other party is authorized to change, modify, or extend the terms of this Limited Warranty in any manner whatsoever. Kontron reserves the right to make changes or improvements in any product without incurring any obligation to similarly alter products previously purchased.

Return Procedure

For any Guarantee or Limited Warranty return, please contact Kontron Customer Service at 800-480-0044 or 858-677-0877 and obtain a Return Material Authorization (RMA) Number. All product(s) returned to Kontron for service or credit **must** be accompanied by a Return Material Authorization (RMA) Number. Freight on all returned items **must** be prepaid by the customer who is responsible for any loss or damage caused by common carrier in transit. Returns for Warranty **must** include a Failure Report for each unit, by serial number(s), as well as a copy of the original invoice showing the date of purchase.

To reduce risk of damage, returns of product must be in an Kontron shipping container. If the original container has been lost or damaged, new shipping containers may be obtained from Kontron Customer Service at a nominal cost.

Kontron owns all parts removed from repaired products. Kontron uses new and reconditioned parts made by various manufacturers in performing warranty repairs and building replacement products. If Kontron repairs or replaces a product, its warranty term is not extended.

Kontron will normally return your replacement or repaired items via ground delivery. Overnight, second day delivery, or delivery via other carriers is available at an additional charge.

Shipments not in compliance with this Guarantee and Limited Warranty Return Policy will not be accepted by Kontron.

Limitation of Liability

In no event shall Kontron be liable for any defect in hardware, software, loss, or inadequacy of data of any kind, or for any direct, indirect, incidental, or consequential damages in connection with or arising out of the performance or use of any product furnished hereunder. Kontron's liability shall in no event exceed the purchase price of the product purchased hereunder. The foregoing limitation of liability shall be equally applicable to any service provided by Kontron or its authorized agent.

Some sales items and customized systems are **not** subject to the guarantee and limited warranty. However in these instances, any deviations will be disclosed prior to sales and noted in the original invoice. **Kontron reserves the right to refuse returns or credits on software or special order items.**

This page intentionally left blank.

Chapter 1

Introduction

Contents

Overview

Flexibility

The following functions are available in many configurations. This gives the user the ability to specify exactly what's needed to minimize costs. Interrupts from each circuit can eliminate the need for polling. Interrupts are individually enabled or disabled via software. A status register is provided to determine the interrupt source.

Analog In

The Analog Inputs feature software programmable gain with ranges of 0-5V, 0-10V, ±5V, and ±10V. The configuration employs an optional instrumentation pre-amplifier per channel which allows for true differential inputs, 200V Common Mode Rejection, and high input impedance. The gain may be set at the factory to accommodate low-level inputs from sensors. Also, any combination of channels may be factory configured to convert 4-20mA current to a digital value between 0 and 4095d. This feature includes a built-in offset to allow for full 12-bit resolution on the current input.

Analog Out

Output ranges of 0-5V, 0-10V, ±5V and ±10V, are field selectable with jumpers. Note that four conversions may take place at once and that, since the D/As are double buffered, data for the next conversion may be loaded simultaneously.

Digital I/O

The circuit uses an 82C55A Programmable Peripheral Interface. Ports A and B (16 lines) are buffered, all lines have pull-up resistors to 5V. Port C features Change of State detection.

Counter/Timer

The circuit uses an 82C54 Programmable Interval Timer (3 sixteen bit counter/timers). The user has access to each counter/timer's gate, clock, and output signals. The output of counter two can be used to generate an interrupt. The Counter/Timer can be used to initiate A/D conversions for more precise timing between samples, thus eliminating "jitter" which can occur when initiating conversions via software command. The software package supports counting events, frequency output, pulse and frequency measurement.

What's Included

The 104-ADIO128 (AD128) is shipped with the following items. If any of these items are missing or damaged, contact Kontron.

- 104-ADIO128 (AD128) adapter
- Nylon Mounting Hardware Kit
- I/O and Communication Documentation CD-ROM
- I/O and Communication Software "A" Series CD-ROM

Chapter 2

Board Setup

Contents

Overview

This chapter provides details about how to properly select base addresses, IRQ levels and DAC voltage ranges and describes address selection to properly configure the 104-ADIO128 (AD128) for your system.

Option Selection

Jumpers are available on the card to select the following options:

- Base address
- IRQ level
- DAC output voltage ranges
- Mode 1 Digital Inversion (82C55) for Digital I/O
- +/-12V Power Options

Please refer to the Setup Program Utility on the provided CD for details of selecting the appropriate options for your application.

As Factory Options, you can order the board with any number (up to 8) of instrumentation amplifiers, and up to 8 inputs with 4-20mA capability. Your board also may be populated with any combination of functionality such as Digital I/O with 4 DAC channels, or Analog Inputs with 82C54 Counter/Timers. This is indicated by a label on the PC/104 connector that has a part number ending in -S0X, where X indicates a unique number identifying a special configuration.

The standard card has all the functionality that the card is capable of with the exception of 4-20mA inputs (Analog Inputs with Instrumentation Amplifiers on all channels, Counter/Timer Chip, Four DAC Channels, 24 Bits of Digital I/O, a DC/DC Converter and standard temperature range). Standard Temperature Range is identified as 0-65 Degrees C. An Extended Temperature range is available as -20 to +85 Degrees C, with a DC/DC converter on board. If your PC/104 stack has +5V *and* +/-12V available, a DC/DC converter is not needed and the Extended Temperature range is rated at -40 to +85 Degrees C.

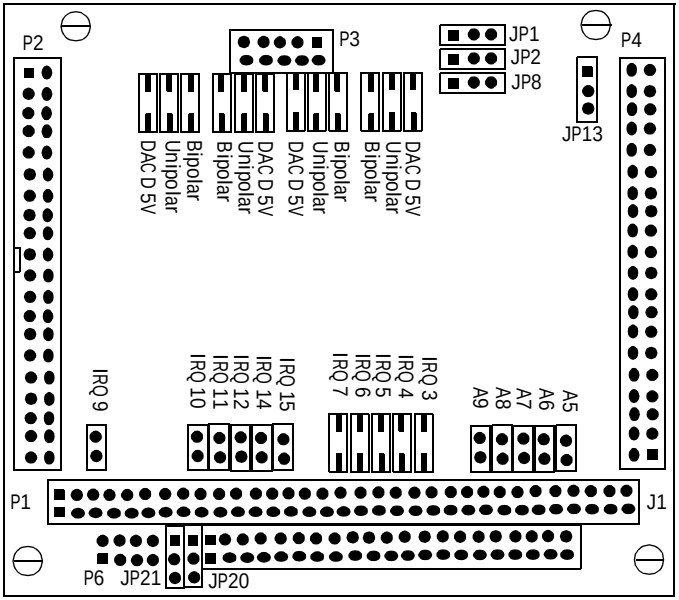

Figure 2-1. Option Selection Map

Address Selection

The card base address on the I/O bus is set by JUMPERS next to the PC/104 connector. The jumper posts are marked A5 through A9 and A5 is the least significant bit of the address. The base addresses can be selected anywhere within the I/O address range 100-3FF provided that they do not overlap with other functions. The FINDBASE software utility provided on CD with your card will help you select a base address that does not conflict with other assignments. If in doubt, refer to the following table for a list of standard address assignments.

In order to configure the desired address, the hexadecimal address must be converted to a binary representation.

For example, as illustrated below, switch selection corresponds to hex **2D0 (or binary 10 101xxxxx).** The "xxxxx" represents address lines A4 through A0 used on the card to select individual registers as described in the Chapter 5, Programming of the manual.

Hex Representation	2		D		
Conversion Factors	2	1	8	4	2
Binary Representation	1	0	1	1	0
Switch Setting	Off	On	Off	Off	On
Switch Label	A9	A8	A7	A6	A5

Please note that "1" = "off" and that "0" = "on."

Review the Address Selection Table carefully before selecting the card address. If the addresses of two installed functions overlap, you will experience unpredictable computer behavior. If you have doubts concerning available addresses in your particular computer, use the FINDBASE utility provided to determine available addresses.

The following table provides a convenient reference for all address jumper configurations. ON indicates the jumper is installed.

Table 2-1. Converting Base Addresses To Jumper Settings

A9	A8	A7	A6	A5	Address Range
					3E0h - 3FFh
				ON	3C0h - 3DFh
			ON		3A0h - 3BFh
			ON	ON	380h - 39Fh
		ON			360h - 37Fh
		ON		ON	340h - 35Fh
		ON	ON		320h - 33Fh
		ON	ON	ON	300h - 31Fh
	ON				2E0h - 2FFh
	ON			ON	2C0h - 2DFh
	ON		ON		2A0h - 2BFh
	ON		ON	ON	280h - 29Fh
	ON	ON			260h - 27Fh
	ON	ON		ON	240h - 25Fh
	ON	ON	ON		220h - 23Fh
	ON	ON	ON	ON	200h - 21Fh
ON					1E0h - 1FFh
ON				ON	1C0h - 1DFh
ON			ON		1A0h - 1BF
ON			ON	ON	180h - 19Fh
ON		ON			160h - 17Fh
ON		ON		ON	140h - 15Fh
ON		ON	ON		120h - 13Fh
ON		ON	ON	ON	100h - 11Fh

Chapter 3

Installation

Contents

Overview

This chapter describes how to install the 104-ADIO128 (AD128) drivers to your system and how to install the 104-ADIO128 (AD128) board into an expansion connector on a PC/104 compatible card.

Software Installation

Please install the proper software for your adapter. Refer to the supplied software for the correct operating system installation procedure.

DOS/WIN3.x

Install the software before installing the hardware as follows:

1) Place the I/O and Communication "A" Series Software CD into your CD-ROM drive.

2) Type `D:` `ENTER` to change the active drive to the CD-ROM drive.

3) Type `INSTALL > ENTER` to run the install program.

Follow the on-screen prompts to install the software for this board.

Windows 95/98/2000/ME

Install the software as follows:

1) Insert the I/O and Communication "A" Series Software CD into your CD-ROM drive. The setup utility should auto run within 30 seconds, or go to START > RUN and type INSTALL and press ENTER.

2) Follow the on-screen prompts to install the software for this board.

Windows NT

Install the software before installing the hardware as follows:

1) Insert the I/O and Communication “A” Series Software CD into your CD-ROM drive.

2) The setup utility should auto run within 30 seconds, or go to START > RUN and type INSTALL and press ENTER.

3) Go to Start > Settings > Control Panel and open the Advanced Ports control panel applet to configure the card for Windows NT.

Linux

Please refer to the Linux subdirectory on your supplied software for up-to-date instructions for various Linux installations.

QNX

Please refer to the QNX subdirectory on your supplied software for up-to-date instructions for various QNX installations.

System Installation

Before installing the 104-ADIO128 (AD128) board, carefully read Chapter 2 of this manual and configure the board according to your requirements. The SETUP program on the I/O and Communication "A" Series Software CD can be used to assist in configuring jumpers and switches on the card.

CAUTION

Extreme care should be taken when installing the 104-ADIO128 (AD128) to avoid causing damage to the connectors.

Installing the Board

1) Turn off PC power. Disconnect the power source.

2) Gently insert the 104-ADIO128 (AD128) connector noting proper key orientation of the expansion connector on a PC/104 compatible card. The 104-ADIO128 (AD128) adapter is keyed per the PC/104 Revision 2.1 Specification. This will aid in preventing the adapter from being inserted incorrectly.

3) Mounting hardware (nylon stand-offs and screws) is provided to insure a good mechanical connection. Retain any mounting hardware not used to allow for future expansion.

4) The cables provided are keyed and can be installed to the board's connectors before or after the adapter is inserted in the stack.

5) Connect the power source.

6) Installation is complete.

Chapter 4

Connector Pin Assignments

Contents

Overview

This chapter provides connector pin assignments for connectors on the 104-ADIO128 (AD128).

Connector Pin Assignments

Table 4-1. P1, Timer/Counter Connector Pin Assignments (see description)

Pin	Pin Assignment	P1 and P2 Combined Pin
Pin 1	Ground	Pin 41
Pin 2	Clock 0 Input	Pin 42
Pin 3	Gate 0 Input	Pin 43
Pin 4	Out 0 Input	Pin 44
Pin 5	Clock 1 Output	Pin 45
Pin 6	Gate 1 Input	Pin 46
Pin 7	Out 1 Output	Pin 47
Pin 8	Clock 2 Input	Pin 48
Pin 9	Gate 2 Input	Pin 49
Pin 10	Out 2 Output	Pin 50

The P1 and P2 Combined Pin column of Table 4-1 identifies pins from the 50-pin connector when P1 & P2 are combined.

Pins 1 and 7 are the clock or event inputs for the Programmable Interval Timer's counters Zero and One inputs and are pulled-up to +5V through a 10K resistor. 8MHz is the maximum frequency. Pin 13 is an output of the 1MHz square wave applied to the clock input of counter Two.

Pins 3, 9, and 15 are the gate inputs and are pulled-up to +5V through a 10K resistor. Pull these inputs low to pause/disable the counters.

Pins 5, 11, and 17 are the counter outputs and can not tri-state.

Either TTL or CMOS signal levels are acceptable at all inputs. The clock signal for counter One (pin 5) is a CMOS output.

As an option, connectors P1 and P2 may be combined into one 50 pin connector. To locate a specific pin, hold the card in front of you with the PC/104 connector closest to you. P1 and P2 are on the left side. P2 is furthest away from you and pin 1 is on the bottom row, furthest away from you. P1 starts where P2 ends (P2 is the A/D inputs and has 34 pins). P1 is the closest to you and pin 1 is on the bottom row. See also the next page for the pinout of P2.

Table 4-2. P3, DAC Connector Pin Assignments

Pin	Pin Assignment
Pin 1	Ground
Pin 2	DAC A Output
Pin 3	Ground
Pin 4	DAC B Output
Pin 5	Ground
Pin 6	4.096V Reference Output
Pin 7	Ground
Pin 8	DAC C Output
Pin 9	Ground
Pin 10	DAC D Output

Each DAC output can drive up to ±10mA. Due to a limitation of the power supply, the total drive of these four signals should be kept below 20mA. If ±12V power is supplied at the ISA bus connectors or at P6, there isn't a cumulative drive current limit.

Each DAC output has three configuration jumpers. If the jumper labeled 'DAC x 5V' (where x is either A, B, C, or D) is in place, the range is limited toz 5V (0-5V or ±5V). If the jumper labeled 'UNIPOLAR' is in place the range is limited to 0-5V or 0-10V. If the jumper labeled 'BIPOLAR' is in place the range is either ±5V or ±10V. Note that 'UNIPOLAR' and 'BIPOLAR' are mutually exclusive.

The 4.096V reference on pin 1 is current-limited by a 4.7K resistor. The Reference Adjust input is limited by a 510K resistor and may have from 1V to 5V applied.

If the optional instrumentation amplifiers are present, the inverting inputs are connected to ground through a 1M resistor. The non-inverting inputs are floating. Also, the instrumentation amplifier outputs are available at the Input/Output pins.

If the amplifiers are not present, pins 6, 8, 14, 16, 22, 24, 30, and 32 are inputs.

If the board is configured to received 4-20mA inputs, simply connect your + wire to the Non-inverting Differential input from your sensor, and the -wire to your power supply return.

Table 4-3. P2, ADC Connector Pin Assignments

Pin	Pin Assignment
Pin 1	4.096V Reference Output
Pin 2	Reference Adjust Input
Pin 3	Ground
Pin 4	Channel 0 Non-inverting Differential Input
Pin 5	Channel 0 Inverting Differential Input
Pin 6	Channel 0 Input / Output
Pin 7	Ground
Pin 8	Channel 1 Input / Output
Pin 9	Channel 1 Inverting Differential Input
Pin 10	Channel 1 Non-inverting Differential Input
Pin 11	Ground

Pin 12	Channel 2 Non-inverting Differential Input
Pin 13	Channel 2 Inverting Differential Input
Pin 14	Channel 2 Input / Output
Pin 15	Ground
Pin 16	Channel 3 Input / Output
Pin 17	Channel 3 Inverting Differential Input
Pin 18	Channel 3 Non-inverting Differential Input
Pin 19	Ground
Pin 20	Channel 4 Non-inverting Differential Input
Pin 21	Channel 4 Inverting Differential Input
Pin 22	Channel 4 Input / Output
Pin 23	Ground
Pin 24	Channel 5 Input / Output
Pin25	Channel 5 Inverting Differential Input
Pin 26	Channel 5 Non-inverting Differential Input
Pin 27	Ground

Pin 28	Channel 6 Non-inverting Differential Input
Pin 29	Channel 6 Inverting Differential Input
Pin 30	Channel 7 Non-inverting Differential Input
Pin 31	Ground
Pin 32	Channel 7 Input / Output
Pin 33	Channel 7 Inverting Differential Input
Pin 34	Channel 7 Non-inverting Differential Input

The digital I/O bits are arranged in an industry standard configuration.

Pin 1 can be identified by the square pad on the bottom of the board. Also, with the PC/104 connector closest to you, pin 1 of P4 is on the bottom row, closest to you.

Table 4-4. P4, Digital I/O

Pin	Signal	Pin	Signal
50	Ground	49	+5V **UNFUSED**
48	Ground	47	Port A Bit 0
46	Ground	45	Port A Bit 1
44	Ground	43	Port A Bit 2
42	Ground	41	Port A Bit 3
40	Ground	39	Port A Bit 4
38	Ground	37	Port A Bit 5
36	Ground	35	Port A Bit 6

Pin	Signal	Pin	Signal
34	Ground	33	Port A Bit 7
32	Ground	31	Port B Bit 0
30	Ground	29	Port B Bit 1
28	Ground	27	Port B Bit 2
26	Ground	25	Port B Bit 3
24	Ground	23	Port B Bit 4
22	Ground	21	Port B Bit 5
20	Ground	19	Port B Bit 6
18	Ground	17	Port B Bit 7
16	Ground	15	Port C Bit 0
14	Ground	13	Port C Bit 1
12	Ground	11	Port C Bit 2
10	Ground	9	Port C Bit 3
8	Ground	7	Port C Bit 4
6	Ground	5	Port C Bit 5
4	Ground	3	Port C Bit 6
2	Ground	1	Port C Bit 7

Chapter 5

Programming

Contents

Overview

This chapter provides advanced programming details for customizing the functionality of the 104-ADIO128 (AD128).

Using the Analog to Digital Converter

This circuit is based on a Maxim ADC chip. Please refer to file MAX197.pdf in the \CHIPDOCS directory on the CD-ROM. A conversion begins when a control byte is written to the ADC. The control byte contains five bit fields: channel selection, bipolar/unipolar, range, acquisition mode, and device mode.

Table 5-1. Control-Byte

Bit	Description
Bit 0	Channel Selection Bit 0
Bit 1	Channel Selection Bit 1
Bit 2	Channel Selection Bit 2
Bit 3	Bipolar / Unipolar
Bit 4	Range
Bit 5	Acquisition Mode
Bit 6	Device Mode 0
Bit 7	Device Mode 1

The two bits in the device mode field select the clock source and the power state. Before putting the ADC in a power down state, a conversion with Normal Operation selected should be triggered. The chip will 'remember' this clock setting if the Standby power-down mode is subsequently used. The Standby state is entered after a conversion is complete, there is no start-up delay on

the next conversion. There is a 50mS start-up delay before a conversion from the full power-down state.

Bit 7	Bit 6	Device Mode
0	0	Normal Operation, selects the external (to the ADC) clock mode, a 2MHz clock frequency is applied
0	1	Internal clock mode, not appropriate for this circuit, unexpected events may occur if this mode is selected
1	0	Standby power-down, supply current will typically be 700uA
1	1	Full power-down, supply current will be 120uA worst case

The ADC has a Sample and Hold circuit controlled by the Acquisition Mode bit. A control byte with this bit set low will select an acquisition interval of 3uS after which a conversion will begin. A noisy signal may require more integration. A control byte with this bit set high will start a user-determined acquisition period, conversion will begin when a 2nd control byte is sent with bit 5 set low. Bits 0, 1, and 2 must be the same value but the power state may be changed.

Range (Bit 4)	Bipolar / Unipolar (Bit 3)	Input Range
0	0	0 - 5V
1	0	0 - 10V
0	1	±5V
1	1	±10V

Bit 4, the range bit, doubles the input voltage range when set.

Bit 3 selects bipolar mode when set.

The channel selection bits direct one of the eight analog inputs connected to the ADC's multiplexor to the Sample and Hold circuit. Bits 2, 1, and 0 make a binary value equal to the channel number.

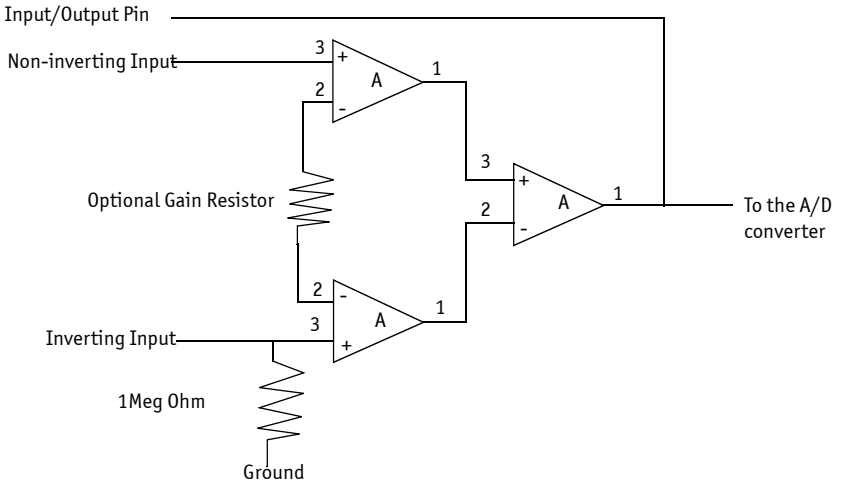

Figure 5-1. Standard Input Stage – Connector P2

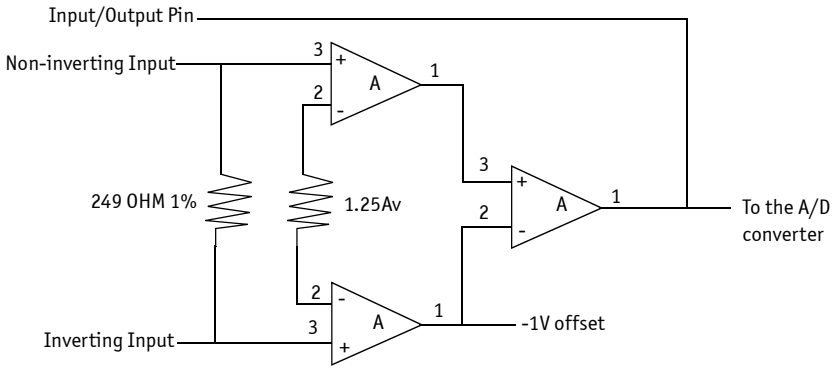

Figure 5-2. 4 to 20mA Input Stage – Connector P2

Using the Digital to Analog Converters

This circuit is based on the Analog Devices AD5343 chip. Please refer to file AD53xx.pdf in the \CHIPDOCS directory. A conversion begins after the most significant byte (of which only the lower 4 bits will be used) has been written to a DAC. The input coding to the DACs are straight binary. Discounting offset and gain errors, the output voltage is given by

Range	0-5V	0-10V	±5V	±10V
Gain	1.22	2.44	2.44	4.88
Offset	0V	0V	-5V	-10V

Vout 3 (Gain * V*ref* * D_4096) + Offset

where V*ref* = 4.096V and D = the decimal equivalent of the binary code written to the DAC (a number between 0 and 4095).

On power-up, the output values will be at the most negative for the selected range.

Using Counter 1 to Trigger A/D and D/A Conversions

In Mode 2 the Counter/Timer chip will generate a 2 microsecond negative going pulse at a programmed rate. If bit 1 of the Timer-Triggered Conversion Enables register (base address + 16h) is set high, the ADC chip will initiate conversions on the tick. If bit 0 is set high the DAC chip will initiate conversions on the tick.

The ADC chip needs a command byte to begin a conversion. This byte is stored in the ADC Command register at base + 15h. Note that only the lowest 5 bits are significant, the top 3 bits will automatically be zeros.

Bit	Description
Bit 0	Channel Selection Bit 0
Bit 1	Channel Selection Bit 1
Bit 2	Channel Selection Bit 2
Bit 3	Bipolar / Unipolar
Bit 4	Range
Bit 5	N/A
Bit 6	N/A
Bit 7	N/A

All of the DACs present will be updated simultaneously. Typically, the user would configure the board to generate an interrupt on the tick from counter 1 and also enable DAC conversions triggered by the same tick.

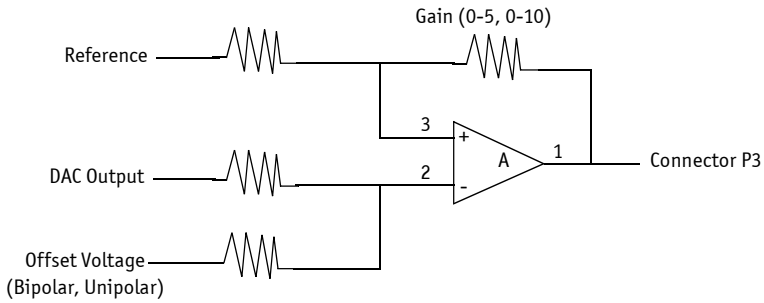

Figure 5-3. D/A Output Stage

Using Digital Input/Output Ports

This circuit is based on an 82C55A chip. Please refer to file 82C55.pdf in the \CHIPDOCS directory.

On power-up or on Reset the circuit will be in the mode 0 input state. That is, ports A and B (each 8 bits) and ports C 'upper' and C 'lower' (each 4 bits) will be readable and any floating pins at connector P4 will be high.

Table 5-2. Digital I/O Command-Byte

Bit	Description	Function
Bit 0	Port C Direction	1 = Input 0 = Output
Bit 1	Port B Direction	1 = Input 0 = Output
Bit 2	Group B Mode	1 = Mode 1 0 = Mode 0
Bit 3	Port C Upper Direction	1 = Input 0 = Output
Bit 4	Port A Direction	1 = Input 0 = Output
Bit 5	Group A Mode	1 = Mode 1 0 = Mode 0
Bit 6	Group A Mode	1 = Mode 2 0 = use Bit 5
Bit 7	Mode Set Flag	1 = Active

To change Port A and Port B I/O configuration, there are two modes. In the default mode the buffers' direction is automatically set by the command-byte. This mode is designed to support 'off the shelf' software.

If bit 0 of the Digital I/O Buffer Control register is set (base address + 14h), an alternate mode is entered (all other bits don't care). When software configures a port to be an output the lines will be low (quirk of the chip). Since most control signals are active-low, on this event the card's glue logic will tri-state the associated buffer and allow the lines to be pulled high. Software would then initialize the port's output and re-enable the buffer(s).

The circuit contains a latch that controls the data-directions and output-enables of the 8 bit buffers on ports A and B. This latch has the same address as the 8255 command byte but can only be written to if the chip is in mode 0 and if Bit 7 is low. To automatically set the data-direction for each port software must simply write the control byte a 2nd time but with Bit 7 cleared.

Note: Port C (hi/low) is not buffered.

This circuit can, as a factory installed option, operate in 8255 programmed I/O Modes 1 and 2. Note that if Bit 6 is set then Bit 5 is unused.

Using the Counter/Timer Circuit

We suggest using mode 2, rate generator, for timer ticks and for timer triggered events. Note that the outputs of the counters go high when each counter's command is written to the Counter/Timer chip. Please see the 82C54 datasheet in the \ChipDocs directory.

Table 5-3. Control Word

Bit	Write
Bit 0	Binary Coded Decimal
Bit 1	Mode Selection Bit 0
Bit 2	Mode Selection Bit1
Bit 3	Mode Selection Bit2
Bit 4	Mode Selection 0
Bit 5	Read/Write Selection Bit1
Bit 6	Counter Selection Bit0
Bit 7	Counter Selection Bit1

For bits 7 and 6:

00 = select counter 0, 01= select counter 1, 10 = select counter 2, 11 = read back

For bits 5 and 4:

0,0 = counter latch, 01= read/write LSB, 10 = read/write MSB, 11 = read/write LSB MSB

For bits 3, 2, and 1:

000 = mode 0, 001 = mode 1, 10 = mode 2, 11 = mode 3, 100 = mode 4, 101 = mode 5

For bit 0:

0 = 16 bit binary, 1 = binary coded decimal

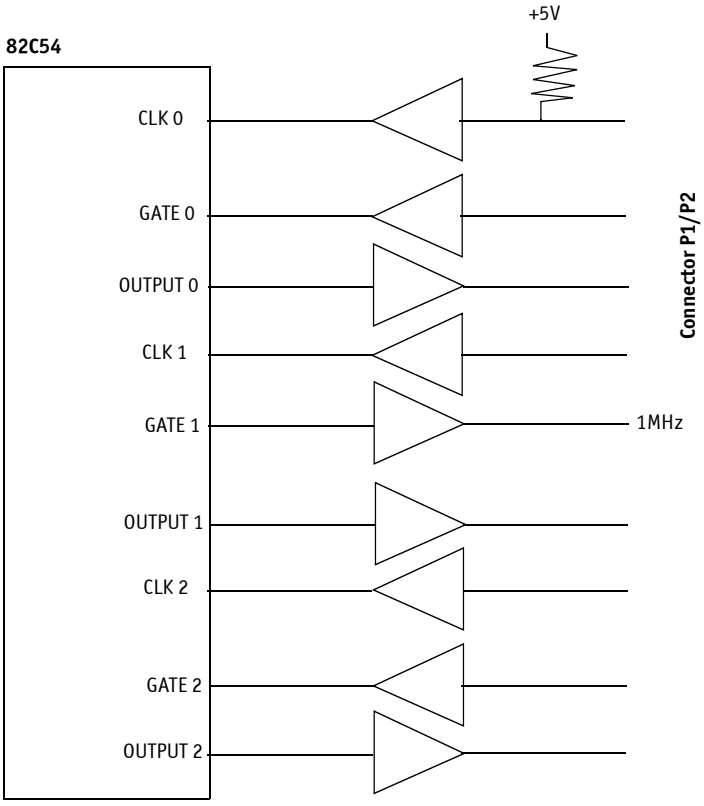

Figure 5-4. Counter/Timer Diagram

Chapter 6

Specifications

Contents

Analog Inputs

Channels

8S.E. or 8 True Differential

Conversion Frequency

100K samples per second

Differential Input Impedance

2Meg Ohms w/pre-amp

S.E. Input Impedance

20K Ohms typical

Common Mode Voltage

+/-200V

Integral Nonlinearity

+/- 1 LSB maximum

Accuracy

0.2% of full scale

Noise Levels

+/- 1 LSB typical

Programmable Voltage Ranges

0-5V, 0-10V, +/- 5V, +/- 10V (4-20mA as a factory option)

Resolution

12-bit

Preamplifier Gain

From 1 to 100 upon request

Reference Output Voltage

4.096V +/-0.02V

Common Mode Rejection Ratio

86dB typical

Full Power-Down Mode

120uA maximum

Gain Temperature Coefficient

3 ppm / ° C typical

Trigger Source(s)

Software selectable for program command or programmable timer

Analog Outputs

Channels

Four

Conversion Frequency

100K conversions per second

Output Drive Capability

20mA total for four channels

Relative Accuracy

+/-0.2 LSB, typical

Voltage Ranges

0-5V, 0-10V, +/-5V, +/-10V

Resolution

12-bit

Power-Down Mode Current Draw

1uA, maximum

Trigger Source(s)

Software selectable for program command or programmable timer

Digital Input/Output

Programmable Peripheral Int.

82C55A

Buffered Channels

16 (ports A and B)

Modes Supported

All (0, 1, and 2)

Channels

twenty-four (24), pulled up to 5V via 10K (or pulled down to ground)

Sink and Source Current

64mA and 32mA

Change of State Detection

8 inputs (port C)

Counter/Timer

Peripheral Interface Timer

Type 82C54

Clock Frequency

8MHz onboard

Supported Modes

Event Counter, Frequency Output, Frequency and Pulse Measurement

Counters

3 x 16-bit down counters

Inputs/Outputs

Fully buffered

Interrupts

Interrupt Requests

Eleven channels, IRQ 2-15

Interrupt Enable/Disable

Software controlled

Operating Temperature

-20 º to 70 º C (4 º to 158 ºF) (non-icing); -20 º to 85 º C (4 º to 185 ºF) available
(w/o DC/DC converter, -40 ºto 85 º C)

Power Consumption

Power Required for Operation
+5 V @ 240mA (w/optional DC/DC conv) typical (depends on populated options selected) +/-12V @ 200mA typical

Physical Dimensions

The 104-ADIO128 (AD128) is PC/104 "compliant" meaning that it conforms to all non-optional aspects of the PC/104 specification, including both the mechanical and the electrical specifications.

Board Length	3.775 inches (9.588 cm)
Board Width	3.550 inches (9.017 cm)
Board Weight	4.5oz (approximate)

Appendix A

Debug Scripts

Contents

Debug Scripts

In DOS, on the command line type “debug < adc_0.dbg” or “debug < counter_0.dbg” or “debug < filename.dbg”. These scripts assume that the board’s address is 0300h.

```
ADC _0.DBG
304 ff
o 305 3
o 302 18
i 303
i 302
o 304 ff
o 305 7
o 302 18
i 303
i 302
o 304 ff
o 305 b
o 302 18
i 303
i 302
o 304 ff
o 305 f
o 302 18
i 303
i 302
o 304 ff
o 305 b
o 302 18
i 303
i 302
o 304 ff
o 305 7
o 302 18
i 303
i 302
o 304 ff
o 305 3
o 302 18
i 303
i 302
o 304 0
o 305 0
o 302 18
i 303
i 302
o 304 ff
o 305 3
o 302 18
i 303
i 302
o 304 ff
o 305 7
o 302 18
i 303
i 302
q
```

This script will use DAC A to output a stepped voltage test pattern. Connect pin 2 of connector P3 to pin 4 of connector P2 if the instrumentation amplifier is present or to pin 6 if the amplifier isn’t present. Also, using the jumpers, select the bipolar output mode for DAC A. When the script is run the ADC will convert the values and debug.exe will display the results. Note that the ADC’s conversions are two’s complement but the DAC’s input is straight binary.

The counter/timer scripts simply put each counter in square-wave mode.

```
COUNTER_0.DBG
o 30f 36
o 30c e8
o 30c 03
q
```

```
COUNTER_1.DBG
o 30f 76
o 30d 64
o 30d 0
q
```

```
COUNTER_2.DBG
o 30f b4
o 30e ff
o 30e 0
q
```

The digital I/O scripts will either configure the ports as inputs and read the values at each or configure the ports as outputs and write values to each.

```
DIO_IN.DBG
o 313 9b
o 313 1b
i 310
i311
i312
q
```

```
DIO_OUT.DBG
o 313 80
o 310 aa
i 311 cc
i312 f0
i313 0
q
```

The DAC script will put a stepped output on pin 2 of connector P3.

```
DAC_A.DBG
o 304 ff
o 305 3
o 304 ffc
o 305 7
o 304 ff
o 305 b
o 304 ff
o 305 f
o 304 ff
o 305 b
o 304 ff
o 305 7
0 304 ff
o 305 3
o 304 0
o 305 0
o 304 ff
o 305 3
o 304 ff
o 305 7
q
```