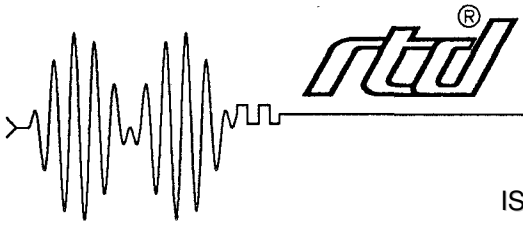
DA600 User's Manual



Real Time Devices, Inc.

"Accessing the Analog World"™

ISO9001 and AS9100 Certified

DA600

User's Manual

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INTRODUCTION

The DA600 dual/quad channel analog output board turns your IBM PC/XT/AT or compatible computer into a high-performance testing and control system. Installed within a single short or full-size expansion slot in the computer, the DA600 features:

- 2 or 4 analog output channels,
- 12-bit resolution,
- Simultaneous updating of each pair of output channels,
- 5 or 10 volt, unipolar or bipolar outputs.

The following paragraphs briefly describe the major functions of the board. More detailed discussions of board functions are included in Chapter 3, *Hardware Description*, and Chapter 4, *Board Operation and Programming*. The board setup is described in Chapter 1, *Board Settings*.

Digital-to-Analog Conversion

The digital-to-analog (D/A) circuitry features two 12-bit converter channels in each AD7537 D/A converter IC. Your board provides two or four output channels, depending on the number of channels specified when ordering. The two channels in each AD7537 are internally double buffered and can be simultaneously updated. The output voltage range is controlled by precision voltage reference(s) installed on the board at U6 for AOUT1 and AOUT2 and U10 for AOUT3 and AOUT4. A 5 volt or a 10 volt reference is specified when ordering. The 5 volt reference provides 0 to +5 and -5 to +5 volt output ranges, and the 10 volt reference provides 0 to +10 and -10 to +10 volt output ranges. Each channel is jumper selectable for unipolar or bipolar operation.

What Comes With Your Board

You receive the following items in your DA600 package:

- DA600 interface board (number of channels and reference voltage user specified)
- Software and diagnostics diskette with example programs in BASIC, Turbo Pascal, and Turbo C; source code
- User's manual

If any item is missing or damaged, please call Real Time Devices' Customer Service Department at (814) 234-8087. If you require service outside the U.S., contact your local distributor.

In addition to the items included in your DA600 package, Real Time Devices offers a full line of board accessories. Key accessories for the DA600 include the TB40 terminal board and XB40 prototype/terminal board for prototype development and easy signal access, EX-XT and EX-AT extender boards for simplified testing and debugging of prototype circuitry, and XC40 single wire flat ribbon cable assemblies for external interfacing.

Using This Manual

This manual is intended to help you install your new board and get it running quickly, while also providing enough detail about the board and its functions so that you can enjoy maximum use of its features even in the most complex applications. We assume that you already have an understanding of data acquisition and control principles and that you can customize the example software or write your own applications programs.

When You Need Help

This manual and the example programs in the software package included with your board provide enough information to properly use all of the board's features. If you have any problems installing or using this board, contact our Technical Support Department, (814) 234-8087, during regular business hours, eastern standard time or eastern daylight time, or send a FAX requesting assistance to (814) 234-5218. When sending a FAX request, please include your company's name and address, your name, your telephone number, and a brief description of the problem.

CHAPTER 1

BOARD SETTINGS

The DA600 board has jumper settings you can change if necessary for your application. The board is factory-configured with the most often used settings. The factory settings are listed and shown on a diagram in the beginning of this chapter. Should you need to change these settings, use these easy-to-follow instructions before you install the board in your computer.

Factory-Configured Jumper Settings

Table 1-1 lists the factory settings of the user-configurable jumpers on the DA600 board. Figure 1-1 shows the board layout and the locations of the factory-set jumpers. The following paragraphs explain how to change the factory settings.

Table 1-1 — Factory Settings

Switch/ Jumper	Function Controlled	Factory Setting
P2	Sets the base address	300 hex (768 decimal)
P3	Selects a unipolar or bipolar output for each analog channel	Unipolar

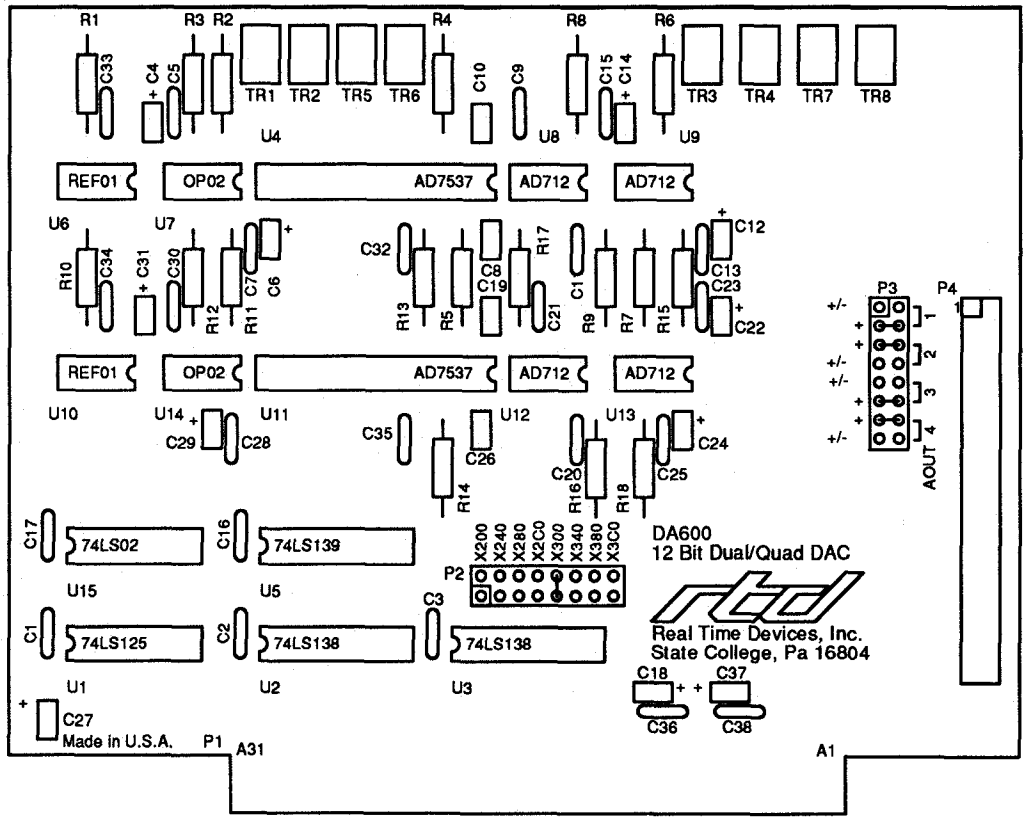


Fig. 1-1 — Board Layout Showing Factory-Configured Settings

P2 — Base Address (Factory Setting: 300 hex (768 decimal))

One of the most common causes of failure when you are first trying your board is address contention. Some of your computer's I/O space is already occupied by internal I/O and other peripherals. When the DA600 board attempts to use I/O address locations already used by another device, contention results and the board does not work.

To avoid this problem, the DA600 has a header connector, P2, which lets you select any one of eight starting addresses in the computer's I/O. Should the factory setting of 300 hex (768 decimal) be unsuitable for your system, you can select a different base address. These addresses are, from left to right on P2:

Hexadecimal	Decimal
200	512
240	576
280	640
2C0	704
300	768
340	832
380	896
3C0	960

To change the base address setting, remove the jumper from the fifth from left pair of pins (300 hex) and, using Figure 1-2 as a guide, install it in the desired location. Record the new base address setting on the table inside the back cover of this manual.

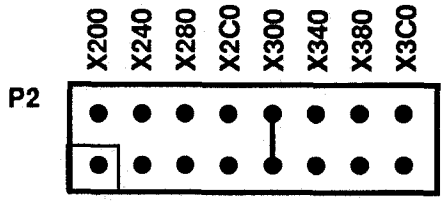


Fig. 1-2 — Base Address Jumper, P2

P3 — Analog Output Channel Polarity (Factory Setting: All Channels Unipolar)

Header connector P3, located next to I/O connector P4, lets you individually set each channel for unipolar or bipolar operation. When set for unipolar, the output is 0 to +5 or 0 to +10 volts, depending on the precision voltage reference installed on the board. When set for bipolar, the output is -5 to +5 or -10 to +10 volts. Figure 1-3 shows this header connector. Note that the board is factory-calibrated for unipolar. When you change the polarity, you should calibrate the board as described in Chapter 5.

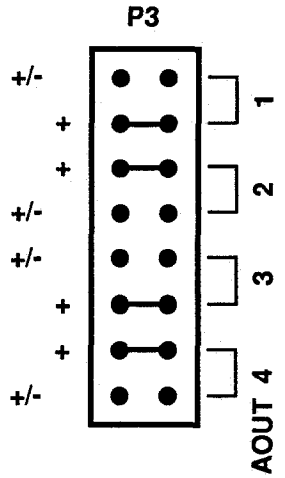


Fig. 1-3 — Analog Output Channel Polarity Jumpers, P3

CHAPTER 2

BOARD INSTALLATION

The DA600 board is easy to install in your IBM PC/XT/AT or compatible computer. It can be placed in any slot, short or full-size. This chapter tells you step-by-step how to install and connect the board.

Board Installation

Keep the board in its antistatic bag until you are ready to install it in your computer. When removing it from the bag, hold the board at the edges and do not touch the components or connectors.

Before installing the board in your computer, check the jumper settings. Chapter 1 reviews the factory settings and how to change them. If you need to change any settings, refer to the appropriate instructions in Chapter 1. Note that incompatible jumper settings can result in unpredictable board operation and erratic response.

To install the board:

1. Turn OFF the power to your computer.
2. Remove the top cover of the computer housing (refer to your owner's manual if you do not already know how to do this).
3. Select any unused short or full-size expansion slot and remove the slot bracket.
4. Touch the metal housing of the computer to discharge any static buildup and then remove the board from its antistatic bag.
5. Holding the board by its edges, orient it so that its card edge (bus) connector lines up with the expansion slot connector in the bottom of the selected expansion slot.
6. After carefully positioning the board in the expansion slot so that the card edge connector is resting on the computer's bus connector, gently and evenly press down on the board until it is secured in the slot.

   NOTE: Do not force the board into the slot. If the board does not slide into place, remove it and try again. Wiggling the board or exerting too much pressure can result in damage to the board or to the computer.
7. After the board is installed, secure the slot bracket back into place and put the cover back on your computer. The board is now ready to be connected via the external I/O connector at the rear panel of your computer.

External I/O Connections

Figure 2-1 shows the DA600's P4 I/O connector pinout. Refer to this diagram as you make your I/O connections.

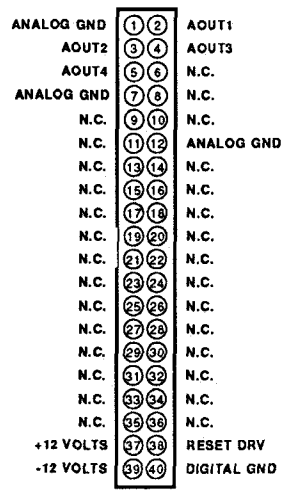


Fig. 2-1 — P4 I/O Connector Pin Assignments

Connecting the Analog Output Pins

The analog outputs are connected to their loads as shown in Figure 2-2. The high side of the device receiving the output signal is connected to the appropriate AOUT channel and the low side is connected to one of the three ANALOG GND pins (P4-1, P4-7, or P4-12).

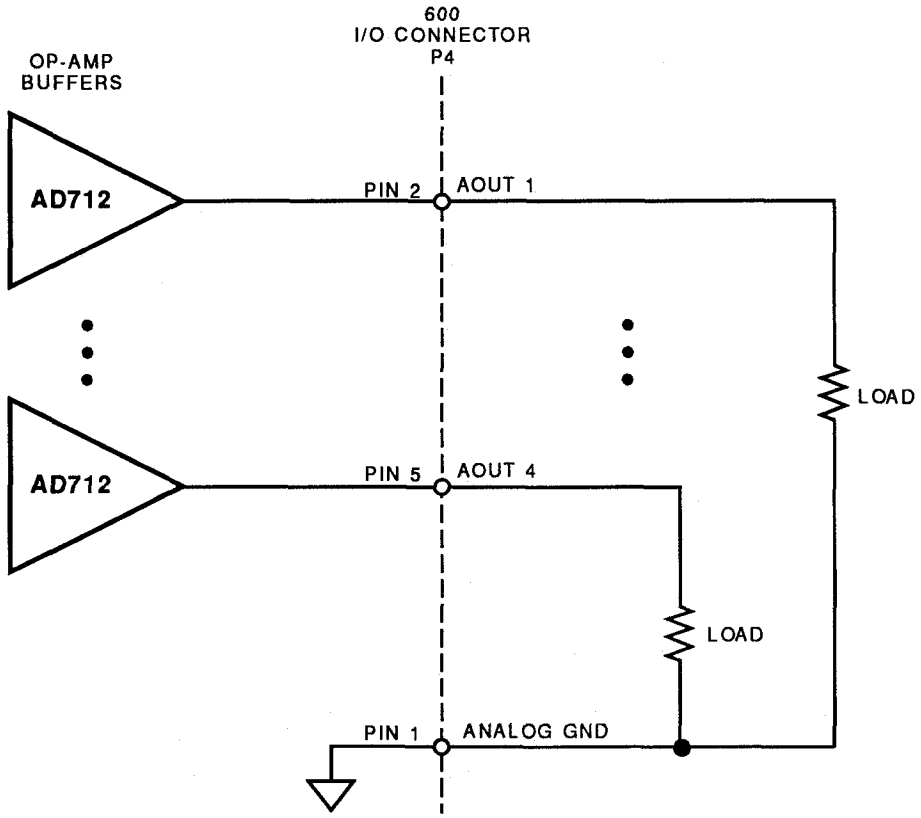


Fig. 2-2 — Analog Output Connections

CHAPTER 3

HARDWARE DESCRIPTION

This chapter describes the DA600 D/A circuitry. Each D/A output channel circuit has two main elements: the D/A converter and the output amplifier.

The DA600 board features two or four analog output channels which can be used for PC generation of analog signals for industrial control and testing applications. The following paragraphs describe the D/A circuitry.

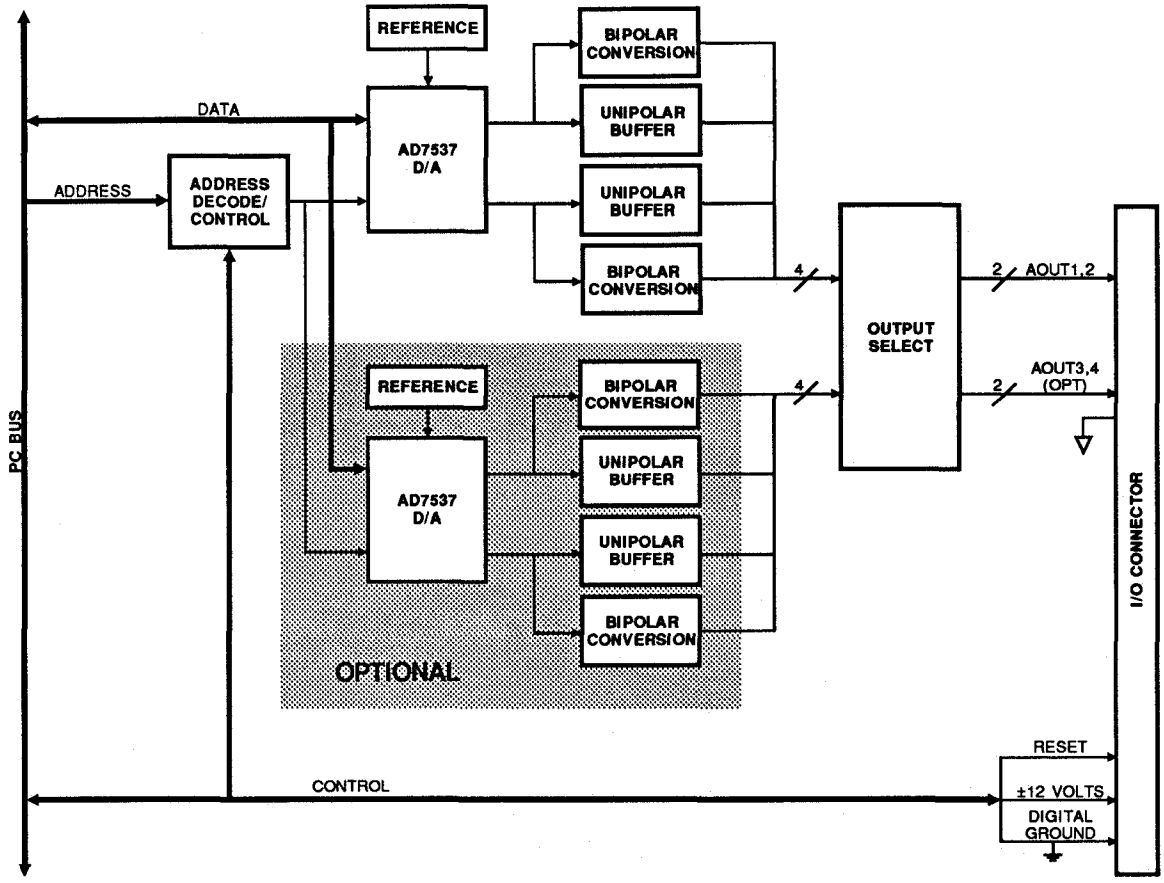


Fig. 3-1 — DA600 Block Diagram

D/A Conversion Circuitry

The DA600 board performs digital-to-analog conversions on up to four analog output channels. The following paragraphs describe the D/A circuitry.

D/A Converter

The AD7537 12-bit D/A converter contains two closely matched, monotonic D/A converter channels in a single IC package to provide excellent thermal tracking across each pair of analog outputs. The data to be converted is double buffered at the D/A input, which allows simultaneous updating of both D/A output channels. The D/A converter registers can be cleared asynchronously under software control.

The AD7537 is a multiplying D/A converter which converts a digital input into a current output. The conversion is performed by a highly stable R-2R ladder and 12 current steering switches.

Output Amplifiers

The AD712 precision operational amplifier converts the AD7537's current output to a unipolar or bipolar voltage. Each AD712 package contains two high speed monolithic op amps, one for each output from the AD7537 D/A converter package. The exceptionally low offset voltage and drift ensure an accurate analog output on each channel.

Output Range

The D/A channel's output range is determined by the precision voltage reference installed on the DA600 board (you can order the board with a 5- or 10-volt reference), and by the setting of the jumpers on P3. Channels can be independently set for unipolar or bipolar operation.

CHAPTER 4

BOARD OPERATION AND PROGRAMMING

This chapter describes the DA600 operation and provides a complete description of the I/O map and a flow diagram to aid you in programming your DA600 board. The example programs included on the disk in your board package are described at the end of this chapter. These programs, written in BASIC, Turbo Pascal, and Turbo C, include source code to simplify your applications programming.

Defining the I/O Map

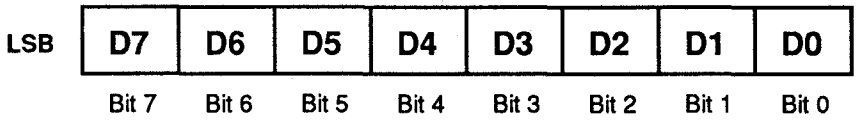
The I/O map for the DA600 is shown in Table 4-1. The base address (designated as BA) can be selected by setting the jumper on P2, as described in Chapter 1, *Board Settings*. One of eight starting address locations can be selected. The board is shipped with the base address set at 300 hex (768 decimal). The following sections describe the register contents of each address used in the I/O map.

Table 4-1 — DA600 I/O Map

Register Description	Read Function	Write Function	Address * (Decimal)
Channel 1 (AOUT1) LSB Input Register	Not used	Programs AOUT1 LSB, bits 0-7	BA + 0
Channel 1 (AOUT1) MSB Input Register	Not used	Programs AOUT1 MSB, bits 8-11	BA + 1
Channel 2 (AOUT2) LSB Input Register	Not used	Programs AOUT2 LSB, bits 0-7	BA + 2
Channel 2 (AOUT2) MSB Input Register	Not used	Programs AOUT2 MSB, bits 8-11	BA + 3
AOUT1/AOUT2 Update	Not used	Simultaneously updates AOUT1 & AOUT2	BA + 8
AOUT1/AOUT2 Clear	Not used	Clears AOUT1 & AOUT2 registers	BA + 16
Channel 3 (AOUT3) LSB Input Register	Not used	Programs AOUT3 LSB, bits 0-7	BA + 24
Channel 3 (AOUT3) MSB Input Register	Not used	Programs AOUT3 MSB, bits 8-11	BA + 25
Channel 4 (AOUT4) LSB Input Register	Not used	Programs AOUT4 LSB, bits 0-7	BA + 26
Channel 4 (AOUT4) MSB Input Register	Not used	Programs AOUT4 MSB, bits 8-11	BA + 27
AOUT3/AOUT4 Update	Not used	Simultaneously updates AOUT3 & AOUT4	BA + 32
AOUT3/AOUT4 Clear	Not used	Clears AOUT3 & AOUT4 registers	BA + 40
* BA = Base Address			

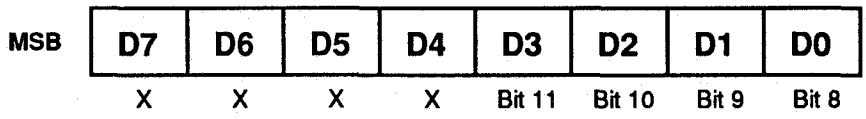
BA + 0: Channel 1 (AOUT1) LSB Input Register (Write Only)

This address is used to load the 8 least significant bits of the 12-bit digital word to be converted by D/A converter channel 1 (AOUT1). The format is shown below.



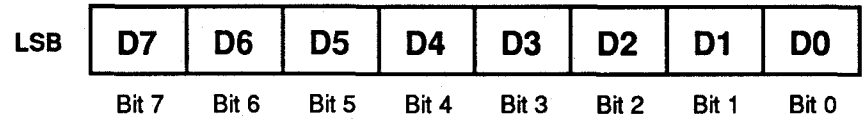
BA + 1: Channel 1 (AOUT1) MSB Input Register (Write Only)

This address is used to load the 4 most significant bits of the 12-bit digital word to be converted by D/A converter channel 1 (AOUT1). The format is shown below.



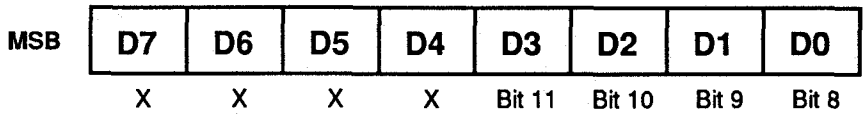
BA + 2: Channel 2 (AOUT2) LSB Input Register (Write Only)

This address is used to load the 8 least significant bits of the 12-bit digital word to be converted by D/A converter channel 2 (AOUT2). The format is shown below.



BA + 3: Channel 2 (AOUT2) MSB Input Register (Write Only)

This address is used to load the 4 most significant bits of the 12-bit digital word to be converted by D/A converter channel 2 (AOUT2). The format is shown below.



BA + 8: Update AOUT1 and AOUT2 (Write Only)

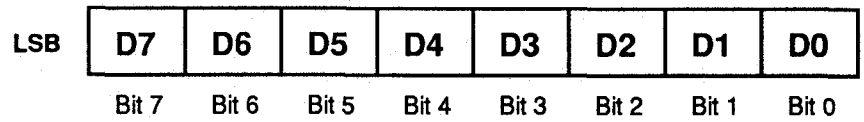
Writing to this address simultaneously updates the outputs of channels 1 and 2 (AOUT1 and AOUT2). The data written is irrelevant.

BA + 16: Clear AOUT1 and AOUT2 (Write Only)

Writing to this address clears the D/A converter's input registers for channels 1 and 2 (AOUT1 and AOUT2). The data written is irrelevant.

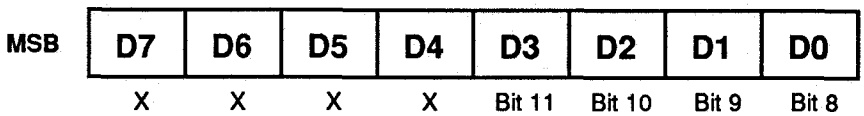
BA + 24: Channel 3 (AOUT3) LSB Input Register (Write Only)

This address is used to load the 8 least significant bits of the 12-bit digital word to be converted by D/A converter channel 3 (AOUT3). The format is shown below.



BA + 25: Channel 3 (AOUT3) MSB Input Register (Write Only)

This address is used to load the 4 most significant bits of the 12-bit digital word to be converted by D/A converter channel 3 (AOUT3). The format is shown below.



BA + 26: Channel 4 (AOUT4) LSB Input Register (Write Only)

This address is used to load the 8 least significant bits of the 12-bit digital word to be converted by D/A converter channel 4 (AOUT4). The format is shown below.

LSB	D7	D6	D5	D4	D3	D2	D1	D0
	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0

BA + 27: Channel 4 (AOUT4) MSB Input Register (Write Only)

This address is used to load the 4 most significant bits of the 12-bit digital word to be converted by D/A converter channel 4 (AOUT4). The format is shown below.

MSB	D7	D6	D5	D4	D3	D2	D1	D0
	X	X	X	X	Bit 11	Bit 10	Bit 9	Bit 8

BA + 32: Update AOUT3 and AOUT4 (Write Only)

Writing to this address simultaneously updates the outputs of channels 3 and 4 (AOUT3 and AOUT4). The data written is irrelevant.

BA + 40: Clear AOUT3 and AOUT4 (Write Only)

Writing to this address clears the D/A converter's input registers for channels 3 and 4 (AOUT3 and AOUT4). The data written is irrelevant.

Programming the DA600

This section gives you some general information about programming and the DA600 board, and then walks you through the major DA600 programming functions. These descriptions and the flow diagram at the end of this chapter will help you as you use the example programs included with the board. All of the program descriptions in this section use decimal values unless otherwise specified.

The DA600 is programmed by writing to and reading from the correct I/O port locations on the board. These I/O ports were defined in the previous section. Most high-level languages such as BASIC, Pascal, C, and C++, and of course assembly language, make it very easy to read/write these ports. The table below shows you how to read from and write to I/O ports using some popular programming languages.

Language	Read	Write
BASIC	Data = INP(Address)	OUT Address, Data
Turbo C	Data = inportb(Address)	outportb(Address, Data)
Turbo Pascal	Data := Port[Address]	Port[Address] := Data

Assembly	mov dx, Address
	in al, dx
		mov dx, Address
		mov al, Data
		out dx, al

Many compilers have functions that can read/write either 8 or 16 bits from/to an I/O port. For example, Turbo Pascal uses **Port** for 8-bit port operations and **PortW** for 16 bits, Turbo C uses **inportb** for an 8-bit read of a port and **inport** for a 16-bit read. **Be sure to use only 8-bit operations with the DA600!**

D/A Conversions

D/A conversions are performed on each pair of channels, AOUT1/AOUT2 or AOUT3/AOUT4, by writing data to the D/A converter registers and then issuing an update command which simultaneously updates the outputs of both channels. The D/A converter registers also can be simultaneously cleared by issuing a clear command.

It is good practice to start your program by clearing the D/A converter registers. If your board has two output channels, AOUT1 and AOUT2, this is a single step process accomplished by writing to BA + 16. The data written is irrelevant. If your board has four output channels, AOUT1 through AOUT4, you write to BA + 16 and BA + 40 to clear all registers.

After clearing the registers, you load the 12-bit digital data for each channel in a two step process, LSB followed by MSB. After the data has been loaded for each pair of channels, the channels are simultaneously updated by issuing the update command. The digital data is converted to a corresponding voltage which is present at the output until another update command is issued, changing the value, or the clear command is issued. The flow diagram at the end of this chapter shows these steps.

The output voltage ranges are determined by the voltage reference installed on the board and the settings of the unipolar/bipolar channel jumpers on P3. One reference is installed for each pair of output channels (U6 for AOUT1/AOUT2 and U10 for AOUT3/AOUT4). Voltage reference REF-02 provides 5 volts and REF-01 provides 10 volts. Unipolar or bipolar operation can be individually set on a per channel basis on P3. The tables below show key digital inputs and their corresponding outputs for unipolar and bipolar ranges. The resolution for each range in included in the range column heading.

Unipolar D/A Conversion Table		
Digital Input	0 to +5 Volt Output (Resolution: 1.22 mV)	0 to +10 Volt Output (Resolution: 2.44 mV)
MSB 0000 0000 0000 LSB	0 volts	0 volts
1000 0000 0000	+2.5000 volts	+5.0000 volts
1111 1111 1111	+4.9988 volts	+9.9976 volts

Bipolar D/A Conversion Table		
Digital Input	-5 to +5 Volt Output (Resolution: 2.44 mV)	-10 to +10 Volt Output (Resolution: 4.88 mV)
MSB 0000 0000 0000 LSB	+5.0000 volts	+10.0000 volts
1000 0000 0000	0 volts	0 volts
1111 1111 1111	-4.9976 volts	-9.9951 volts

Example Programs

The software included with your DA600 board contains example programs in BASIC, Turbo Pascal, and Turbo C to help you get started using the board. These programs show you how to set the outputs and how to generate ramp functions. Source code is also included.

The DA600 board is easily programmed from any high-level language's I/O reference instructions. In BASIC, these instructions are INP and OUT; in Turbo Pascal, they are port and port; and in Turbo C, they are inportb and outportb.

Before using the software included with your board, make a backup copy of the disk. You may make as many backups as you need.

Lexicon Test and Diagnostics Tool

An interactive data collection and plotting utility program, Lexicon, is provided as a test and diagnostics tool. The program is self-explanatory using the instructions on disk.

D/A Conversion Flow Diagram

This flow diagram shows you how to generate a voltage output on AOUT1 and AOUT2. A conversion is initiated each time the channels are simultaneously updated by writing to BA + 8.

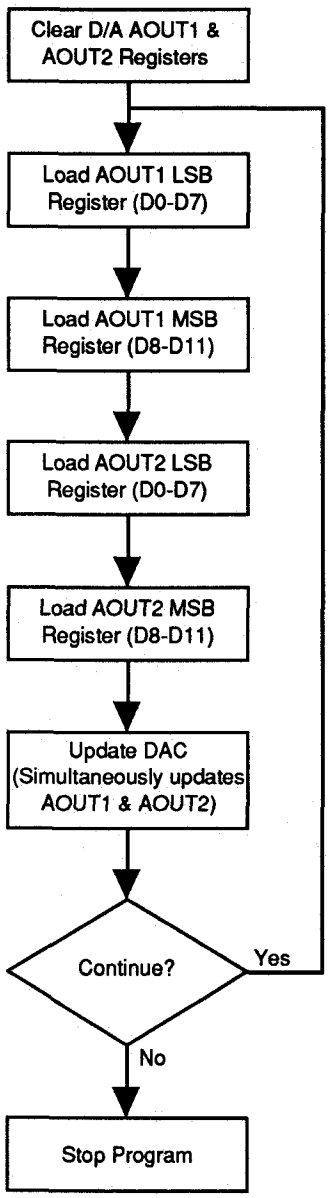


Fig. 4-1 — D/A Conversion Flow Diagram

CHAPTER 5

CALIBRATION

This chapter tells you how to calibrate the DA600 analog outputs using the eight trimpots on the board. These trimpots calibrate the D/A for unipolar or bipolar operation. Calibration may be required if you change the voltage range or polarity of a channel, or whenever you suspect inaccurate readings.

This chapter tells you how to calibrate the D/A converter for unipolar or bipolar operation. The board has been factory-calibrated for unipolar operation. Unipolar calibration is accomplished by making a full-scale adjustment on each output channel. Bipolar calibration involves making a mid-scale and full-scale adjustment on each channel. Any time you suspect inaccurate readings, you can check the accuracy of your conversions using the procedure below, and make adjustments as necessary.

Calibration is done with the board installed in your PC. You can access the trimpots with the computer's cover removed. Power up the computer and let the board circuitry stabilize for 15 minutes before you start calibrating.

Required Equipment

The following equipment is required for calibration:

- Digital Voltmeter: 5-1/2 digits
- Small Screwdriver (for trimpot adjustment)

Figure 5-1 shows the board layout. The eight trimpots used for calibration are shaded in the upper right area of the board. Trimpots 1 through 4 are used when adjusting AOUT1 and AOUT2, and trimpots 5 through 8 are used when adjusting AOUT3 and AOUT4. If your board has only two output channels, ignore the adjustments for AOUT3 and AOUT4.

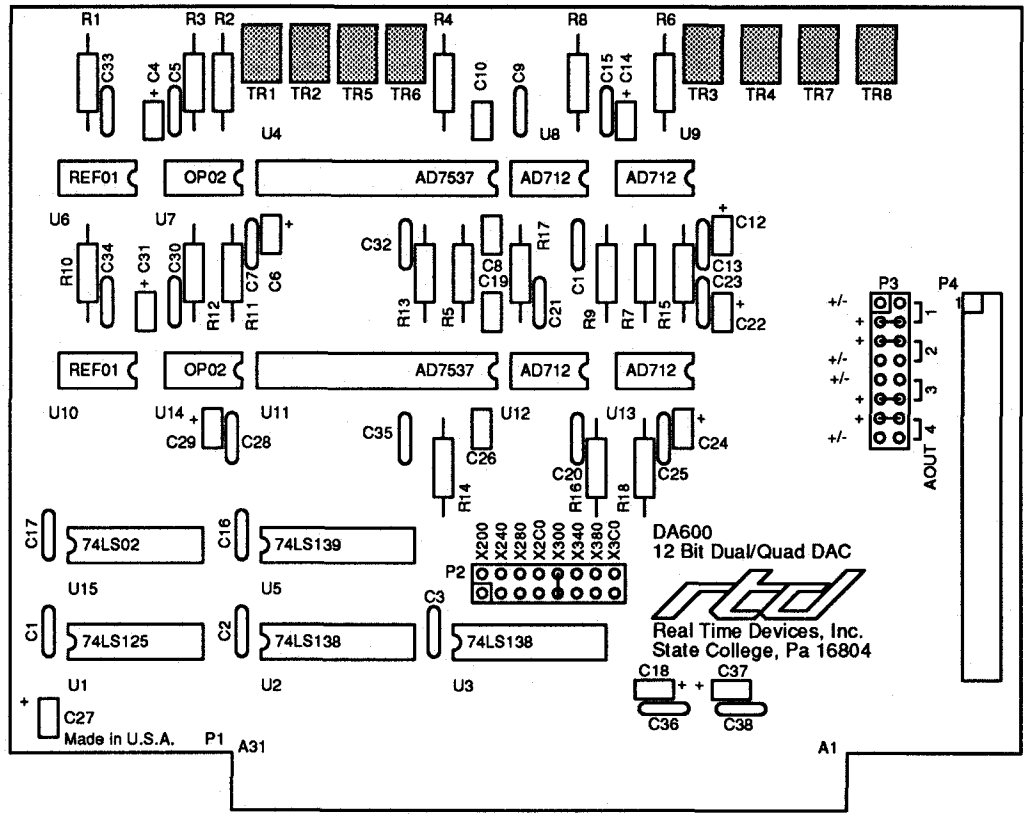


Fig. 5-1 — Board Layout Showing Calibration Trimpots

D/A Calibration

During this procedure, you will make connections to the analog outputs at external I/O connector P4. The pin assignments for P4 are given in Appendix B.

Unipolar Calibration Procedure

Unipolar calibration is accomplished by adjusting each output channel for full-scale output. The full-scale adjustment calibrates the reference voltage used by the D/A converter to compensate for the analog output circuitry of the DA600. Following Table 5-1 below, connect the positive lead of your voltmeter to the output channel and the negative lead to an ANALOG GND pin on P4. Program the D/A converter to output the full-scale voltage, as shown in the table. Then adjust the appropriate trimpot until the output matches the voltage in the table for the voltage range you are using. Voltage reference REF-02 provides a 5-volt range; REF-01 provides a 10-volt range. If you have a two-channel board, you will need to adjust TR1 and TR2 only.

Table 5-1 — Full-Scale Unipolar Calibration

Channel	Digital Input	Output Voltage Range		Trimpot
		0 to +5V	0 to +10V	
AOUT1	1111 1111 1111	+4.9988 volts	+9.9976 volts	TR1
AOUT2	1111 1111 1111	+4.9988 volts	+9.9976 volts	TR2
AOUT3	1111 1111 1111	+4.9988 volts	+9.9976 volts	TR5
AOUT4	1111 1111 1111	+4.9988 volts	+9.9976 volts	TR6

Table 5-2 provides a complete listing of the ideal unipolar output voltages for each bit weight.

Table 5-2 — D/A Converter Unipolar Calibration Table

D/A Bit Weight	Ideal Output Voltage (in millivolts)	
	0 to +5 V	0 to +10 V
4095 (Max. Output)	4998.8	9997.6
2048	2500.0	5000.0
1024	1250.0	2500.0
512	625.00	1250.0
256	312.50	625.00
128	156.250	312.50
64	78.125	156.250
32	39.063	78.125
16	19.5313	39.063
8	9.7656	19.5313
4	4.8828	9.7656
2	2.4414	4.8828
1	1.2207	2.4414
0	0.0000	0.0000

Bipolar Calibration Procedure

Bipolar calibration requires two adjustments for each channel: a mid-scale adjustment and a full-scale adjustment.

Following Table 5-3 below, perform the mid-scale adjustment. Connect the positive lead of your voltmeter to the output channel and the negative lead to an ANALOG GND pin on P4 and program the D/A converter to output the mid-scale voltage, as shown in Table 5-3. Then adjust the appropriate trimpot until the output matches the voltage in the table for the voltage range you are using. Note that for bipolar calibration, the mid-scale trimpots are the same as those used for full-scale unipolar calibration. Voltage reference REF-02 provides a 5-volt range; REF-01 provides a 10-volt range.

Table 5-3 — Mid-Scale Bipolar Calibration

Channel	Digital Input	Output Voltage Range		Trimpot
		-5 to +5V	-10 to +10V	
AOUT1	1000 0000 0000	0 volts	0 volts	TR1
AOUT2	1000 0000 0000	0 volts	0 volts	TR2
AOUT3	1000 0000 0000	0 volts	0 volts	TR5
AOUT4	1000 0000 0000	0 volts	0 volts	TR6

Now, following Table 5-4 below, perform the full-scale adjustment. After these adjustments are made, you can load the D/A converter with all zeros and verify that the output is +5.0000 or +10.0000 volts, depending on your voltage reference.

Table 5-4 — Full-Scale Bipolar Calibration

Channel	Digital Input	Output Voltage Range		Trimpot
		-5 to +5V	-10 to +10V	
AOUT1	1111 1111 1111	-4.9976 volts	-9.9951 volts	TR3
AOUT2	1111 1111 1111	-4.9976 volts	-9.9951 volts	TR4
AOUT3	1111 1111 1111	-4.9976 volts	-9.9951 volts	TR7
AOUT4	1111 1111 1111	-4.9976 volts	-9.9951 volts	TR8

Table 5-5 on the following page provides a complete listing of the ideal bipolar output voltages for each bit weight.

Table 5-5 — D/A Converter Bipolar Calibration Table		
	Ideal Output Voltage (in millivolts)	
D/A Bit Weight	±5 V	±10 V
4095 (Max. Output)	-4997.6	-9995.1
2048	0.0	0.0
1024	+2500.0	+5000.0
512	+3750.0	+7500.0
256	+4375.0	+8750.0
128	+4687.5	+9375.0
64	+4843.8	+9687.5
32	+4921.9	+9843.8
16	+4960.9	+9921.9
8	+4980.5	+9960.9
4	+4990.2	+9980.5
2	+4995.1	+9990.2
1	+4997.6	+9995.1
0	+5000.0	+10000.0

APPENDIX A

DA600 SPECIFICATIONS

DA600 Characteristics Typical @ 25° C

Interface

IBM PC/XT/AT compatible
Jumper-selectable base address, I/O mapped

D/A Converter AD7537

Analog outputs ..... 2 or 4 channels
Resolution ..... 12 bits
Relative accuracy ..... ±1 LSB, max
Full-scale accuracy ..... ±3 LSB, max
Non-linearity ..... ±1 LSB, max
Channel-to-channel isolation ..... 84 dB, typ (each pair)

Analog Output AD712

Chip selectable output ranges:
5 volts (REF-02) ..... 0 to +5 volts; jumper-selectable to ±5 volts
10 volts (REF-01) ..... 0 to +10 volts; jumper-selectable to ±10 volts
Settling time, to 0.01% FSR ..... 1.8 µsec, typ; 3.3 µsec, max
Zero error ..... ±1/2 LSB, typ
Crosstalk ..... 90 dB, typ
Output current, max ..... 10 mA

Miscellaneous Outputs (PC bus-sourced)

Reset output
±12 volts
Digital ground

Current Requirements

+5 volts ..... 33 mA
+12 volts (each pair) ..... 11 mA
–12 volts (each pair) ..... 8 mA

Connector

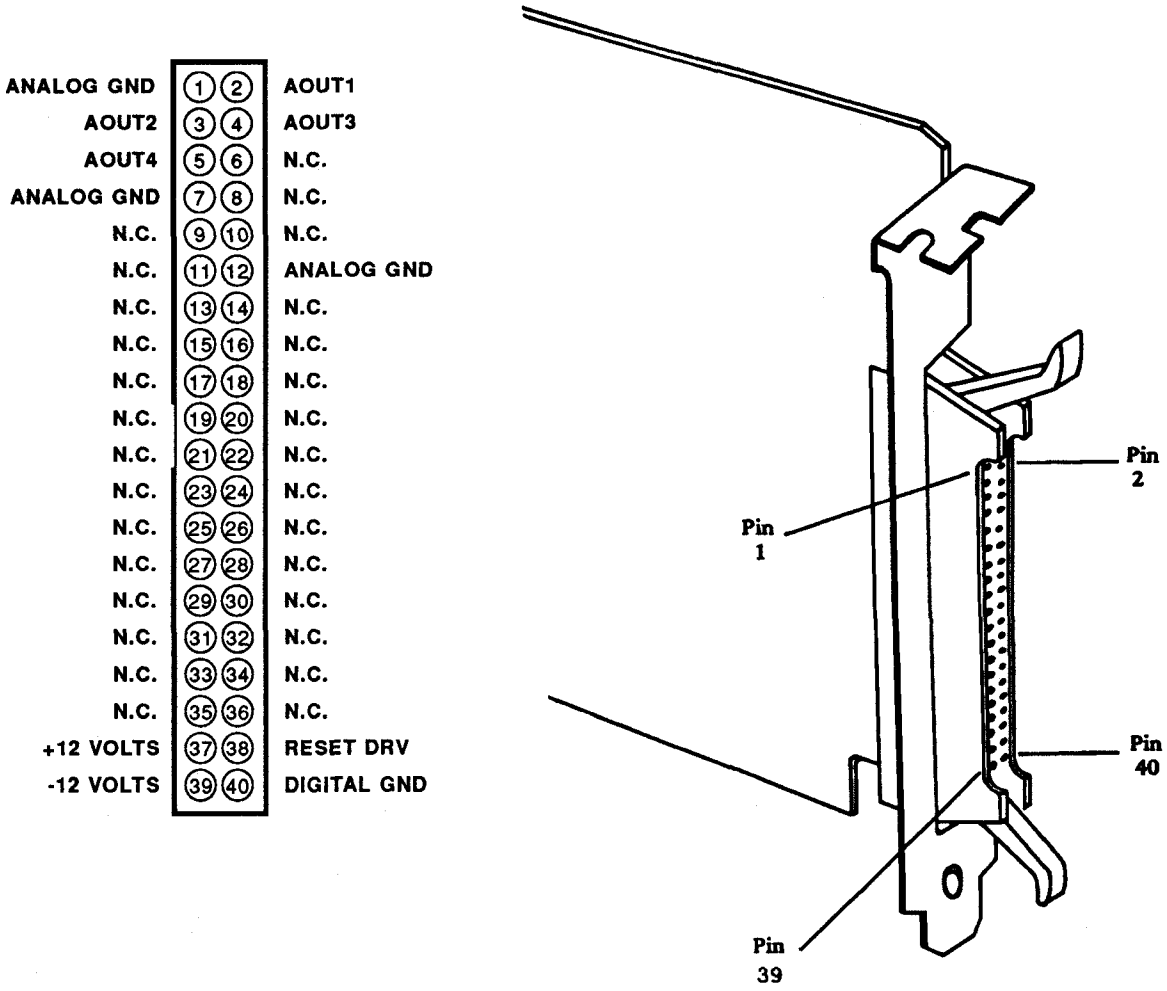
40-pin, right angle, shrouded header with ejector tabs

Size

Short slot — 3.875"H x 5.25"W (99mm x 134mm)

APPENDIX B

CONNECTOR PIN ASSIGNMENTS



DA600 P4 Connector/Mating Connector		
Manufacturer	**DA600 P4 Connector**	**P4 Mating Connector**
Fujitsu 3M Robinson Nugent MIL C-83503	FCN-705Q040-AU/M	FCN-707B040-AU/B 3417-7040 IDS-C40PK-C-SR-TG M83503/7-09

APPENDIX C

WARRANTY

LIMITED WARRANTY

Real Time Devices, Inc. warrants the hardware and software products it manufactures and produces to be free from defects in materials and workmanship for one year following the date of shipment from REAL TIME DEVICES. This warranty is limited to the original purchaser of product and is not transferable.

During the one year warranty period, REAL TIME DEVICES will repair or replace, at its option, any defective products or parts at no additional charge, provided that the product is returned, shipping prepaid, to REAL TIME DEVICES. All replaced parts and products become the property of REAL TIME DEVICES. **Before returning any product for repair, customers are required to contact the factory for an RMA number.**

THIS LIMITED WARRANTY DOES NOT EXTEND TO ANY PRODUCTS WHICH HAVE BEEN DAMAGED AS A RESULT OF ACCIDENT, MISUSE, ABUSE (such as: use of incorrect input voltages, improper or insufficient ventilation, failure to follow the operating instructions that are provided by REAL TIME DEVICES, "acts of God" or other contingencies beyond the control of REAL TIME DEVICES), OR AS A RESULT OF SERVICE OR MODIFICATION BY ANYONE OTHER THAN REAL TIME DEVICES. EXCEPT AS EXPRESSLY SET FORTH ABOVE, NO OTHER WARRANTIES ARE EXPRESSED OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, ANY IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, AND REAL TIME DEVICES EXPRESSLY DISCLAIMS ALL WARRANTIES NOT STATED HEREIN. ALL IMPLIED WARRANTIES, INCLUDING IMPLIED WARRANTIES FOR MECHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, ARE LIMITED TO THE DURATION OF THIS WARRANTY. IN THE EVENT THE PRODUCT IS NOT FREE FROM DEFECTS AS WARRANTED ABOVE, THE PURCHASER'S SOLE REMEDY SHALL BE REPAIR OR REPLACEMENT AS PROVIDED ABOVE. UNDER NO CIRCUMSTANCES WILL REAL TIME DEVICES BE LIABLE TO THE PURCHASER OR ANY USER FOR ANY DAMAGES, INCLUDING ANY INCIDENTAL OR CONSEQUENTIAL DAMAGES, EXPENSES, LOST PROFITS, LOST SAVINGS, OR OTHER DAMAGES ARISING OUT OF THE USE OR INABILITY TO USE THE PRODUCT.

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THIS WARRANTY GIVES YOU SPECIFIC LEGAL RIGHTS, AND YOU MAY ALSO HAVE OTHER RIGHTS WHICH VARY FROM STATE TO STATE.

600 Board User-Selected Settings	
Base I/O Address:	
(hex)	(decimal)