ARTISAN®
TECHNOLOGY GROUP

Your **definitive** source for quality pre-owned equipment.

Artisan Technology Group
(217) 352-9330 | sales@artisantg.com | artisantg.com

Full-service, independent repair center
with experienced engineers and technicians on staff.

We buy your excess, underutilized, and idle equipment
along with credit for buybacks and trade-ins.

Custom engineering
so your equipment works exactly as you specify.

- Critical and expedited services
- In stock / Ready-to-ship
- Leasing / Rentals / Demos
- ITAR-certified secure asset solutions

Expert team | Trust guarantee | 100% satisfaction

All trademarks, brand names, and brands appearing herein are the property of their respective owners.

Find the *Keithley DDA-06* at our website: *Click HERE*

DDA-06

USER'S GUIDE

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

DDA-06 User's Guide

Revision B - July 1994
Part Number: 61860

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

New Contact Information

Keithley Instruments, Inc.
28775 Aurora Road
Cleveland, OH 44139

Technical Support: 1-888-KEITHLEY
Monday – Friday 8:00 a.m. to 5:00 p.m (EST)
Fax: (440) 248-6168

Visit our website at http://www.keithley.com

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

The information contained in this manual is believed to be accurate and reliable. However, Keithley Instruments, Inc., assumes no responsibility for its use or for any infringements of patents or other rights of third parties that may result from its use. No license is granted by implication or otherwise under any patent rights of Keithley Instruments, Inc.

KEITHLEY INSTRUMENTS, INC., SHALL NOT BE LIABLE FOR ANY SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES RELATED TO THE USE OF THIS PRODUCT. THIS PRODUCT IS NOT DESIGNED WITH COMPONENTS OF A LEVEL OF RELIABILITY SUITABLE FOR USE IN LIFE SUPPORT OR CRITICAL APPLICATIONS.

Refer to your Keithley Instruments license agreement and Conditions of Sale document for specific warranty and liability information.

MetraByte is a trademark of Keithley Instruments, Inc. VIEWDAC, EASYEST LX, EASYEST AG, and ASYST are registered trademarks of Keithley Instruments, Inc. All other brand and product names are trademarks or registered trademarks of their respective companies.

© Copyright Keithley Instruments, Inc., 1985, 1994.

All rights reserved. Reproduction or adaptation of any part of this documentation beyond that permitted by Section 117 of the 1976 United States Copyright Act without permission of the Copyright owner is unlawful.

Keithley MetraByte Division

Keithley Instruments, Inc.

440 Myles Standish Blvd. Taunton, MA 02780

Telephone: (508) 880-3000 • FAX: (508) 880-0179

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Preface

The *DDA-06 User's Guide* is intended to help you understand the installation, interface requirements, functions, and operation of the DDA-06 board. This guide focuses primarily on describing the board and its capabilities, setting up the board and its associated software, making typical hookups, and operating the Control Panel software. There are also chapters on calibration and troubleshooting. To follow the information and instructions contained in this manual, you must be familiar with the operation of an IBM® PC/XT™, PC AT®, or compatible computer in the MS-DOS® and Windows™ environments. You must also be familiar with data-acquisition principles and applications.

The *DDA-06 User's Guide* is organized as follows:

- Chapter 1 describes features, accessories, and software options of the board.
- Chapter 2 summarizes operating features of the board. This chapter contains a block diagram and brief descriptions of the features as they relate to your options for setting up and using the boards.
- Chapter 3 contains instructions for inspection, software installation, configuration, and board installation.
- Chapter 4 shows the preferred methods of making I/O (Input/Output) connections, using the available accessories and cables.
- Chapter 5 provides starting instructions and a brief description of the Control Panel program.
- Chapter 6 provides an I/O address map, some programming information, and some programming examples.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

- Chapter 7 discusses calibration requirements and gives instructions for starting the calibration program.
- Chapter 8 contains information on isolating and determining the source of operating problems. This chapter also contains instructions for obtaining technical support.
- Appendix A contains specifications for the DDA-06 board.
- Appendix B contains pin assignments for the main I/O connector of DDA-06 board.
- An index completes the manual.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Table of Contents

Preface

1 Overview
Features and Applications 1-1
Supporting Software. 1-2
Accessories. 1-3

2 Functional Description
Digital I/O Features 2-2
Analog Output Features 2-2

3 Setup and Installation
Unpacking and Inspecting 3-1
Installing the Software Package 3-2
Configuring the Board 3-2
Setting the Base Address 3-3
Setting the Output Range 3-5
Setting the Data Transfer Mode 3-5
Setting the Output Mode 3-5
Installing the Board 3-6

4 Cabling and Wiring
Attaching an STA-U, SSIO-24, or ERB-24 4-2
Attaching an STC-37 Accessory 4-2
Typical Output Configurations 4-3

5 The Control Panel

6 Programming
I/O Address Map 6-1
Data Format 6-2
Programming Examples 6-3
Example 1: Write to Any DAC 6-3
Example 2: Read/Write the Digital I/O Ports 6-4

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

7 Calibration
Equipment Requirements 7-1
Switch, Jumper, and Potentiometer Locations 7-2

8 Troubleshooting
Problem Isolation 8-1
Identifying Symptoms and Possible Causes 8-1
Testing the Board and Host Computer 8-4
Testing the Accessory Slot and I/O Connections 8-4
Technical Support. 8-5

A Specifications

B Connector Pin Assignments

Index

List of Figures

Figure 2-1. Block Diagram of DDA-06 2-1
Figure 3-1. Switch and Jumper Locations 3-3
Figure 4-1. Pin Assignments for the Main I/O Connector 4-1
Figure 4-2. Attaching an STA-U, SSIO-24, or ERB-24. 4-2
Figure 4-3. Attaching an STC-37 Accessory 4-2
Figure 4-4. Voltage Output. 4-3
Figure 4-5. 4 to 20 mA Current Output (Floating Load) 4-3
Figure 4-6. 4 to 20 mA Current Output (Grounded Load) 4-4
Figure 7-1. Switch, Jumper, and Potentiometer Locations. . . . 7-2
Figure B-1. Main I/O Connector Pin Assignments B-1

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

List of Tables

Table 3-1. Values of Base Address Switch Positions 3-3
Table 3-2. Standard Address Assignments 3-4
Table 3-3. Range Switch Settings 3-5
Table 6-1. DDA-06 Register I/O Address Map 6-1
Table 6-2. DAC Data Format 6-2
Table 6-3. Control Code Requirements for Port I/O Settings 6-4
Table 8-1. Troubleshooting Information 8-2
Table A-1. Digital I/O Specifications A-1
Table A-2. DAC Specifications A-2
Table A-3. Environmental Specifications A-3
Table A-4. Power Specifications A-3

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

1

Overview

The DDA-06 is a digital I/O and analog output board for an accessory slot of an IBM PC/XT, PC AT, or compatible computer. This chapter lists features and applications of the board and describes supporting software and accessories.

Features and Applications

Features of the DDA-06 are as follows:

- 24 bits of parallel, digital I/O
- Six channels of 12-bit analog output
- +5, +10, ±2.5, ±5, and ±10 V analog output ranges
- 4 to 20 mA current-loop (sink) capability at the analog output
- Switch selectable, simultaneous updating on all channels

Typical applications for the DDA-06 are as follows:

- Servo control
- Programmable voltage source
- Programmable current sink
- Function generator
- Product test

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Supporting Software

The software package for the DDA-06 is provided on 3.5-inch or 5.25-inch diskettes. This package includes example programs in Microsoft® QuickBasic™ 4.5, Microsoft Professional BASIC, C, Pascal, and Microsoft Visual Basic™ for Windows. The package also includes support files and the following utility programs:

- **General Utility** - This utility (UTIL06.EXE) is a program for installing, calibrating, and testing the DDA-06.
- **Control Panel** - The Control Panel is a stand-alone program (CTL06W.EXE) supplied for Windows. This program provides access to all DDA-06 board operations without programming. Control Panel operations include acquiring analog inputs, controlling analog outputs, and controlling digital I/O. The Control Panel is a means of testing the board and your application; it is also a means of performing simple applications. Refer to Chapter 5 for more information about the Control Panel.
- **PORTIO.DLL** - A Dynamic Link Library providing I/O functions to users of Visual Basic for Windows. The purpose and use of this file are discussed in the accompanying file, PORTIO.TXT.
- **Data acquisition and analysis application software** - VIEWDAC®, EASYEST LX™, and EASYEST AG™ are integrated software packages available for the DDA-06 boards. Programming tools, such as ASYST® scientific and engineering programming language, are also available to help you in writing your application programs. You must use external driver part number DVRDA06 with these software packages. Refer to the Keithley MetraByte product catalog for more information.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Accessories

The following accessories are available for use with the DDA-06:

Note: The main I/O connector of the DDA-06 contains no power supply connections. Therefore you must connect all accessories requiring power to an external source.

- **STA-U** - Screw terminal accessory that enables all signals of the DDA-06 to be accessible through screw-terminal connections. Use a C-1800 cable to connect this accessory to the DDA-06.
- **C-1800** - An 18-inch ribbon cable terminated at each end with a 37-pin female type D connector.
- **STC-37** - Screw terminal connector panel. This accessory connects directly the the main I/O connector of a DDA-06 board to provide general-purpose, screw-terminal connections in a compact form factor.
- **ERB-24** - Electrical relay board. This accessory provides 24 electromechanical double-pole, double-throw relays for controlling and switching up to 3 A at 120 V_{rms}. The ERB-24 connects to the main I/O connector of the DDA-06 through a C-1800 cable.
- **SSIO-24** - 24-channel mounting panel for up to 24 solid-state, miniature I/O modules with functions of DC input, DC output, AC input, and AC output. The SSIO-24 connects to the main I/O connector of the DDA-06 through a C-1800 cable.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

2

Functional Description

This chapter describes the features of the digital I/O and analog output sections of the DDA-06 board. These descriptions are provided to familiarize you with the operating options and to enable you to make the best use of your board. Figure 2-1 shows a block diagram of the DDA-06 board.

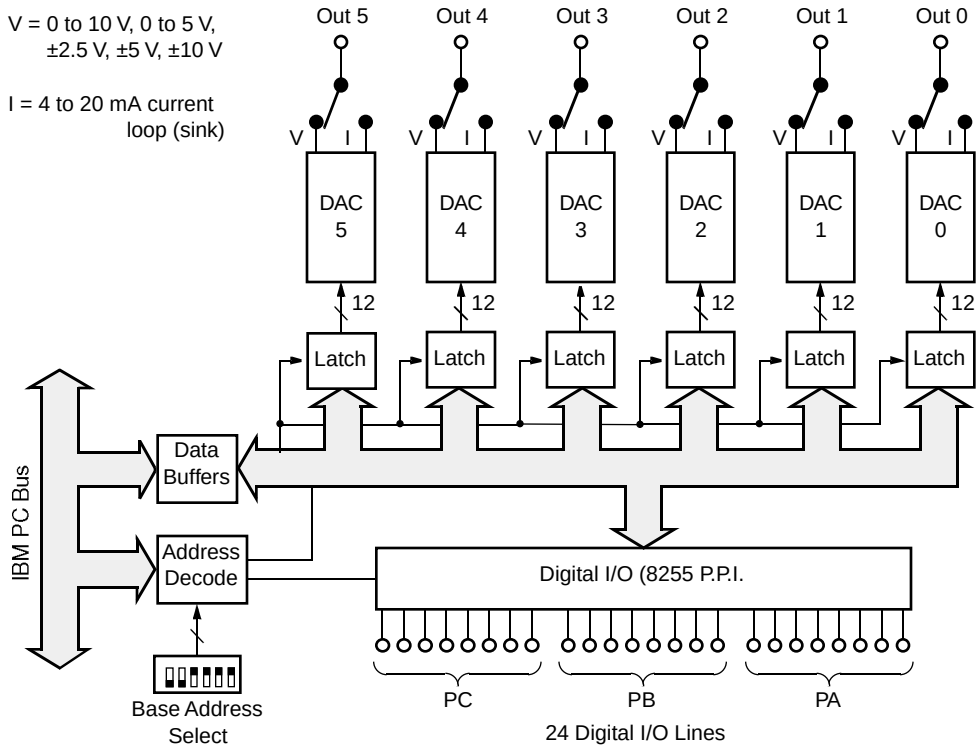


Figure 2-1. Block Diagram of DDA-06

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Digital I/O Features

The 24 bits of digital I/O delivered to the main I/O connector are configured as three 8-bit ports. Each of these ports can be independently programmed as an input or an output and is TTL/CMOS compatible.

The DDA-06 uses an 8255 P.P.I. (programmable peripheral interface) chip for digital I/O; this chip can operate in any of the 8255 modes (modes 0 to 2), which are straight I/O, strobed I/O, and bidirectional I/O.

Analog Output Features

The DDA-06 board contains six, independent, 12-bit DACs (digital-to-analog converters) that are individually switch-selectable for any of the following ranges:

- 0 to 10 V
- 0 to 5 V
- ±2.5 V
- ±5 V
- ±10 V
- 4 to 20 mA current loop (sink)

Each DAC has a double-buffered input for single-step update, and each occupies its own I/O location.

You can set a jumper block at each DAC for individual or simultaneous update.

Each DAC output has its own pin on the main I/O connector. You can jumper the output of each DAC to deliver either voltage (V) or current (I) to this pin. In voltage mode, output settling time is typically 3 µs to 0.01% for a full-scale step.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

3

Setup and Installation

This chapter contains instructions for installing the DDA-06 board. The installation task includes three basic steps: unpacking and inspecting the board, setting the configuration switches and jumpers, and installing the board in the computer. These steps are described in the sections that follow.

Unpacking and Inspecting

Caution: A discharge of static electricity from your hands can seriously damage certain electrical components on any circuit board. Before handling any board, discharge static electricity from yourself by touching a grounded conductor such as your computer chassis (your computer must be turned off) or by wearing an anti-static strap. Whenever you handle a board, hold it by the edges and avoid touching any board components.

Use the following procedure to unwrap and inspect a DDA-06 board.

1. Factory packaging of the DDA-06 board includes a final wrap of protective, anti-static material. Remove the board from its anti-static wrapping material. You may wish to store the wrapping material for possible future use.

2. Inspect the board for signs of damage. If damage is apparent, arrange to return the board to the factory (see “Technical Support” on page 8-5).

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

3. Check the remaining contents of your package against the packing list to be sure your order is complete. Report any missing items, immediately.

4. When you are satisfied with the inspection, proceed with the software and hardware setup instructions.

Installing the Software Package

Before you work with the DDA-06 software, copy the software package diskette either to your computer hard drive or to another diskette. To copy the software to your computer hard drive, make a new directory to contain the software, such as *DDA06*. Store the original diskette as a backup.

After you copy the software package, read the text file *FILES.TXT* to familiarize yourself with the contents of the package. Note that the DOS program UTIL06.EXE is available to facilitate the installation, calibration, and test of your DDA-06. Note also that the Windows program CTL06W.EXE, the *Control Panel*, is available for the operation of your DDA-06.

If you plan to use the PORTIO.DLL to write applications in Visual Basic for Windows for operation of your DDA-06, read the text file *PORTIO.TXT* for information and for prototypes of I/O functions.

Configuring the Board

The base address and the selection of range, data transfer mode, and output mode are all specified through switch or jumper settings. Although the factory settings may be suitable for some installations, check each of these settings against the needs of your application and make any necessary changes. The locations of these switches and jumpers are shown in Figure 3-1.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

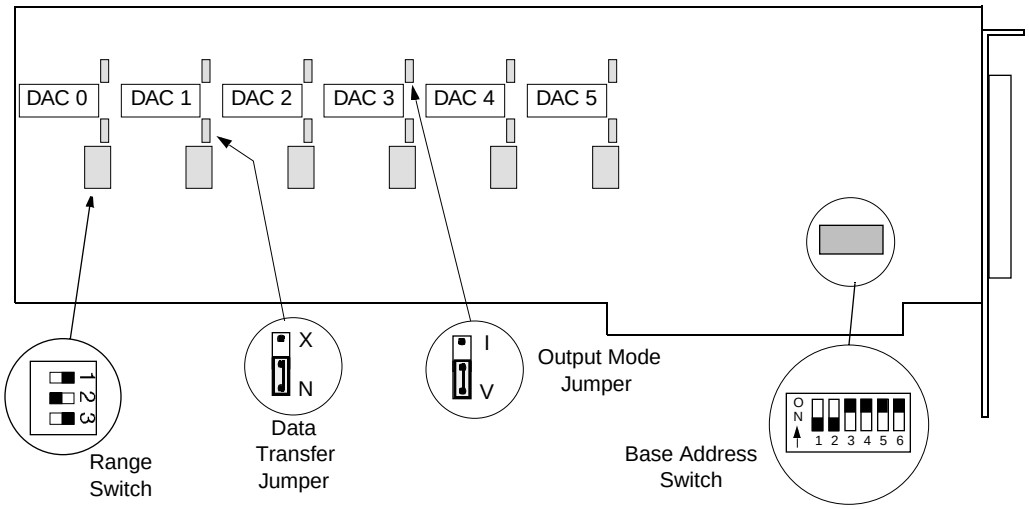


Figure 3-1. Switch and Jumper Locations

Setting the Base Address

The base address switch is preset at the factory for 300h (see Figure 3-1). Table 3-1 lists the values for each position of the base address switch.

Table 3-1. Values of Base Address Switch Positions

Switch Position	Address Line	Value When Switch Is OFF	
		Decimal	Hexadecimal
1	A9	512	200
2	A8	256	100
3	A7	128	80
4	A6	64	40
5	A5	32	20
6	A4	16	10

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

If the default address is already assigned to some other device in your computer, specify a different address. The address you specify must be within the range of 200 to 3F0h (512 to 1008 decimal) and on a 16-byte boundary. When selecting a base address, do not select an address that conflicts with those already in use. Table 3-2 lists standard address assignments and their corresponding devices.

Table 3-2. Standard Address Assignments

Address (Hexadecimal)	Device	Address (Hexadecimal)	Device
000 - 0FF	Internal I/O	378 - 37F	Printer
100 - 1FF	Undecoded	380 - 389	Binary comm. 2
200 - 20F	Joy stick Port	380 - 38C	SDLC comm.
210 - 217	Expansion unit	390 - 39F	Available
218 - 21F	Available	3A0 - 3A9	Binary comm.
220 - 24F	Reserved	3AA - 3AF	Available
250 - 277	Available	3B0 - 3BF	Mono disp./printer
278 - 27F	Reserved	3C0 - 3CF	Reserved
280 - 2EF	Available	3D0 - 3DF	Color/graphics
2F0 - 2F7	Reserved	3E0 - 3E7	Reserved
2F8 - 2FF	Com2:	3E8 - 3EF	Available
300 - 31F	Available	3F0 - 3F7	Floppy disk
320 - 32F	Fixed disk	3F8 - 3FF	Com1:
330 - 377	Available	—	—

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Setting the Output Range

The output range switch for each DAC is a 3-position DIP switch located below the DACs, as shown in Figure 3-1 on page 3-3. The settings of each position for each available range are as shown in Table 3-3.

Table 3-3. Range Switch Settings

Output Range	Position 1	Position 2	Position 3
0 to 5 V	Left	Right	Left
0 to 10 V	Left	Left	Left
±2.5 V	Left	Right	Right
±5 V	Left	Left	Right
±10 V	Right	Left	Right
4 to 20 mA	Left	Right	Left

Setting the Data Transfer Mode

The data transfer mode jumper for each DAC is a 2-position jumper located between the output range switches and the DACs, as shown in Figure 3-1 on page 3-3. When the data transfer mode jumper is at position N (normal), the adjacent DAC updates after writing the high byte. When the data transfer mode jumper for a channel is at position X (transfer), the DAC for that channel updates simultaneously with all other DACs jumpered at position X on a read of any I/O address in the range of Base Address +0h to Base Address +Bh.

Setting the Output Mode

The output mode jumper for each DAC is a 2-position jumper located above the DACs, as shown in Figure 3-1 on page 3-3. When the output mode jumper for a channel is at position V (voltage), the output of that channel is voltage. When the output mode jumper for a channel is at position I (current), the output of that channel is 4 to 20 mA.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Caution: Do not connect a 4 to 20 mA current loop to a DAC set for the voltage mode; the loop supply can cause irreversible damage to the DAC.

Installing the Board

Caution: Installing or removing a board while power is on can damage your computer.

Use the following steps to install a DDA-06 board in an accessory slot of your computer:

1. Turn off power to the computer and all attached equipment.
2. Remove the computer chassis cover.
3. Select an unoccupied accessory slot, and remove the corresponding blank plate from the I/O connector panel.
4. Insert and secure the board in the selected slot.
5. Replace the computer cover.

You are now ready to attach accessories or other external connections to the board, as described in Chapter 4.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

4

Cabling and Wiring

This chapter shows how to attach accessories and I/O signals to the main I/O connector of your DDA-06 board. The main I/O connector of the DDA-06 is a 37-pin, D-type. Pin assignments for this connector are shown in Figure 4-1.

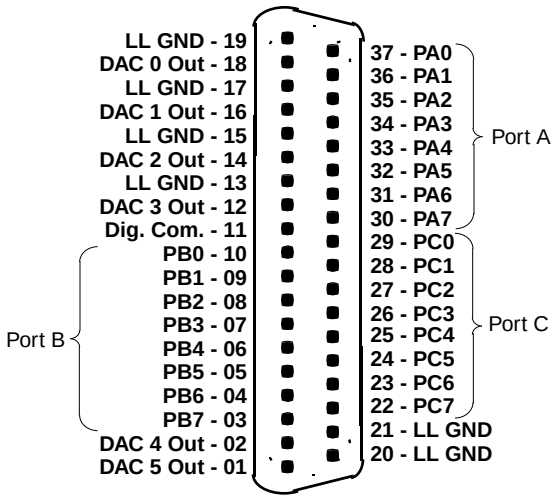


Figure 4-1. Pin Assignments for the Main I/O Connector

Caution: To avoid electrical damage, turn off power to the computer and any attached accessories before making connections to a DDA-06 board.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Attaching an STA-U, SSIO-24, or ERB-24

To attach an STA-U, SSIO-24, or ERB-24 accessory to the DDA-06, use a C-1800 cable, as shown in Figure 4-2.

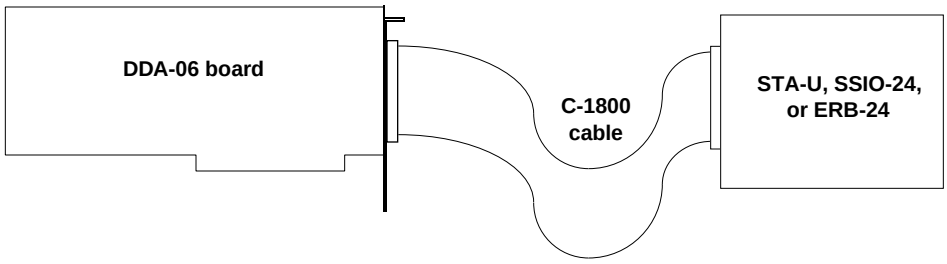


Figure 4-2. Attaching an STA-U, SSIO-24, or ERB-24

Attaching an STC-37 Accessory

The STC-37 connects to the DDA-06 main I/O connector as shown in Figure 4-3. The screw terminal numbers of the STC-37 correspond to the pin numbers of the main I/O connector.

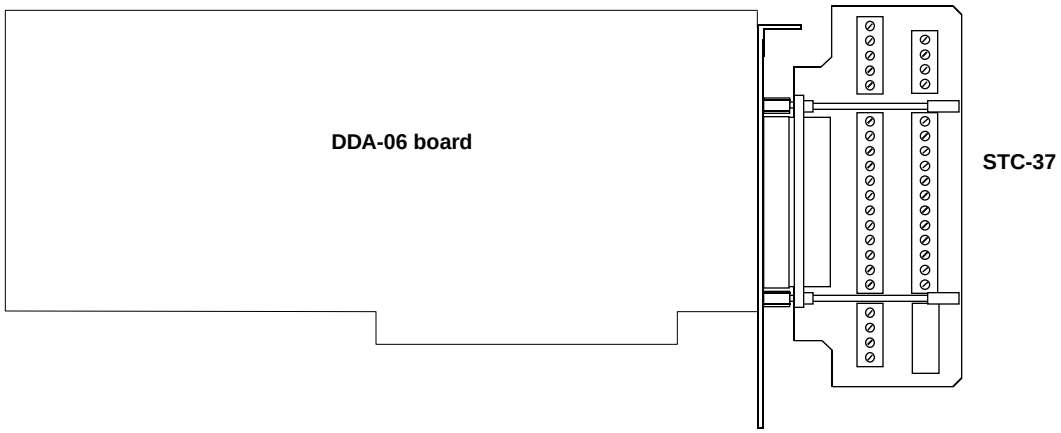


Figure 4-3. Attaching an STC-37 Accessory

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Typical Output Configurations

Circuits shown in the following three diagrams represent typical output configurations for the DDA-06.

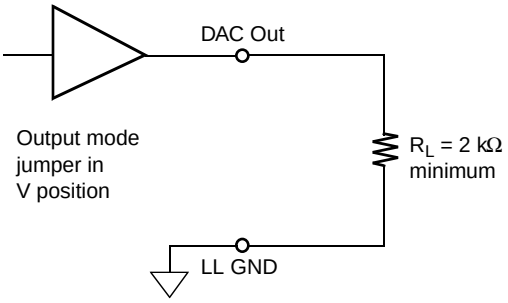


Figure 4-4. Voltage Output

Caution: Do not connect a 4 to 20 mA current loop to a DAC channel set for the voltage output mode, as the loop supply can cause irreversible damage to the DAC.

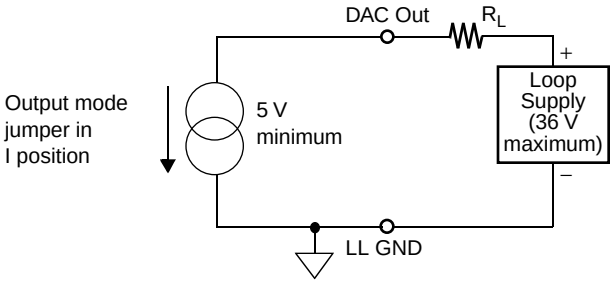


Figure 4-5. 4 to 20 mA Current Output (Floating Load)

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

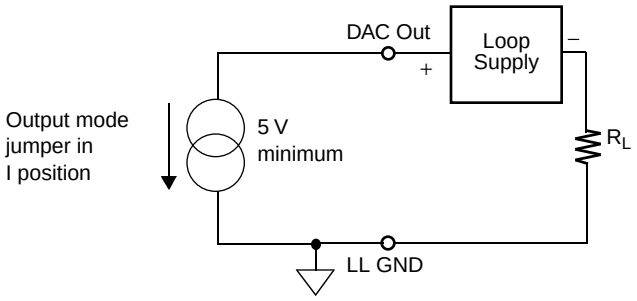


Figure 4-6. 4 to 20 mA Current Output (Grounded Load)

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

5

The Control Panel

The Control Panel is a utility program (CTL06W.EXE) for testing the functions of your DDA-06 boards in the Windows environment. This program is a part of the DDA-06 software package.

To use the Control Panel, perform the following steps:

1. Start the Control Panel from the Windows environment by clicking on Run in the File menu of the Program Manager and making the following entry in the Command Line dialogue box:

   path\CTL06W

   Use the Browse option to determine the path.

2. To configure the base address and DAC output ranges, select File from the Control Panel menu. When the Control Panel displays the File menu, select Config to display the Configuration setup panel for your selections.

3. To set up and perform an analog output operation, select Analog from the Control Panel menu. When the Control Panel displays the Analog menu, select Single to display the Single Point Output or Multiple to display Multiple Point Output setup panel for your entries.

4. To set up and perform a digital I/O operation, select Digital from the Control Panel menu to display the DIGITAL setup panel for your selections and entries.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

5. To obtain information on the setup and performance of an operation, use the Help option in the Control Panel menu. To obtain information on DDA-06 board functions and parameters, refer to Chapter 2.

6. When you finish using the Control Panel, select Exit from the File menu to terminate the program.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

6

Programming

You can operate the DDA-06 by writing I/O commands in programming languages such as BASIC, QuickBasic, C, and Pascal. This chapter provides the register-level programming information you need for writing these I/O commands.

I/O Address Map

The DDA-06 uses 16 consecutive addresses in the I/O address space of the computer. The board's base address (Base Address +0h) determines where the registers of the board are located in the I/O space. Table 6-1 is a map of the DDA-06 register I/O addresses; refer to this table when you look at the example programs later in this chapter.

Table 6-1. DDA-06 Register I/O Address Map

I/O Address	Function		I/O Address	Function
Base Address +0h	DAC 0 low byte (W[1])		Base Address +8h	DAC4 low byte (W)
Base Address +1h	DAC 0 high byte (W)		Base Address +9h	DAC 4 high byte (W)
Base Address +2h	DAC 1 low byte(W)		Base Address +Ah	DAC 5 low byte (W)
Base Address +3h	DAC 1 high byte (W)		Base Address +Bh	DAC 5 high byte (W)
Base Address +4h	DAC 2 low byte (W)		Base Address +Ch	PA port (R/W[2])
Base Address +5h	DAC 2 high byte (W)		Base Address +Dh	PB port (R/W)
Base Address +6h	DAC 3 low byte (W)		Base Address +Eh	PC port (R/W)
Base Address +7h	DAC 3 high byte (W)		Base Address +Fh	Control (W)

Notes
[1] W = write only
[2] R/W = read or write

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

A read of any address in the range Base Address +0h to Base Address +Bh performs an update of any DACs jumpered for simultaneous update.

Users of IBM PC AT or equivalent computers should note that all ports are 8-bit (one byte) and should perform byte read/write operations rather than word (16-bit) operations.

Data Format

Data is written the DACs in true, binary, right-justified form, as shown in Table 6-2.

Table 6-2. DAC Data Format

Address	D7	D6	D5	D4	D3	D2	D1	D0
Low byte (Base Address +Even)	B7	B6	B5	B4	B3	B2	B1	B0 (LSB[1])
High byte (Base Address +Odd)	x[2]	x	x	x	B11 (MSB[3])	B10	B9	B8

Notes
[1] LSB = least significant bit
[2] x = value irrelevant
[3] MSB = most significant bit

For unipolar ranges (0 to full scale), coding is true binary, as follows:

- 0000 0000 0000 Zero
- 1000 0000 0000 1/2 scale
- 1111 1111 1111 +full scale (minus one bit)

For bipolar ranges (–full Scale to +full Scale), coding is offset binary, as follows:

- 0000 0000 0000 –full scale
- 1000 0000 0000 Zero
- 1111 1111 1111 +full scale (minus one bit)

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Programming Examples

The examples in this section are in BASIC but translate readily into other programming languages.

Example 1: Write to Any DAC

Let D = data in the range of 0 to 4095 (12 bits).

Let BASE = the base address of the board as a decimal number.

```
05 BASE = 768           'Select the base address
10 XH% = INT(D/256)     'Put the 4 MSBs in XH%
20 XL% = D - XH% * 256  'Put the 8 LSBs in XL%
30 OUT (BASE +0), XL%   'Write the 8 LSBs to the low
40                      'byte of DAC 0
50 OUT (BASE +1), XH%   'Write the MSBs to the high
60                      'byte of DAC 0
```

For a normal update, the DAC is automatically updated after the MSB write performed on line 50. For a simultaneous update, add the following when all the DACs are loaded:

```
X% = INP(BASE)          'X% is a dummy variable
```

To write to a different DAC, change lines 30 and 50 to write to the appropriate registers. The following example shows the changes required to write to DAC 4.

```
30 OUT (BASE +8), XL%   'Write the 8 LSBs to the low
40                      'byte of DAC 4
50 OUT (BASE +9), XH%   'Write the MSBs to the high
60                      'byte of DAC 4
```


Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Example 2: Read/Write the Digital I/O Ports

First, set ports A, B, and C as input or output by writing to the Control register, at Base Address +Fh. Most applications require all eight bits in each register to be set as input or output. Table 6-3 provides a small set of the codes that must be written to the Control register for input/output possibilities.

Table 6-3. Control Code Requirements for Port I/O Settings

PA	PB	PC	Control Code
Input	Input	Input	9Bh
Input	Input	Output	92h
Input	Output	Input	99h
Input	Output	Output	90h
Output	Input	Input	8Bh
Output	Input	Output	82h
Output	Output	Input	89h
Output	Output	Output	80h

For more code information, refer to the Intel 8255 data sheet (Intel Corporation, Literature Department, 3065 Bowers Avenue, Santa Clara, California 95051).

The following program sets port A as an output while setting ports B and C as inputs. The program then reads data from ports B and C, performs a logical OR on the data, and writes the result to port A. Refer to the I/O map (Table 6-1 on page 6-1) for register locations.

Let BASE = the base address of the board as a decimal number.

```
05 BASE = 768               'Set base address to 768
10 OUT(BASE + &H0F), &H8B   'PA output, PB and PC input
20 B% = INP(BASE + &H0D)    'Read PB, data in B%
30 C% = INP(BASE + &H0E)    'Read PC, data in C%
40 A% = B% or C%            'OR PB and PC, data in A%
50 OUT(BASE + &H0C), A%     'Write data to PA
```


Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

7

Calibration

Your DDA-06 board is initially calibrated at the factory. You are advised to check the calibration of a board after setting a new range and periodically thereafter. For laboratory environments, a 6-month to 1-year calibration interval is recommended. For extremes of temperature, vibration, and humidity, a 3-month calibration interval is recommended. In any case, the long-term zero drift is not likely to exceed ±1 mV, and gain drift is not likely to exceed ±0.1%.

If you are unable to adjust a DAC to correct settings or the DAC exhibits nonlinearity, you must replace the DAC. The DACs are plug-in DAC-80N or DAC-80Z units (Keithley MetraByte part number DAC-12).

This chapter provides the information you need to calibrate a DDA-06 board.

Equipment Requirements

The equipment requirements for calibrating a DDA-06 board are as follows:

- A digital voltmeter accurate to 6 1/2 digits, such as a Keithley Instruments Model 199
- An STA-U accessory with C-1800 cable, an STC-37 accessory, or a user-designed interface

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Switch, Jumper, and Potentiometer Locations

Figure 7-1 shows the switch, jumper, and potentiometer locations on a DDA-06 board. The calibration program, in UTIL06.EXE, directs you to these components and explains what to do with them during the calibration process.

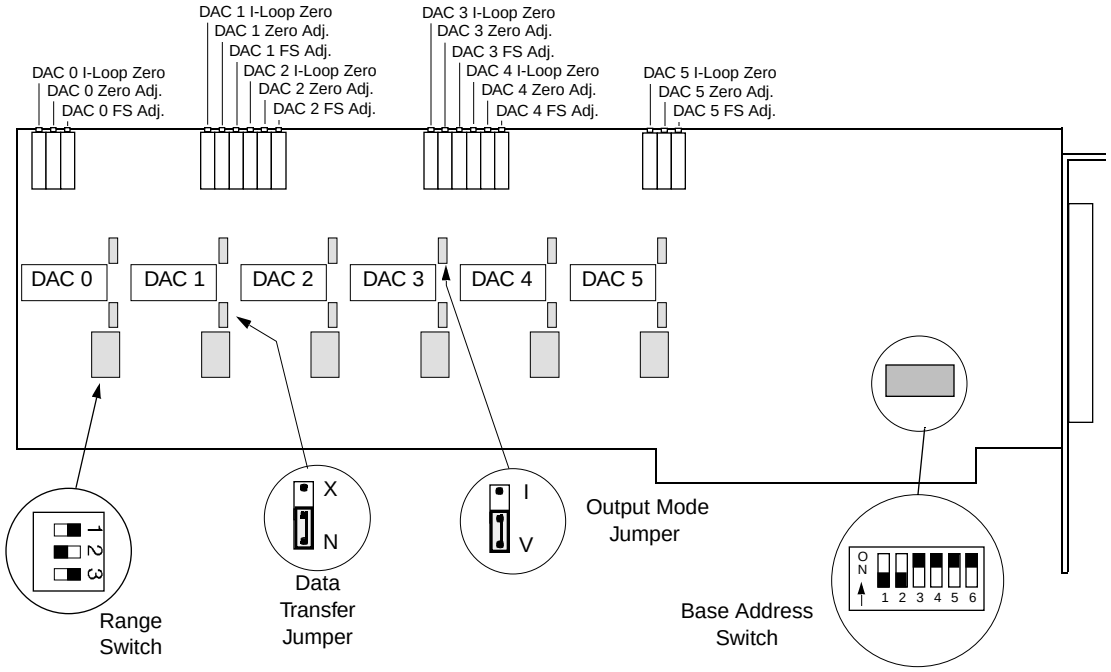


Figure 7-1. Switch, Jumper, and Potentiometer Locations

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

8

Troubleshooting

If your DDA-06 board is not operating properly, use the information in this chapter to isolate the problem. If the problem appears serious enough to warrant technical support, refer to “Technical Support” on page 8-5 for information on how to contact an applications engineer.

Problem Isolation

If you encounter a problem with a DDA-06 board, use the instructions in this section to isolate the cause of the problem before calling Keithley MetraByte Hardware Applications Engineering.

Identifying Symptoms and Possible Causes

Use the troubleshooting information in Table 8-1 to try to isolate the problem. Table 8-1 lists general symptoms and possible solutions for problems with DDA-06 boards.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Table 8-1. Troubleshooting Information

Symptom	Possible Cause	Possible Solution
Board does not respond	Base address is incorrect or not consistent with what the program is addressing.	Check the base-address-switch setting on the board against the setting shown in the configuration utility. If the base address is set correctly, make sure no other computer device is using any of the I/O locations beginning at the specified base address. If necessary, reconfigure the base address. Refer to page 3-3 for instructions on setting the base address.
	The board is incorrectly aligned in the accessory slot.	Check the board for proper seating.
	The board is damaged.	Contact the Keithley MetraByte Hardware Applications Engineering Department; see page 8-5.
Intermittent operation	The most common cause of this problem is that the I/O bus speed is in excess of 8 MHz.	Reduce I/O bus speed to a maximum of 8 MHz (to change the I/O bus speed, run BIOS setup). See your computer documentation for instructions on running BIOS setup.
	Vibrations or loose connections exist.	Cushion source of vibration and tighten connections.
	The board is overheating.	Check environmental and ambient temperature. See the documentation for your computer.
	Electrical noise exists.	Provide better shielding or reroute unshielded wiring.
Low or no output voltage	Trying to drive a load of less than 5 mA	Reduce load or buffer the DAC output

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Table 8-1. Troubleshooting Information (cont.)

Symptom	Possible Cause	Possible Solution
Data appears to be invalid	The most common cause of this problem is that the I/O bus speed is in excess of 8 MHz.	Reduce I/O bus speed to a maximum of 8 MHz (to change the I/O bus speed, run BIOS setup). See the documentation for your computer for instructions on running BIOS setup.
	An open connection exists.	Check wiring to screw terminal.
	Another system resource is using the specified base address.	Reconfigure the base address of the DDA-06 board; refer to page 3-3 for more information. Check the I/O assignments of other system resources and reconfigure, if necessary.
Computer does not boot.	Board not seated properly.	Check the installation of the board.
	The base address setting of the DDA-06 board conflicts with that of another system resource.	Check the base address settings of your system resources; each address must be unique.
	The power supply of the host computer is too small to handle all the system resources.	Check the needs of all system resources and obtain a larger power supply.
System lockup	A timing error occurred.	Press **[Ctrl] + [Break]**.

If your board is not operating properly after using the information in Table 8-1, continue with the next two sections to further isolate the problem.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Testing the Board and Host Computer

To isolate the problem to the DDA-06 board or to the host computer, use the following steps:

1. Turn the power to the host computer OFF, and remove power connections to the computer.

   Caution: Removing a board with the power ON can cause damage to your board and/or computer.

2. While keeping connections to any accessory board intact, unplug the accessory connector or cable from the DDA-06 board.

3. Remove the DDA-06 board from the computer and visually check for damage. If a board is obviously damaged, refer to “Technical Support” on page 8-5 for information on returning the board.

4. With the DDA-06 board out of the computer, check the computer for proper operation. Power up the computer and perform any necessary diagnostics.

At this point, if you have another DDA-06 board that you know is functional, you can test the slot and I/O connections using the instructions in the next section. If you do not have another board, refer to the instructions on page 8-5 before calling Keithley Technical Support.

Testing the Accessory Slot and I/O Connections

When you are sure that the computer is operating properly, test the computer accessory slot and I/O connections using another DDA-06 board that you know is functional. To test the computer accessory slot and the I/O connections, follow these steps:

1. Remove computer power again, and install a DDA-06 board that you know is functional. Do not make any I/O connections.

2. Turn computer power ON and check operation with the functional board in place. This test checks the computer accessory slot. If you

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

were using more than one DDA-06 board when the problem occurred, use the functional board to test the other slot, as well.

3. If the accessory slots are functional, use the functional board to check the I/O connections. Reconnect and check the operation of the I/O connections, one at a time.

4. If operation fails for an I/O connection, check the individual inputs one at a time for shorts and opens.

5. If operation remains normal to this point, the problem is in the DDA-06 board(s) originally in the computer. If you were using more than one board, try each board one at a time in the computer to determine which is faulty.

6. If you cannot isolate the problem, refer to the next section for instructions on obtaining assistance.

Technical Support

Before returning any equipment for repair, call the Keithley MetraByte Hardware Applications Engineering Department at:

(508) 880-3000

Monday - Friday, 8:00 A.M. - 6:00 P.M., Eastern Time

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

An applications engineer will help you diagnose and resolve your problem over the telephone. Please make sure that you have the following information available before you call:

DDA-06 Board Configuration	Model	_____
	Serial #	_____
	Revision code	_____
	Base address setting	_____
	Number of channels	_____
Computer	Manufacturer	_____
	CPU type	_____
	Clock speed (MHz)	_____
	KB of RAM	_____
	Video system	_____
	BIOS type	_____
Operating System	DOS version	_____
	Windows version	_____
	Windows mode	_____
Software package	Name	_____
	Serial #	_____
	Version	_____
	Invoice/Order #	_____
Compiler (if applicable)	Language	_____
	Manufacturer	_____
	Version	_____
Accessories	Type	_____
	Type	_____
	Type	_____
	Type	_____
	Type	_____
	Type	_____
	Type	_____
	Type	_____

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

If a telephone resolution is not possible, the applications engineer will issue you a Return Material Authorization (RMA) number and ask you to return the equipment. Include the RMA number with any documentation regarding the equipment.

When returning equipment for repair, include the following information:

- Your name, address, and telephone number.
- The invoice or order number and date of equipment purchase.
- A description of the problem or its symptoms.
- The RMA number on the **outside** of the package.

Repackage the equipment, using the original anti-static wrapping, if possible, and handling it with ground protection. Ship the equipment to:

ATTN: RMA #_____
Repair Department
Keithley MetraByte
440 Myles Standish Boulevard
Taunton, Massachusetts 02780

Telephone (508) 880-3000
Telex 503989
FAX 508/880-0179

Notes: If you are submitting your equipment for repair under warranty, you must include the invoice number and date of purchase.

To enable Keithley Metrabyte to respond as quickly as possible, you must include the RMA number on the outside of the package.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

A

Specifications

This appendix provides specifications for the DDA-06 board.

Table A-1. Digital I/O Specifications

Feature	Specification
Type	8255 P.P.I.
Number	24 lines (three 8-bit ports)
Control	Each port software-programmable as input or output; supports all 8255 operating modes
TTL/DTL/CMOS compatible input characteristics	Logic low level: –0.5 V minimum to +0.8 V maximum Logic high level: +2.0 V minimum to +5.0 V maximum Input current: ±10 µA (logic high or low)
TTL/DTL/CMOS compatible output characterstics	Output low sink current: 1.7 mA at V_{ol} = 0.45 V Output high: –200 µA at V_{oh} = 2.4 V Source current (Darlington drive current): –1 mA minimum; –4 mA maximum at 1.5 V (available on any eight pins simultaneously from PB and PC ports)

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Table A-2. DAC Specifications

Feature	Specification
Channels	6
Resolution	12 bits (1 part in 4095 decimal)
DAC type	DAC-80N (6 used)
Latches	Double buffered with optional simultaneous update
Linearity	±1/2 bit
Monotonicity	±1/2 bit
Temperature drift of zero	1 ppm typical; 3 ppm maximum of full-scale range
Temperature drift of gain (full scale)	15 ppm typical; 30 ppm maximum
Output ranges	0 to 5 V 0 to 10 V ±2.5 V ±5 V ±10 V 4 to 20 mA (current sink to ground)
Voltage output characteristics	Load current: ±5 mA maximum Short-circuit current: 40 mA maximum Output resistance: < 0.1 Ω Settling time: 4 µs maximum to 0.01% for full-scale step
4 to 20 mA current loop characteristics	Type: 4 to 20 mA constant current sink to ground Output resistance: >100 MΩ Minimum loop excitation voltage: +6 V Maximum loop excitation voltage: +36 V

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Table A-3. Environmental Specifications

Feature	Specification
Operating temperature range	0 to 50˚ C
Storage temperature range	–20 to +70˚ C
Humidity	0 to 90% noncondensing
Weight	10 oz. (290 gm)

Table A-4. Power Specifications

Feature	Specification
+5 V supply	450 mA typical; 550 mA maximum
+12 V supply	60 mA typical; 100 mA maximum
–12 V supply	140 mA typical; 180 mA maximum
Power dissipation	4.7 W typical (16 BTU/hr)

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

B

Connector Pin Assignments

The connection between an external I/O device and a DDA-06 board is made at the main I/O connector, which is a standard 37-pin, D-type male connector. The mating connector is a 37-pin, D-type female connector (part# SFC-37). Figure B-1 illustrates pin assignments of the main I/O connector.

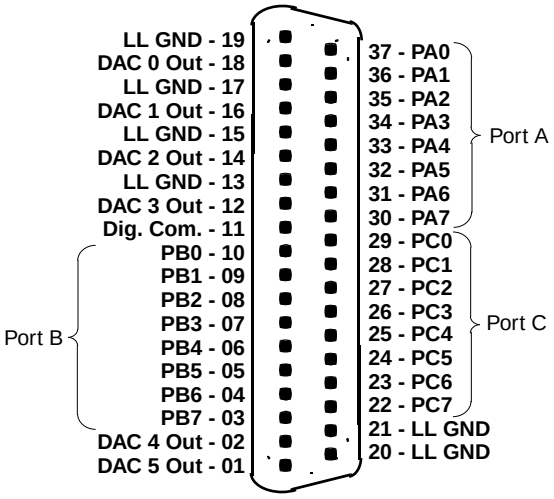


Figure B-1. Main I/O Connector Pin Assignments

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Index

A

accessory
    ERB-24 1-3
    SSIO-24 1-3
    STA-U 1-3
    STC-37 1-3
analog output functions 2-2
anti-static wrapping material 3-1
Applications Engineering Department 8-5
ASYST 1-2
attaching
    ERB-24 4-2
    SSIO-24 4-2
    STA-U 4-2
    STC-37 accessory 4-2

B

base address switch 3-3
block diagram 2-1

C

cable, C-1800 1-3, 4-2
cabling and wiring 4-1
calibration 7-1
chip
    8255 P.P.I. 2-2
    DAC-80N A-2
connector, 37-pin female type D 1-3
Control Panel utility 1-2, 5-1

D

DACs (digital-to-analog converters) 2-2
Darlington drive current A-1
data format 6-2
data transfer mode jumper 3-5
diagram, block 2-1
digital I/O functions 2-2
double-buffered input 2-2

E

EASYEST AG 1-2
EASYEST LX 1-2
equipment requirements 7-1
ERB-24 accessory 1-3
examples, programming 6-3

F

FILES.TXT 3-2

G

general utility 1-2

I

I/O address map 6-1
I/O commands 6-1
installing a DDA-06 board 3-6

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

J

jumper
    data transfer mode 3-5
    output mode 3-5

L

list, packing 3-2
long-term zero drift 7-1

M

main I/O connector B-1
mode, voltage or current 2-2
modes, 8255 2-2

N

nonlinearity 7-1

O

output mode jumper 3-5
output range switch 3-5

P

packing list 3-2
pin assignments B-1
PORTIO.DLL 1-2
PORTIO.TXT 3-2
potentiometers 7-2
problem isolation 8-1
programming examples 6-3

R

ranges, DAC output 2-2
register I/O addresses 6-1
returning equipment 8-6
RMA number 8-6

S

setting
    the base address 3-3
    the data transfer mode 3-5
    the output range 3-5
setting the output mode jumper 3-5
settling time 2-2
single-step update 2-2
software package 1-2, 3-2
specifications
    DAC A-2
    digital I/O A-1
    environmental A-3
    power A-3
SSIO-24 accessory 1-3
static electricity 3-1
STA-U accessory 1-3
STC-37 accessory 1-3
switch
    base address 3-3
    output range 3-5
switch and jumper locations 3-2

T

Technical Support 8-5
troubleshooting 8-1
TTL/CMOS compatible 2-2
typical output configurations 4-3

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

U

unpacking and inspecting 3-1
update
    individual 2-2
    simultaneous 2-2
utility
    Control Panel 1-2, 5-1
    general 1-2
    PORTIO.DLL 1-2

V

VIEWDAC 1-2

W

warranty repairs 8-7

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Artisan Technology Group is an independent supplier of quality pre-owned equipment

Gold-standard solutions

Extend the life of your critical industrial, commercial, and military systems with our superior service and support.

We buy equipment

Planning to upgrade your current equipment? Have surplus equipment taking up shelf space? We'll give it a new home.

Learn more!

Visit us at **artisantg.com** for more info on price quotes, drivers, technical specifications, manuals, and documentation.

Artisan Scientific Corporation dba Artisan Technology Group is not an affiliate, representative, or authorized distributor for any manufacturer listed herein.

We're here to make your life easier. How can we help you today?

(217) 352-9330 | sales@artisantg.com | artisantg.com

ARTISAN® TECHNOLOGY GROUP