Digidata® 1440A
Low-noise Data Acquisition System

User Guide

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Molecular Devices

For research use only. Not for use in diagnostic procedures.

Product manufactured by Molecular Devices, LLC.
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Molecular Devices, LLC is ISO 9001 registered.

Contents

1 Introduction

Introduction to the Digidata 1440A Digitizer

The Digidata® 1440A Low-noise Data Acquisition System is a high-resolution, low-noise digitizer intended for precision scientific applications. It is particularly designed for electrophysiology experiments, to send and receive signals from microelectrode amplifiers, and to interact with peripheral instruments such as solution changers and stimulators.

The Digidata 1440A Digitizer digitizes its 16 independent analog input channels at up to 250 kHz each, and has four independent 16-bit analog outputs. There are eight digital output lines, as well as Tag and Start digital inputs.

The Digidata 1440A Digitizer communicates with the host computer using USB 2.0.

The Digidata 1440A Digitizer is a plug-and-play device, so it is automatically recognized by Windows. The Digidata 1440A Digitizer is supported on Windows systems by AxoScope 10 and by pCLAMP's Clampex 10. AxoScope is an easy-to-use, full-featured data acquisition program for Windows that is included with the Digidata 1440A Digitizer.

Previous Digidata models multiplexed their analog inputs, so as analog input channels were added, the maximum per channel sampling rate decreased. However, the Digidata 1440A Digitizer does not have this limitation, as all 16 analog input channels can be acquired simultaneously at the maximum 250 kHz sampling rate through a high-speed USB 2.0 port.

The Digidata 1440A Digitizer is contained within a rack-mount case, but it also has adjustable bayonet feet for use on a desktop.

Components

- Digidata 1440A Digitizer interface
- External power supply and power cord
- USB 2.0 cable
- CD-ROM with AxoScope 10 Software for Windows
- Printed user guide

Minimum Computer Requirements

- IBM PC-compatible computer with a 1 GHz CPU
- Windows 2000 (PC)
- 256 MB RAM
- 500 MB hard disk
- 800 × 600 display system (small fonts)
- High-speed built-in USB 2.0 port

Recommended Computer System

- IBM PC-compatible computer with a 2 GHz CPU (or faster)
- Windows 7 (32-bit or 64-bit)
- 1 GB RAM (or more)
- 2 GB hard disk (or more)
- 1024 × 768 display system (large or small fonts)
- High-speed built-in USB 2.0 port

Programming

The Digidata 1440A Digitizer is supplied with the AxoScope 10 turnkey software for continuous data acquisition. No programming is required for use with this program, or with the pCLAMP 10 data acquisition software.

For third-party programming of the digitizer, contact Molecular Devices Technical Support regarding the availability of a Digidata 1440A Test Bed.

Installation

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Instructions

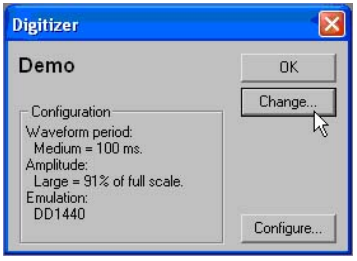
Note: This installation procedure will not uninstall or disable previously installed hardware or software items on a Windows system, such as a Digidata® 1200 or 1320 series digitizer running with earlier versions of AxoScope or pCLAMP software. If you will no longer be running any of these items, uninstall them from your system before you begin this installation procedure.

1. Install the AxoScope 10 or pCLAMP 10 software, which includes the Digidata 1440A drivers. An AxoScope 10 software CD is included for Windows systems. However, if you have purchased the pCLAMP 10 software, install that instead of AxoScope 10 software.

   Note: Before installing the software from a CD-ROM, contact Molecular Devices to make sure that your CD-ROM contains the latest version. If you do not have the latest version, you can download the it from the knowledge base area of the support web site at www.moleculardevices.com/Support.html.

   - Insert the AxoScope 10 or pCLAMP 10 software CD-ROM into the CD-ROM drive.
   - The setup dialog is displayed automatically. If it does not, double-click the **Computer** icon on the Windows desktop and then double-click the icon for your CD-ROM drive. The installation menu appears.
   - Follow the on-screen instruction to install the AxoScope or pCLAMP software.
2. If your computer does not have a USB 2.0 port, install a USB 2.0 card into your computer. If you do not know if you have USB 2.0 ports on your Windows system, do the following to check, see Appendix B: Troubleshooting on page 17.
3. Connect the Digidata 1440A Digitizer's power cord to an AC outlet, and then to the supplied external power supply unit. With the digitizer's front panel power switch in the "off" position (o), connect the external power supply to the digitizer's DC-POWER input.

4. Attach the USB 2 cable to a USB 2.0 port on your computer, and then to the digitizer.
5. Turn on the Digidata 1440A Digitizer.
6. Windows will find the New Hardware and install it. There is no need to search for external drivers.
7. Configure the digitizer in your software application. For the AxoScope or pCLAMP software:
   - Run AxoScope or Clampex by double-clicking on the icon on the Windows desktop.
   - Click **Configure > Digitizer** to open the **Digitizer** dialog and then click the **Change** button.



   - In the **Change Digitizer** dialog select **Digidata 1440 Series** from the **Digitizer Type** list.

   - Click the **Scan** button to detect the digitizer. The **Configuration** field changes from **Not present** to **Available** and the **OK** button is enabled.
   - Click **OK** to exit this dialog, and then click **OK** again to exit the **Digitizer** dialog.
8. The Digidata 1440A Digitizer is now ready to perform experiments.

Interface Description

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Front Panel

The following is a description of the Digidata® 1440A Digitizer's front panel.

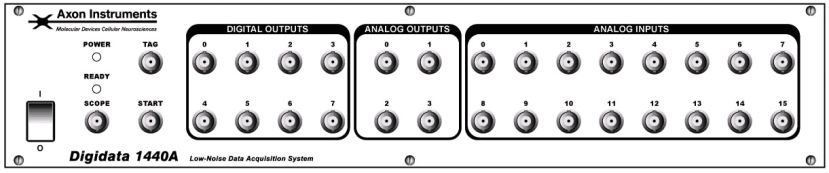


Figure 3-1 Front panel of the Digidata 1440A Digitizer.

There is a single rocker-style **On/Off** switch.

There are two indicator lights: **POWER** and **READY**.

- When the digitizer is powered on, the green **POWER** light is continuously on.
- When the digitizer is recognized by the software and ready for use, the yellow **READY** light is continuously on.

The front panel connectors are all BNCs.

Analog Inputs

There are sixteen 16-bit single-ended analog input channels. The BNC shields for the Analog Inputs are connected to the Analog ground. All of these channels can be used simultaneously without any reduction in each channel's throughput. These input channels are typically used to digitize biological signals.

Analog Outputs

The front panel has four 16-bit analog output channels. Each channel has an operational amplifier to buffer the output signal of the D/A converter. The four analog output channels can be simultaneously used for waveform generation.

Digital Outputs

Digital Outputs 0–7 are on the front panel of the Digidata 1440A Digitizer. These output levels are set to high (+5 V) or low (0 V). They can be used to trigger a wide variety of external devices.

Start and Tag Input Triggers

START and TAG are digital input triggers compatible with TTL-level signals.

- The START input is used to begin data acquisition through an external trigger source.
- The TAG input is used to automatically mark events (for example, perfusion ON) within the data.

Scope Output

The SCOPE output is a digital signal that reflects specific actions in Clampex and AxoScope, such as the beginning of an acquisition recording, sweep, event, or level. It is useful as an oscilloscope trigger, or to synchronize data acquisition with other devices.

Rear Panel

There are several connectors on the rear panel of the Digidata 1440A Digitizer: four BNCs, one USB connector, one 25-pin connector, and one DC-Power input.

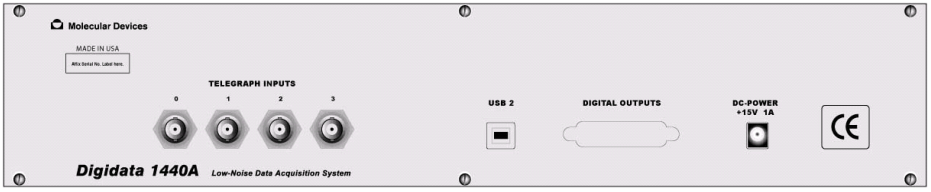


Figure 3-2 Rear panel of the Digidata 1440A Digitizer.

Telegraph Inputs

The Digidata 1440A Digitizer has a dedicated 12-bit A/D converter that provides four telegraph input channels on the rear panel. These telegraph input channels provide gain, frequency, and capacitance values from manually-controlled amplifiers (for example, Axopatch 200B). These inputs are independent of the 16 analog input channels. Computer-controlled amplifiers (for example, MultiClamp 700A/B, Axoclamp 900A) use software signals instead of such hard-wired telegraph signals.

USB 2.0 Port

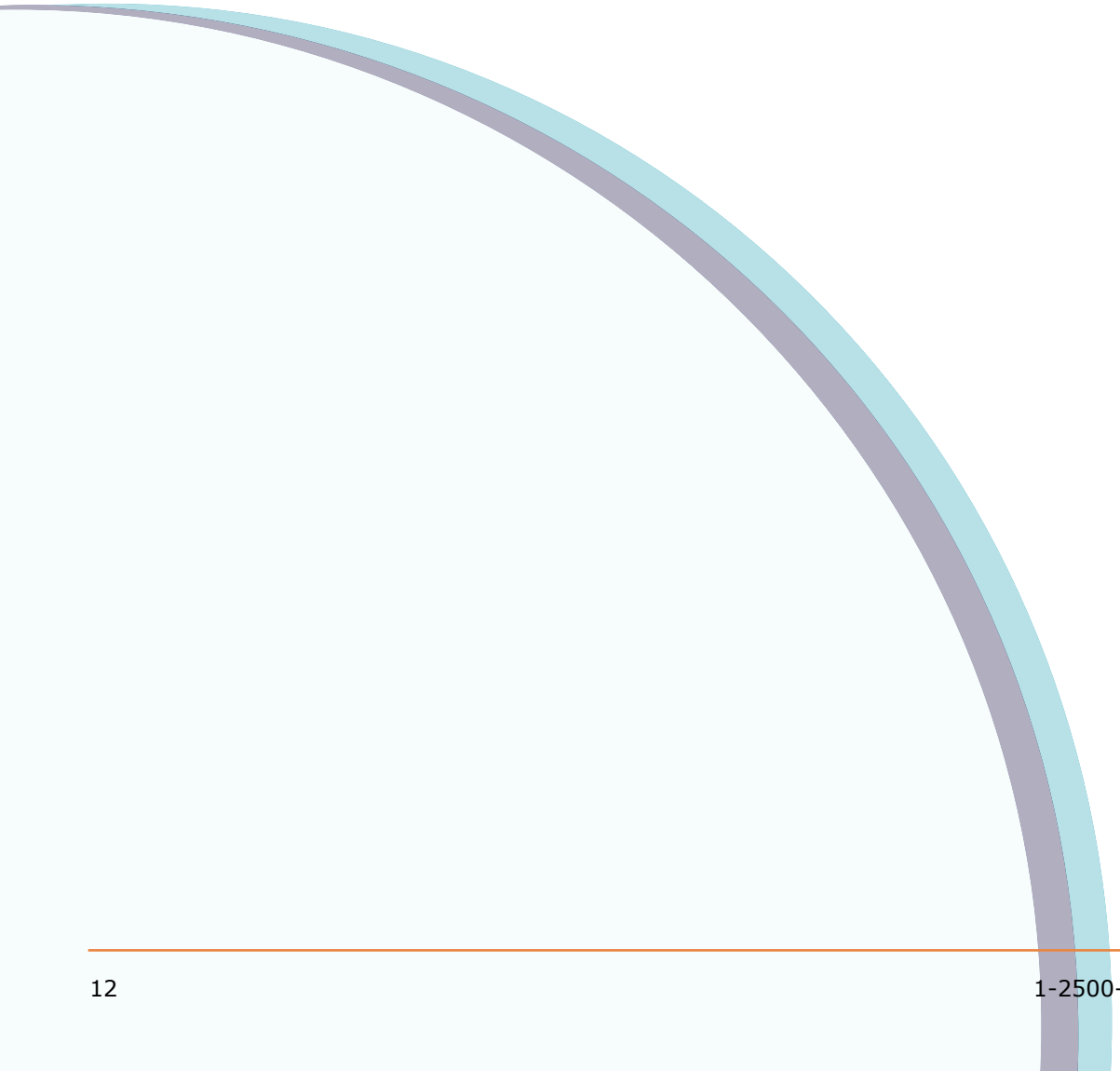
There is a single USB 2.0 type B female port on the rear panel for attaching a USB 2.0 cable to allow connection to the host computer's USB 2.0 port.

Digital Outputs

A DB 25-pin female connector is provided as an alternative way to access the software-controlled digital outputs. Note that only digital outputs 0–7 are supported in existing Molecular Devices software. See Appendix A: Specifications on page 13 for pin definitions to make your own cable.

DC-Power

The DC-POWER connector is for the supplied external power supply, which provides power through a universal input for voltages of 100 V–240 V AC, 50–60 Hz.



Specifications

A

Analog Inputs

Table A-1 Analog Inputs

Input Name	Description
Number of channels	16 (8 supported in pCLAMP 10 software)
Type of channels	single-ended
Resolution	16-bit, 1 in 65536
Sample rates per channel	1 Hz to 250 kHz
Input range	-10.000 V to +10.000 V
Input resistance	1 MΩ
Gain value	1
Digitization noise	< ±1 mV Avg (p-p)
Crosstalk noise	< ±1 mV Avg (p-p)

Analog Outputs

Table A-2 Analog Outputs

Output Name	Description
Number of channels	4
Resolution	16-bit
Sample rates per channel	1 Hz to 250 kHz
Output range	–10.000 V to +10.000 V
Output impedance	< 0.1 Ω
Output short circuit to signal ground	±25 mA

Digital Inputs

Table A-3 Digital Inputs

Input Name	Description
Input type	TTL compatible
START trigger	rising edge sensitive
TAG trigger	rising edge sensitive

Digital Outputs

Table A-4 Digital Outputs

Output Name	Description
Number of bits	16 (8 supported in software)
Output driver	advanced CMOS
(AC) compatible output current	±4 mA
SCOPE trigger	shared bit

A DB 25-pin female connector is provided with pin assignments as listed in Table A-5: Pin Assignments.

Table A-5 Pin Assignments

Pin number	Digital Output
1	0
2	2
3	4
4	6
5	N/C
6	Analog ground
7	Analog ground
8	8
9	10
10	12
11	14
12	Analog ground

Table A-5 Pin Assignments (cont'd)

Pin number	Digital Output
13	Analog ground
14	1
15	3
16	5
17	7
18	Analog ground
19	Analog ground
20	Analog ground
21	9
22	11
23	13
24	Scope Output (or 15)[1]
25	Analog ground

1. Pin 24 is configured to mimic the front panel SCOPE output, through J213 on the main board with a jumper connecting pins 2 and 3. For use with third-party software, pin 24 can be reverted to the hardware's 16th digital bit (15) by jumpering pins 1 and 2.

Telegraph Inputs

Table A-6 Telegraph Inputs

Input Name	Description
Number of channels	4
Resolution	12-bit
Sample rates per channel	40 kHz
Input range	0 V to +10 V

DC Power

DC Power is supplied from an external power supply unit (PSU) with universal input.

Table A-7 DC Power

Voltage	Description
Voltage input rating for 1440A	15 VDC, 1.0 A
PSU voltage input	100 V–240 V AC, 50–60 Hz
PSU voltage output	15 VDC, 2.0 A
PSU voltage output rating	30 W Max

Functional Checkout

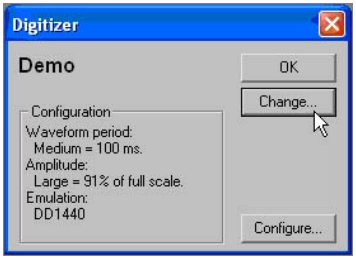
The Functional Checkout procedure provides step-by-step instructions to verify signals.

Step 1

If you are able to configure the Digidata® 1440A Digitizer in the software, then the digitizer is properly installed in Windows.

To configure the digitizer for AxoScope or Clampex:

1. Click **Configure > Digitizer**.
2. If Digidata 1440 Series is not displayed:
   - Click the **Change** button.



   - In the **Change Digitizer** dialog select Digidata 1440 Series from the **Digitizer Type** list.

- Click the **Scan** button to detect the digitizer. The **Configuration** field changes from **Not present** to **Available** and the **OK** button is enabled.
- Click **OK** to exit this dialog.

3. Click the **Configure** button.
4. The Configure Digidata 1440 dialog displays the serial number of the device and the firmware version.
   - The serial number should match the number on the barcode label of the unit.
   - The Power-on Holding Levels section is used to set the voltage on the Analog Out channels at the time that the Digidata 1440A Digitizer is turned on. The initial Digital Out levels can also be set high or low by selecting the check boxes above the numbers corresponding to each digital output (selected means high, cleared means low). Attach an oscilloscope to each output to verify their levels, both prior to launching the software (AxoScope or Clampex) and after launching the software.

Step 2

Check that you have a USB 2.0 port in your computer.

1. Right-click **Computer** and select **Properties**.

   In Windows XP, right-click **My Computer** and select **Properties**.
2. Click **Device Manager**.

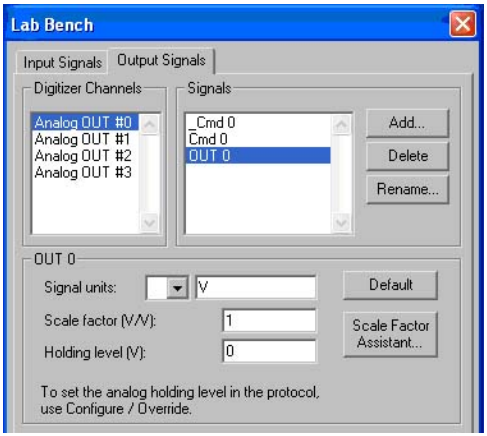
   In Windows XP, click the **Hardware** tab and then click **Device Manager**.
3. Expand the **Universal Serial Bus** controllers tree.
4. If you do not have an entry for **USB 2**, then look for **Enhanced PCI to USB Host Controller**. “Enhanced” is a key word indicating a USB 2.0 controller.

Step 3

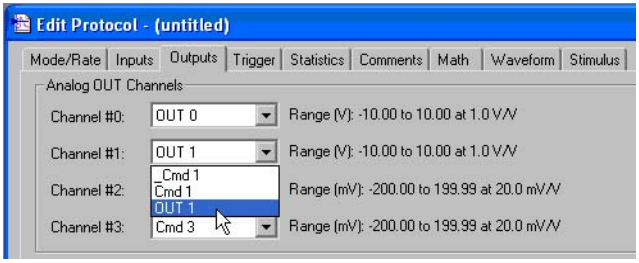
Verify analog and digital outputs.

With AxoScope or Clampex:

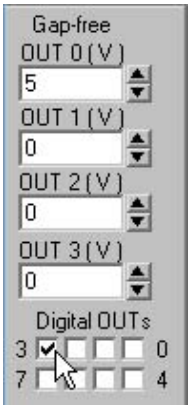
1.  Click the **Lab Bench** button (or click **Configure > Lab Bench**) and select the **Output Signals** tab. For each of the Digitizer Channels (for example, **Analog OUT #0**), select a matching **Signal** (for example, **OUT 0**), and configure that signal with unity scaling (for example, **Scale factor (V/V): 1**).



2. Set up a protocol through the **Acquire > New Protocol** menu command, and then on the **Mode/Rate** tab, select the **Gap-free** mode. On the **Outputs** tab, for each of the **Analog OUT Channels**, select the matching signal (for example, **OUT 1**) from its list.



3. Attach the digitizer's outputs to an oscilloscope or 10-bit DVM (digital volt meter).



4. For each output signal, use the software's **Real Time Control** panel to change voltage levels. For analog outputs, either use the spinners, or type a value and press the **Enter** key. For digital outputs, click on the box corresponding to the digital bit to be tested. Verify the output signal levels on the oscilloscope or DVM.

Step 4

Verify analog inputs.

With AxoScope or Clampex:

1. Click the **Lab Bench** button (or click **Configure > Lab Bench**) and select the **Input Signal** tab. For each of the **Digitizer Channels** (for example, **Analog IN #0**), select a matching **Signal** (for example, **IN 0**), and configure that signal with unity scaling (for example, **Scale factor** (**V/V): 1**).

2. Click the **Edit Protocol** button (or click **Acquire > Edit Protocol**) and then, on the **Inputs** tab, for each of the **Analog IN** Channels, select the matching signal (for example, **IN 0**) from its list.

3. Connect a BNC cable from the analog outputs to the analog inputs to be tested.

4. Click the **Record** button (or click **Acquire > Record**) to acquire data. For each analog output signal, use the software's **Real Time Control** panel to change voltage levels. Either use the spinners or type a value and then press **Enter**.

5.  Click the **Last Recording** button (or click **File > Last Recording**) to open the data file. Verify the input signal levels using the cursors in the window. To display a subset of the signals, right-click on the data display area, select **Properties**, and go to the **Show/Hide** tab.

Grounding and Minimizing Noise

To avoid ground-loops, Molecular Devices recommends that you plug in the Digidata 1440A Digitizer to the same power strip as the computer. Also, be aware that each Analog Input BNC on the Digidata 1440A Digitizer is a single-ended input (all BNC shells are connected to signal ground).

When noise in the system occurs, the first step is diagnosis. Take all instruments out of their racks, and connect to one of them with only ONE BNC connection. Observe if the hum (50–60 Hz noise) is eliminated. Also observe if the hum is produced from headstage pickup by shielding the headstage and watching the magnitude of the hum.

If the hum is eliminated at this step, then connect the second BNC cable. If hum is now observed, this is probably a ground loop that is picking up an alternating magnetic field. Next try to eliminate the source of the alternating magnetic field: a cheap transformer or an electric motor, such as found in a nearby fan or refrigerator. Try to rearrange the two BNC cables to determine if their positioning tells you anything about the source of the alternating field. High frequency components (20–50 kHz) might also appear if there is a ground loop. These can originate from the switching power supply of the computer, or from a monitor, and can be picked up in the analog signal inputs of the Digidata 1440A Digitizer.

If removing the source of the alternating field is not possible, eliminate the ground loop by constructing one of the connections between the two instruments without a shield. Make this either with a naked unshielded wire, or with a BNC cable that has its shielding cut at one end. Make a break in the shielding away from the interface, near the connection on the instrument suspected of creating the ground loop.

Additionally, the quality of the AC power should also be checked. In particular, check for proper grounding of the outlets.

For users of Molecular Devices microelectrode amplifiers, more information regarding noise reduction procedures can be found in the user guides for the MultiClamp, Axopatch, and Axoclamp amplifiers.

Troubleshooting Problems and Solutions

This section provides specific troubleshooting advice on possible problems and their solutions.

Before contacting Molecular Devices Technical Support regarding problems, please review this section to see if you can address the problem yourself. For more information, see Contacting Support on page 25 for faster resolution of your problem.

Isolating the Problem

The first rule in troubleshooting the digitizer or your software is to isolate the problem.

1. It is best to simplify your software configuration by turning off all other programs. It might appear that there are no other programs running in the background, but this might not be the case. To see if other programs are running in the background, in Windows, click on an empty place on the desktop and then press **Ctrl+Alt+Del** (holding these three keys down at the same time) and then select **Task Manager**.
2. On the **Applications** tab, close all unnecessary programs. Note that virus checkers and automated Internet accesses can also affect system performance.
3. Disconnect all external instruments and test the digitizer/computer combination by itself.
4. Next, swap the unit with a known good unit to help determine whether the problem is with the digitizer or the computer.

Power light on the front panel is off

Check the power supply to make sure that all cables are firmly attached, as well as the USB 2.0 cable to the computer.

Ready light on the front panel flashes continually during operation

The Digidata 1440A Digitizer is in a problem state. Call Technical Support at Molecular Devices for a Service Request (SR) number before returning the unit for repairs.

Problems with analog or digital outputs

Check the **Lab Bench** and protocol. Use a voltmeter or oscilloscope to examine the output signals.

Note: Oscilloscopes can potentially introduce unwanted ground loops and noise.

Problems with analog or digital inputs

Check the **Lab Bench** and protocol. Connect a known signal source to an analog input, such as a signal generator, or even the digitizer's analog output, if you know it is working properly.

Screen shows a straight line instead of the input signal

- Check if all external connections are properly made.
- Swap BNC cables to check BNC cables for continuity problems.
- Make sure the USB cable is securely attached to both the computer and the interface box.

Screen shows a noisy signal that is a different shape than expected

Verify that the acquisition software is not configured for a demo digitizer (**Configure > Digitizer**). Demo mode reproduces a command waveform with added noise, or generates artificial spike trains.

Noise is introduced when the data is digitized

- Verify that the acquisition software is not configured for a demo digitizer (**Configure > Digitizer**). Demo mode either reproduces a command waveform with added noise, or generates artificial spike trains.
- If noise is added to the signal on the analog input, make sure that all cables are routed away from switching power supplies, power cords, monitors, or any other major sources of noise.
- Check for proper ground connections. See Grounding and Minimizing Noise on page 21 for more information on proper grounding practices.

Digitizer does not work properly

Digitizer does not work at all, it locks up the computer when doing certain operations, or it exhibits other strange behavior.

- Double check that you are using a USB 2.0 braided shielded cable. Improper shielding can lead to USB communication problems that manifest in a variety of odd behaviors, ranging from minor to severe.
- Reset the digitizer by turning it off and then back on. Then restart the computer.
- For Windows, reset the Windows registry digitizer settings back to the manufacturer defaults (**Start > All Programs > Molecular Devices > pCLAMP 10.x.x > Reset to Program Defaults**).
- Clear relevant registry items one at a time. Try items such as Digitizers, Clampex, AxoScope, pCLAMP 10, and Common Settings. However, note that for application program items, while any customized window settings will be lost, signal names and protocols are preserved.
- Run a check on the computer's hard disk file structure and RAM.
- Call Technical Support if the problem persists.

Data throughput problems

- If decreasing the number of analog input channels or the sampling rate improves performance, you likely have a data throughput problem. Verify that the digitizer is connected to a high-speed USB 2.0 port on your computer. See Instructions on page 7. If the digitizer is connected to a USB hub, remove any other devices connected to the hub.
- Try the digitizer on a faster computer. CPU speed is only one part of the equation. Other relevant components include hard disk speed, RAM speed, and front-side bus speed.
- To improve data-throughput related acquisition performance problems in Clampex or AxoScope, try the following:
  - In **Configure > Lab Book Options**, select **Never log any events**.
  - In **Configure > Program Options**, select **Disable screen saver during data acquisition**.

Contacting Support

Check the Support section of the Molecular Devices web site at www.moleculardevices.com/Support.html. A web-based "Knowledge Base" is maintained at this site. It contains product-specific questions and answers to many common issues.

If you still need to contact us, please first gather the information described below before contacting Technical Support. This information helps us to more quickly identify possible problems and known conflicts.

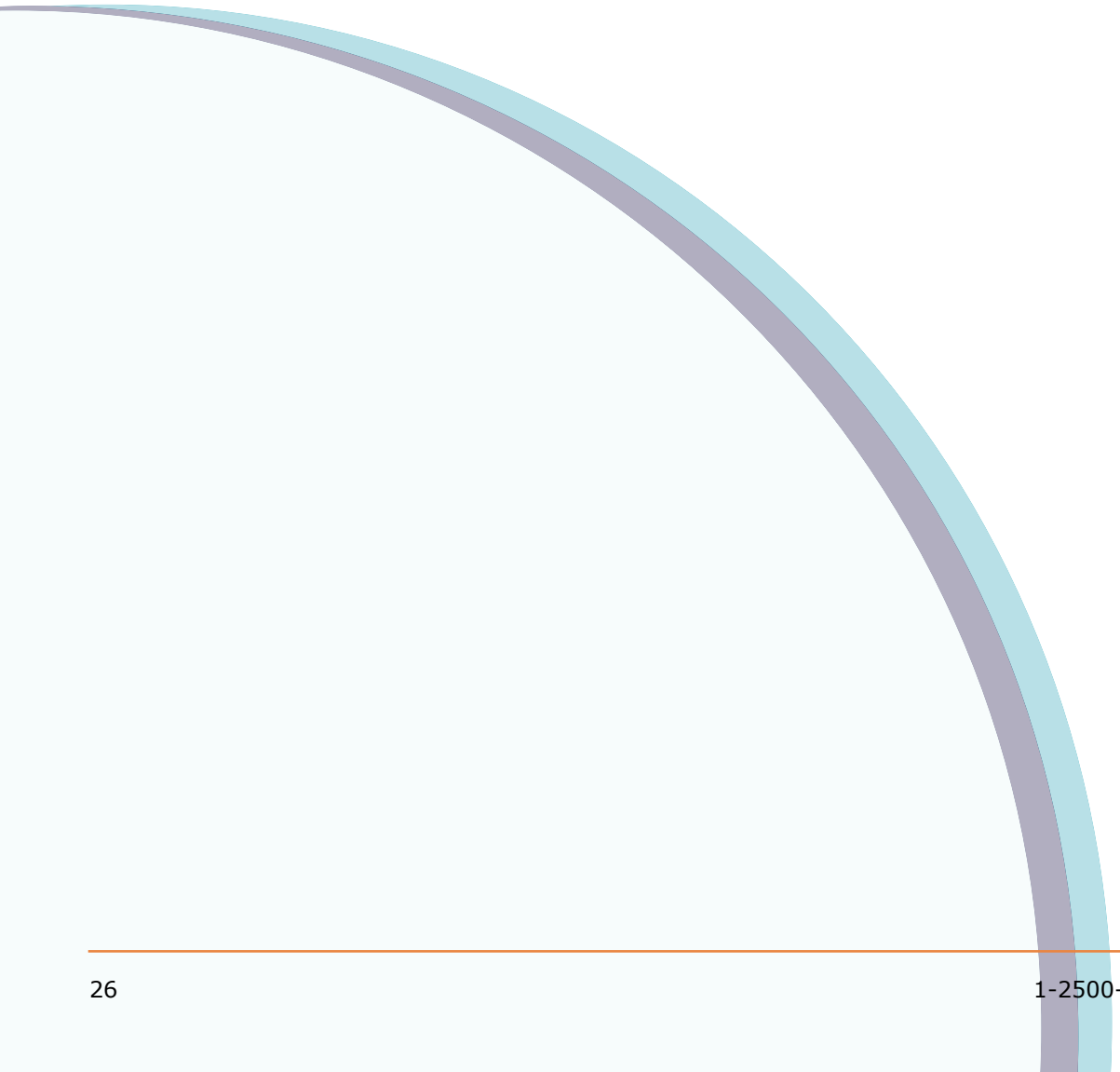
For more information, contact Molecular Devices Technical Support at 1-800-635-5577 (US only); elsewhere, contact your local representative.

Before you call

1. What is the model and serial number of the digitizer? The serial number is on a small barcode sticker on the digitizer's back panel.
2. What is the computer environment? This information is available in Windows if you right-click **Computer**, select **Properties**.

   In Windows XP, right-click **My Computer**, select **Properties**, and then click the **General** tab.

   - The brand and model of computer you use (for example, Dell Dimension 8300).
   - The speed (for example, 3.2 GHz) of the CPU.
   - How much RAM is installed (for example, 512 MB).
   - The specific operating system installed (for example, Windows XP Pro SP2).
3. The specific version of the application software running the digitizer (for example, Clampex 10.0.0.55).
4. Clampex users: connect Analog Out 0 to Analog In 0. Then run an Episodic mode protocol with a waveform specified. Do you see the waveform when you click the **View Only** button?
5. If you can reproduce a problem by following a series of steps, please write them down so that we can follow your exact steps.
6. Email us a copy of the protocol(s) and data file(s) that illustrate your problems. This helps in understanding and duplicating your problem.



Electromagnetic Compatibility (EMC)

C

REGULATORY INFORMATION FOR CANADA (ICES/NMB-001:2006)

This ISM device complies with Canadian ICES-001.

Cet appareil ISM est confomre à la norme NMB-001 du Canada.

ISM EQUIPMENT CLASSIFICATION (Group 1, Class A)

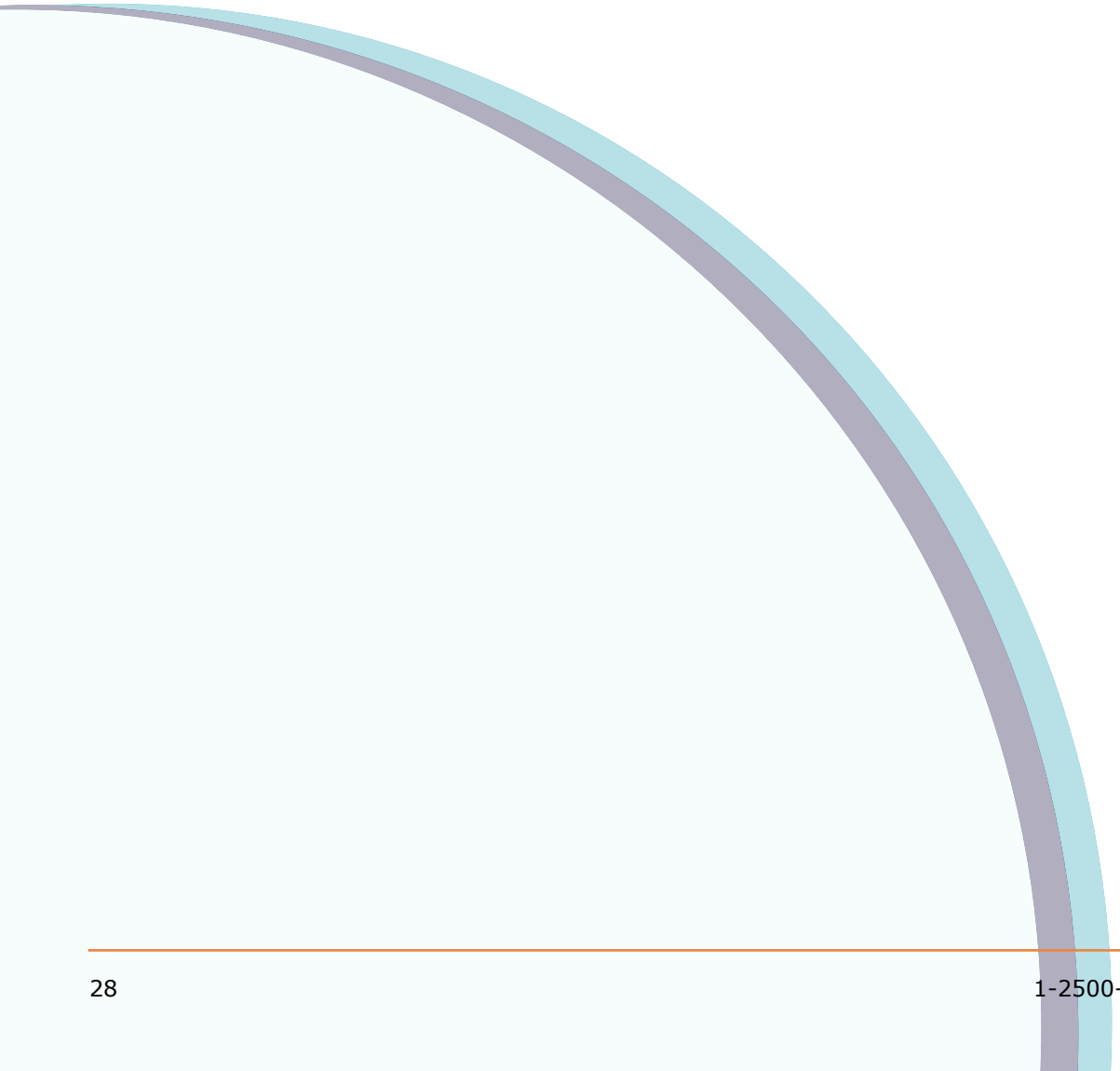
This equipment is designated as scientific equipment for laboratory use that intentionally generate and/or use conductively coupled radio-frequency energy for internal functioning, and are suitable for use in all establishments, other than domestic and those directly connected to a low voltage power supply network which supply buildings used for domestic purposes.

INFORMATION FOR THE USER (FCC NOTICE)

This equipment has been tested and found to comply with the limits for non-consumer ISM equipment, pursuant to part 18 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a non-residential installation. This equipment generates, uses, and can radiate radio frequency energy and if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

In order to maintain compliance with FCC regulations, shielded cables must be used with this equipment. Operation with non-approved equipment or unshielded cables is likely to result in interference to radio and TV reception. The user is cautioned that changes and modifications made to the equipment without the approval of the manufacturer could void the user's authority to operate this equipment.



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