

# The CED Micro1401 Owners handbook

Version 1.3

May 2000

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# The CED Micro1401 Owners Handbook

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# General information

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**Typographic conventions** The following conventions apply to the text in this manual:

- Ordinary text is in Times New Roman.
- Titles of chapters, other manuals and other publications are in *italics*.
- Labels and identifiers appearing on the equipment described in this manual are in Arial.
- Menu items, buttons, and other contents of computer displays are in *Arial italics*.
- Dialogue that you type in at a keyboard is in `courier new lowercase`. Names of keyboard effector keys are enclosed in angular brackets, e.g.: `<esc>`, `<enter>`.
- Names of files, drives, paths and directories are in Courier New.
- Signal names are in Times New Roman, SMALL CAPS.

**Use of symbols** Where applied, the following symbols have the meanings below:

 This symbol declares that the equipment passes the relevant clauses of EU directives on safety and EMC emissions; see the certificate reproduced on page 63.



Attention, consult accompanying documents.



The DC symbol indicates that the Power1401 chassis is powered from a DC-only supply.



The earth symbol indicates a metallic contact at mains earth potential.

**Potential for  
Radio/Television  
Interference**  
*(USA only)*

The Micro1401 generates and uses radio frequency energy and may cause interference to radio and television reception. Your Micro1401 complies with the Specification in Subpart J of Part 15 of the Federal Communications rules for a Class A computing device. These specifications provide reasonable protection against such interference in a residential installation. However there is no guarantee that interference will not occur in a particular installation. If the Micro1401 does cause interference to radio or television reception, which can be determined by turning the Micro1401 mains supply off and on, you can try to eliminate the interference problem by doing one or more of the following:

- Re-orient the receiving antenna
- Re-orient the position of the Micro1401 with respect to the receiver
- Move the Micro1401 away from the receiver
- Plug the Micro1401 into a different outlet so that the Micro1401 and the receiver are on different branch circuits

If necessary, consult CED or an experienced radio/television technician for additional suggestions. You may find the booklet, prepared by the Federal Communications Commission, helpful: *How to Identify and Resolve Radio/TV Interference Problems*. The booklet is available from the US Government Printing Office, Washington D.C. 20402, Stock no. 004-000-00345-4.

To comply with FCC rules, Part 15 J Class A Computing device, use only shielded interface cables.

**Life support** CED products are not authorised for use as critical components in life support systems without the express written approval of the chairman of the board of directors of CED.

Life support systems in this context are systems which support or sustain life, and whose failure to perform, when properly used in accordance with instructions for use provided, can be reasonably expected to result in a significant injury to the user. A critical component in this context is any component of a life support system whose failure to perform can reasonably be expected to cause the failure of the life support system, or to affect its safety or effectiveness.

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# Fast installation guide for experienced users

## USB

page 6

Power up & connect the Micro1401

- Windows 98, Windows NT 2000  
Insert distribution disk when prompted

## PCI

page 9

Plug the interface card into the computer

- Windows 9x, Windows NT 2000  
Plug'n'Play will autodetect – insert distribution disk when prompted
- Windows NT 4  
Install the driver – use *Start, Settings, Control panel, Add/remove programs*

## ISA

page 17

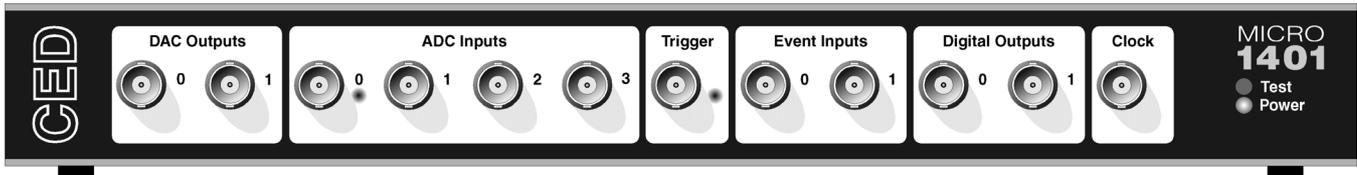
Plug the interface card into the computer

Adjust jumpers as required

- Windows 9x, Windows NT 2000  
Use Add New Hardware Wizard
- Windows NT 4  
Install the driver – use *Start, Settings, Control panel, Add/remove programs*

**Applications** Follow instructions supplied with disks

# Getting started with Micro1401



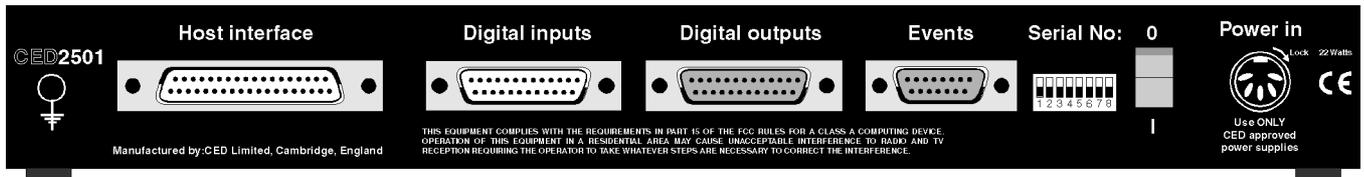
**Introduction** This manual will guide you through the initial check and installation of your Micro1401 (or  $\mu$ 1401 for short). It introduces you to the external inputs and outputs. It also describes maintenance and diagnostic procedures. This manual does not cover 1401 programming or the use of application programs with 1401.

- Checklist** The installation kit for your  $\mu$ 1401 comprises:
- A  $\mu$ 1401, with optional rack-mount kit
  - A power brick with attached DC supply cable
  - A power brick mains cable, suitable for your country
  - An interface card to adapt the  $\mu$ 1401 to your computer (unless you are using a USB port)
  - A suitable data cable to connect  $\mu$ 1401 and computer
  - An installation disk to allow you to install and check out your  $\mu$ 1401
  - This owners manual

**The power brick** The power brick will run with no adjustment on any mains voltage from 100V to 240V, 47-63 Hz, drawing a maximum of 0.8 Amps. It has no switch, being controlled by plugging in and switching on at the mains socket.

The rear-panel switch controls input of DC power from the power brick to the Micro1401. For complete electrical isolation, you must disconnect mains power from the power brick.





**Confidence check** Your Micro1401 was soak-tested at CED before shipping. To pass the test, a  $\mu$ 1401 must not generate a single error in at least 96 hours of testing. The next procedure checks that the 1401 hardware is in the same state as it left the factory.

Check that the DC switch on the back of the Micro1401, marked O/I, is off (position O). Connect the power-brick output plug to the DC Power In socket. Do not connect the data cable. Switch the  $\mu$ 1401 on. The green Power LED should light and stay on. The red Test LED should light for a few seconds while the yellow LEDs flicker. Test should then turn off. If this is not the case, turn to *Trouble shooting* on page 56.

### Installing the Micro1401

Once the Micro1401 has passed the confidence check, you should turn to the section which deals with installation for your computer and interface. The remainder of this section deals with general topics. The section starting on page 39 describes the signal inputs and outputs. Following sections deal with maintenance and troubleshooting.

### Storage and operating environment

The storage and operating environment for a Micro1401 must not exceed the temperature range  $-5^{\circ}$  to  $+50^{\circ}$  Celsius, in conditions of non-condensing humidity. Humidity should not exceed 95% saturation. The  $\mu$ 1401 is suitable for continuous operation. The  $\mu$ 1401 is not protected against ingress of water or dust. There are no hazardous voltages inside the  $\mu$ 1401. The  $\mu$ 1401 complies with relevant EU and USA requirements for electromagnetic interference.

At some point you will choose a permanent position for your Micro1401. It is happy in the same sort of environment that suits the host computer. The  $\mu$ 1401 normally stands on its base, but it will work on its side or upside down, if required.

**Application software** The Micro1401 requires application software to run it. Most customers will run CED application programs for the  $\mu$ 1401, such as Signal or Spike2, or products supplied by third parties. Alternatively, you may wish to write your own programs, with the help of the *1401 Language support for MS-DOS and Windows* library and your own computer programming manuals.

**Operating platforms** We support the 1401 family (including the  $\mu$ 1401) under Windows 9x, Windows NT 2000 and Windows NT 4. Much of CED's old MS-DOS software will run in a DOS box. Macintosh installations require System 7 or System 8.

**Installing CED application software** CED application software such as Spike2 or Signal is installed separately from the driver. Typically this is done by running *setup.exe* from a CD-ROM. The installation guide with the software will give more detailed instructions.

**Information on application programs** Technical information required to use CED application programs is contained in the software manuals. Technical histories of some of our programs, upgrade information, and in many cases downloadable files, may be found on the CED Web site: [www.ced.co.uk](http://www.ced.co.uk).

**Information for programmers** The 1401 language support kit, for users who wish to program their  $\mu$ 1401 from their host computer, includes the *1401 family programming manual* for detailed descriptions of the 1401 standard command library. The  $\mu$ 1401 command development kit includes the *Micro1401 technical manual*, which documents the  $\mu$ 1401's internal structure, and *Writing commands for the Micro1401* which deals with writing commands in C to run on the ARM™ processor.

**Circuit diagrams** Circuit diagrams for the Micro1401 can be made available for a fee. Purchasers must sign a non-disclosure agreement.

# Installation

---

**Overview** This section provides an overview on how to install a Micro1401 in an IBM PC or compatible, or Macintosh.

To install the Micro1401 you will need:

- A  $\mu$ 1401, power brick and mains cable
- A 1401 data cable, or else a USB cable
- A 1401 interface card (except for USB installations)
- Any tools needed to access the bus slots in your computer
- The CED 1401 installation disk

**Organisation of sections** The sections that follow deal with installing

- the PC USB interface
- the PC PCI interface
- the PC ISA interface and
- the Macintosh PCI interface

in that order. The instructions take you through the hardware part of the installation (making the physical connection between the  $\mu$ 1401 and your computer) and the software part (installing the 1401 device driver and utility programs). For PC interfaces, the three operating systems, Windows 9x, Windows NT 2000 and Windows NT 4 are covered in each section.

**Drivers** Having installed the hardware, you have to install the driver (the systems file that enables application software to communicate with the  $\mu$ 1401), and assign hardware resources (base address, interrupt and DMA settings). This process is largely automatic if your hardware is Plug'n'Play. ISA cards are not Plug'n'Play, and Windows NT 4 does not support Plug'n'Play. These cases require more care; in particular, clashes with other hardware have to be sorted out manually.

**Test and diagnostic utilities** A suite of test and diagnostic programs is available on the installation disk. They are of great use if something goes wrong, but not essential for normal operation. We describe the installation of these utilities after the sections on the hardware and drivers.

## Installing the USB interface

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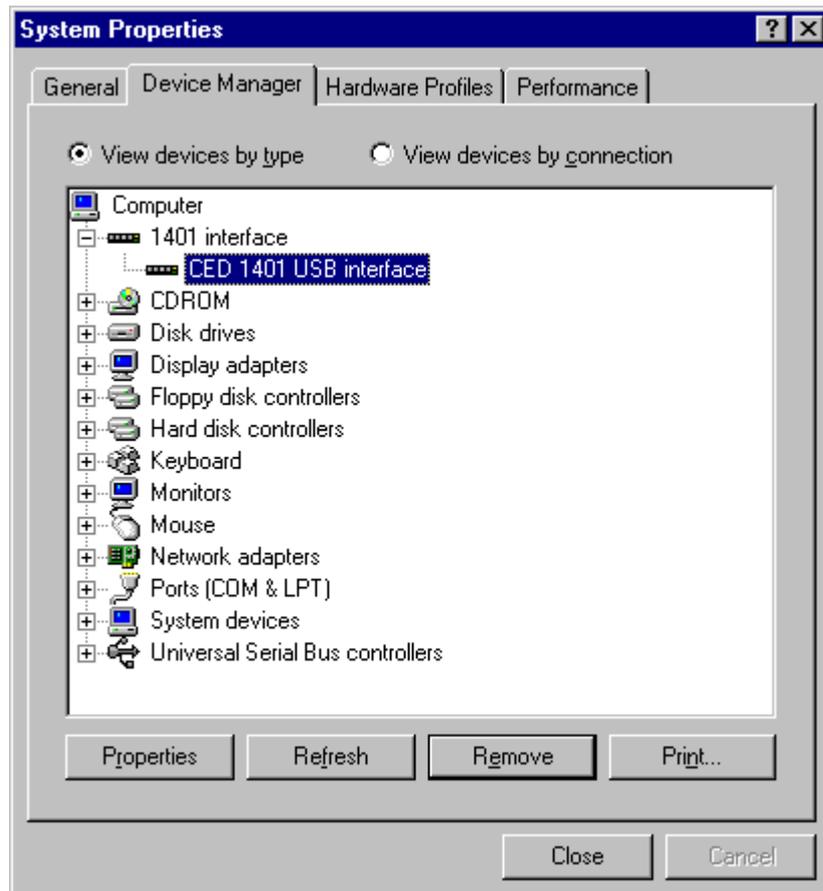
**Hardware installation** Micro1401s using the USB interface require a computer with a USB connector, but do not need an interface card. All you have to do is connect the USB cable between the computer and the  $\mu$ 1401. You must be running Windows 98 or Windows NT 2000 in order to use the USB interface.

**Installing the driver** With the hardware installed, you now have to install the device driver. We describe installation under Windows 98 first, then Windows NT 2000. Note that USB is not supported under Windows 95, Windows NT 4, Windows 3.x or DOS.

Device drivers are supplied on the 1401 support for Windows disk. Drivers can also be found in CED software directories, e.g. \Spike2\1401\Windrv, if you have already installed application software.

**Windows 98** After a Micro1401 has been plugged into a USB port, it will be detected automatically as soon as PC and  $\mu$ 1401 are both powered up. Windows 98 will announce that it has detected a new USB device and is looking for its driver. Unless 1401 support has already been installed for an earlier system, it will not find it. The ‘Add New Hardware Wizard’ will be invoked. Read the wizard’s messages, pressing the *Next* button as required. The wizard will ask you to insert the 1401 Support for Windows disk. The wizard will announce that it has found the CED 1401 USB software. Press the *Finish* button. When the USB driver has been installed, a *CED 1401* icon will appear in the Device Manager, but only when the Micro1401 is plugged in and powered up.

*System Properties,  
Device Manager tab*



**Tabs in Properties** *General* provides overall device status, and allows for enabling/disabling the device. *Driver* lists device driver usage and version information. It has the *Change Driver* button, used to load device driver upgrades.

**Windows NT 2000** The Micro1401 should be plugged into the USB port while both machines are powered up. The USB hardware will immediately detect the 1401 and Windows NT 2000 will announce that it has found a new USB device and is looking for its driver. Unless 1401 support has already been installed for an earlier system, the ‘Update Device Driver Wizard’ will be invoked. Read the wizard’s messages, pressing the *Next* button as required. The wizard will ask you to insert the 1401 support for Windows disk. The wizard will announce that it has found the CED 1401 USB interface software. Press the *Finish* button. When the USB interface driver has been installed, the  $\mu$ 1401 becomes a recognised USB device, and the *CED 1401* icon will appear in the Hardware Device Manager whenever the 1401 is plugged in and powered up.

**USB interface properties sheet** You can view the 1401 USB settings by selecting *Start, Settings, Control panel*, and click on the *System* icon. Select the *Hardware* tab and press the *Device manager* button. This reveals the hardware devices tree. The “1401 interface” icon will be on a node with a boxed +, indicating that a device is present. Click on this to display the “CED 1401 USB interface” icon. Opening this reveals only three tabs of the properties window: *General*, *Settings*, and *Driver*. You can reset the Micro1401 from the *Settings* tab.

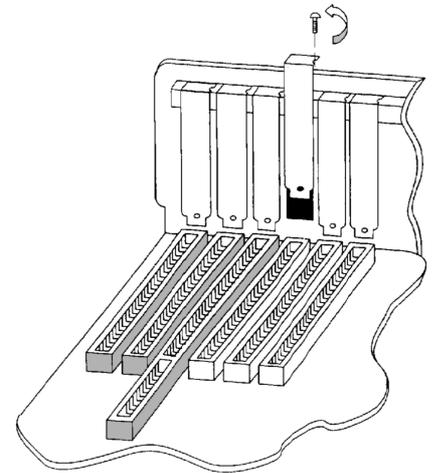
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## Installing the PCI interface

**PCI card installation** Remove power from your computer and clear a space round it; you will be taking off the cover in order to install the card. Follow the directions in your computer manual for installing option cards. Usually you will need to undo some screws and slide the cover off, to expose the slots where the interface card is fitted. Take precautions against static electricity: earth your computer to local mains earth, then earth yourself to your computer, preferably via a wrist strap.

Your interface card is the CED PCI interface (1401-60). See page 16 for technical details of this card.

1. Locate an unused slot. PCI cards need a (white) PCI slot.
2. Remove the blanking plate for your slot by undoing the securing screw. Keep the screw safe.
3. Offer the card to the slot and push it firmly home. Fix the metal bracket at the rear with the screw you saved, and replace the cover.



4. Now connect the 1401 data cable between the port at the rear of the interface card, and the Host interface connector at the rear of the Micro1401. The cable is reversible end for end.
5. Plug the DC power cable into the rear of the Micro1401.
6. Hardware installation is now complete.

**Installing the driver** With the hardware installed, you now have to install the device driver. We describe installation under Windows 9x first, followed by Windows NT 2000, then Windows NT 4. If you do need to install in Windows 3.x or DOS, please contact CED.

Device drivers are supplied on the 1401 support for Windows disk. Drivers can also be found in CED software directories, e.g. `\Spike2\1401\Windrv`, if you have already installed application software.

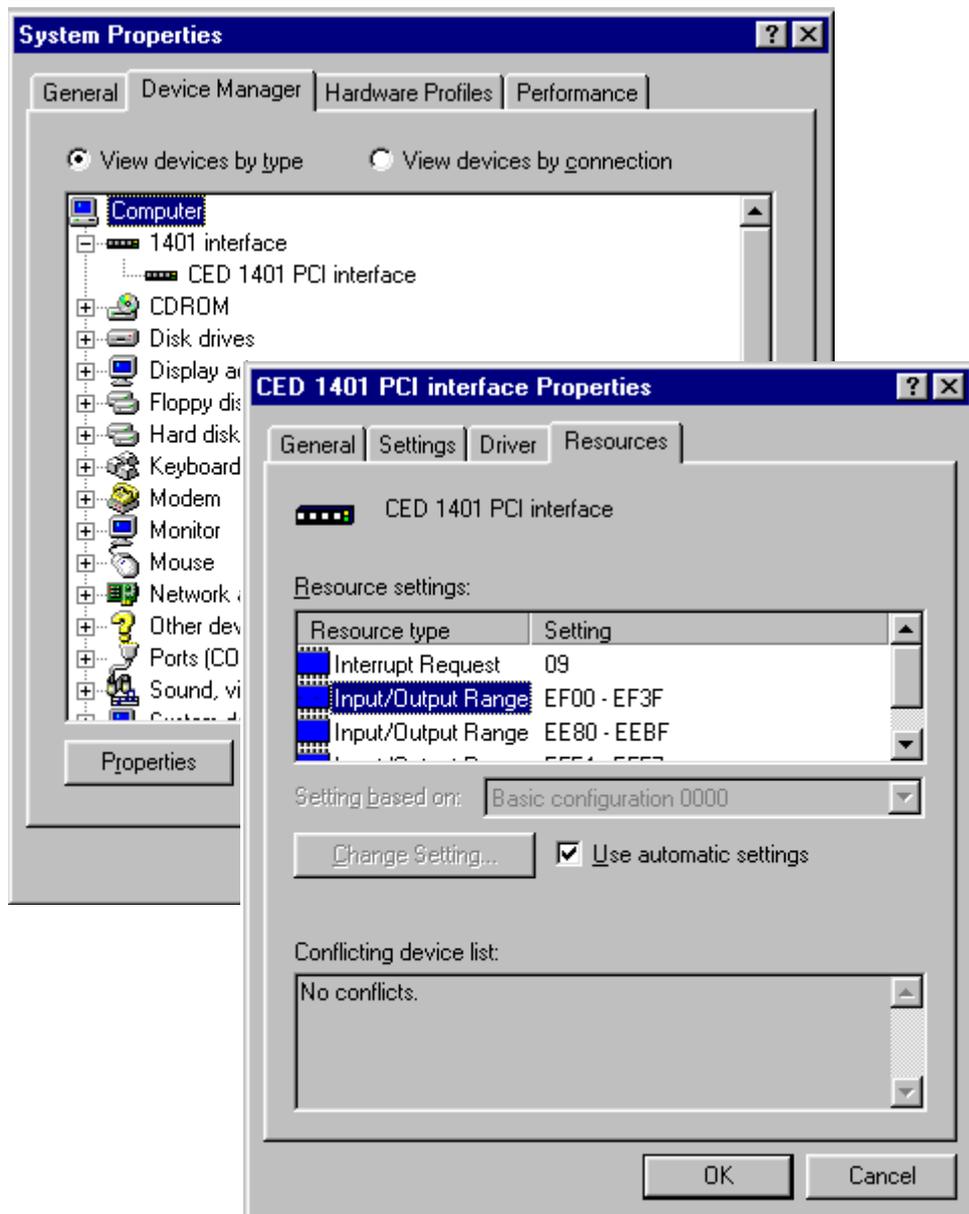
**Windows 95** After a 1401 PCI interface card has been fitted, it is found automatically when the PC is next powered up. Windows 9x will announce that it has detected a new PCI card and is looking for its driver. Unless 1401 support has already been installed for an earlier system, it will not find it. The 'Install New Hardware Wizard' will be invoked. Read the wizard's messages, pressing the *Next* button as required. The wizard will ask you to insert the 1401 support for Windows disk. The wizard will announce that it has found the CED 1401 PCI interface software. Press the *Finish* button. When the PCI interface driver has been installed, a *CED 1401* icon will appear in the System Device Manager.

**PCI interface settings** You can view the 1401 PCI interface settings by selecting *Start, Settings, Control Panel, System*.

A window opens with four tabs; select *Device Manager*. The *1401* icon will be seen among the installed-devices tree. The boxed + on the 1401 node means a device is present: click on it to reveal *CED 1401 PCI interface*. Select this, then click on the *Properties* button at the bottom of the window. A new window opens, with more tabs; select *Resources* to view interrupt settings and I/O block usage. If there are hardware resource clashes they will be reported. You can then tell Windows 9x to edit values automatically, or else do it manually until the clash disappears.

System Properties,  
Device manager tab

PCI interface  
Properties, Resources  
tab ➤



**Other tabs in Properties** You can reset the  $\mu$ 1401 from the *Settings* tab. *General* provides overall device status, and allows for enabling/disabling the device. *Driver* lists device driver usage and version information. It has the *Change Driver* button, used to load device driver upgrades.

**Windows NT 2000** A newly installed 1401 PCI interface card is detected automatically when the PC is next powered up. Windows NT 2000 will announce that it has detected a new PCI card and is looking for a driver. Unless 1401 support has already been installed for an earlier system, the 'Add New Hardware Wizard' will be invoked. Read the wizard's messages, pressing the *Next* button as required. The wizard will ask you to insert the 1401 support for Windows disk. The wizard will announce that it has found the CED 1401 PCI interface software. Press the *Finish* button. When the PCI interface driver has been installed, a *CED 1401* icon will appear in the Hardware Device Manager.

**PCI driver properties sheet** You can view the 1401 PCI interface settings by selecting *Start, Settings, Control panel*, and click on the *System* icon. Select the *Hardware* tab and press the *Device manager* button. This reveals the hardware devices tree. The "1401 interface" icon will be on a node with a boxed +, indicating that a device is present. Click on this to display the "CED 1401 PCI interface" icon. Opening this reveals the four tabs of the properties window, one of which is *Resources*. This lists the I/O blocks and interrupt use, and reports any clashes as each item is selected. There ought not to be any, since the PCI interface is Plug'n'Play. If there are, you can edit values with the scroll buttons until the clash disappears.

**Windows NT 4** After a 1401 interface card has been fitted, switch the PC on. Windows NT 4 is not a Plug'n'Play operating system, so you should therefore proceed as follows:

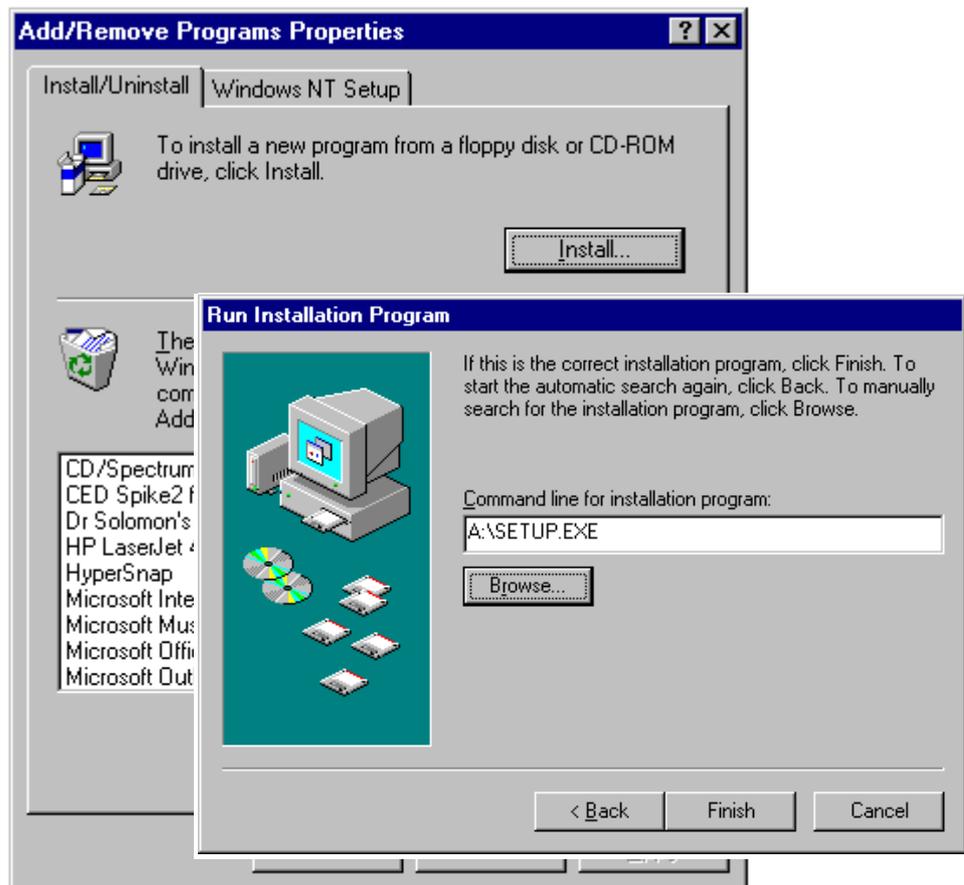
Select *Start, Settings, Control Panel*. Double-click on the *Add/Remove Programs* icon. Press the *Install...* button and select the *Install/Uninstall* tab. Windows NT 4 will invite you to insert a disk with the new software. Insert the installation floppy/CD-ROM and press the *Next* button. Select *setup.exe*, browsing if necessary, then press *Finish*. If you prefer, you can start installation by selecting *Start, Run*, and typing

a:\setup.exe or d:\setup.exe

depending on which drive you are installing from.

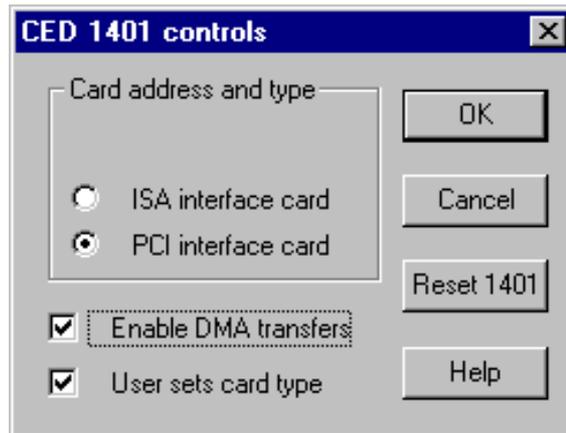
**Add/Remove Programs, Install/Uninstall tab**

**Run Installation Program >**



**1401 control panel** Setup will install the 1401 driver and any application software, and a Control Panel applet that is automatically run on installation. You must now tell the system that your 1401 interface is a PCI card: check the *User sets card type* box, then press the appropriate button. You can reset the Micro1401 from the Control Panel.

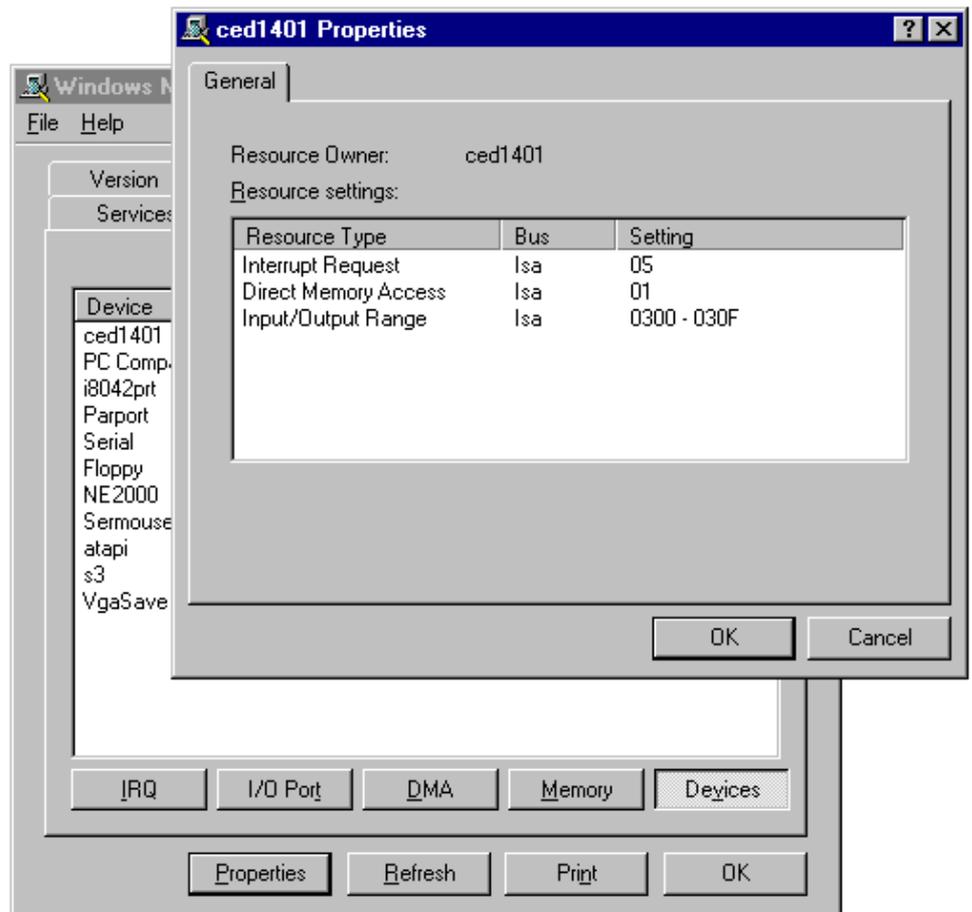
**1401 Control Panel Applet**



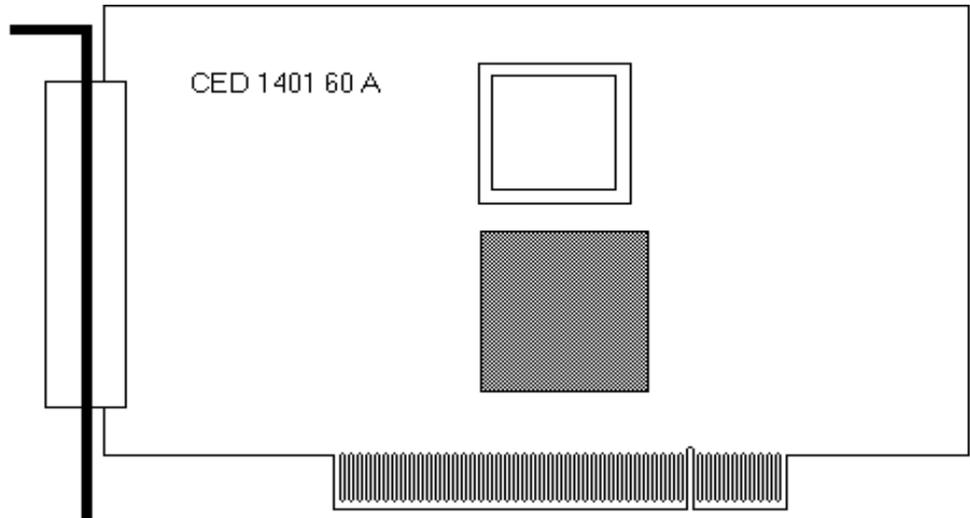
**Interface settings** To view the 1401 interface hardware settings, select *Start, Programs, Administrative Tools, Windows NT Diagnostics*.

A window opens with nine tabs; select *Resources*. This displays the I/O usage, DMA, interrupts etc. grouped in various ways. Press the *Devices* button at the bottom of the window. Select *ced1401* from the list that is displayed, then press the *Properties* button, also at the bottom of the window. The resource usage of the 1401 interface card is displayed.

**Windows NT  
Diagnostics**  
**1401 Interface  
Resource Usage** ➤



**The PCI interface card** The standard interface for the PCI bus is the 1401-60. This card has no hardware switches; its base address and interrupt are set up automatically by the device driver software.



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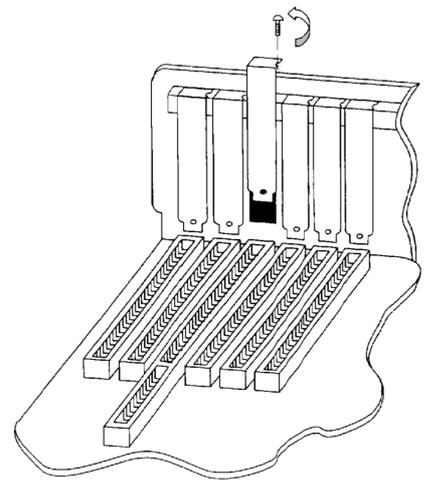
## Installing the ISA interface

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**ISA card installation** Remove power from your computer and clear a space round it; you will be taking off the cover in order to install the card. Follow the directions in your computer manual for installing option cards. Usually you will need to undo some screws and slide the cover off, to expose the slots where the interface card is fitted. Take precautions against static electricity: earth your computer to local mains earth, then earth yourself to your computer, preferably via a wrist strap.

Your interface card may be a standard ISA interface (1401-10), or a quad rate ISA interface (1401-50). See page 26 for technical details of these cards.

1. Locate an unused slot. ISA slots are black (as opposed to white PCI slots) and may be single, 8-bit connectors or double, 16-bit connectors. Either kind will do for our card.
2. Remove the blanking plate for your slot by undoing the securing screw. Keep the screw safe.
3. Check that the jumper settings are correct. Use the factory settings unless you know you need to change them. If you have changed an ISA card address, you must adjust the software; this is dealt with in the section describing installation of ISA interfaces. See page 28 for advice on checking jumper settings.
4. Offer the card to the slot and push it firmly home. Fix the metal bracket at the rear with the screw you saved, and replace the cover.
5. Now connect the 1401 data cable between the port at the rear of the interface card, and the Host interface connector at the rear of the Micro1401. The cable is reversible end for end.
6. Plug the DC power cable into the rear of the Micro1401.
7. Hardware installation is now complete.



**Installing the driver** With the hardware installed, you now have to install the device driver. We describe installation under Windows 9x first, followed by Windows NT 2000, then Windows NT 4. If you do need to install in Windows 3.x or DOS, please contact CED.

Device drivers are supplied on the 1401 support for Windows disk. Drivers can also be found in CED software directories, e.g. `\Spike2\1401\Windrv`, if you have already installed application software.

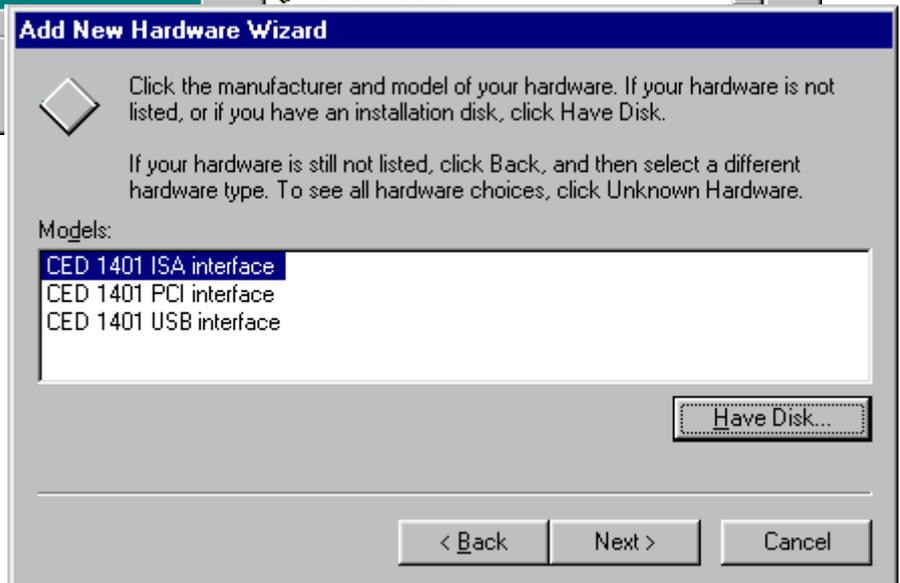
**Windows 95** After a 1401 ISA interface card has been fitted, switch the PC  
**Windows 98** on. Windows 9x will not detect the new hardware because ISA devices are not Plug'n'Play. You should therefore proceed as follows:

Select *Start, Settings, Control Panel*. Double-click on the *Add New Hardware* icon. Windows 9x will offer to search for the new hardware, but press *No* (and press the *Next* button as required.) A list of device types is displayed. Select *Other Devices*. A list of specific devices is displayed, but ignore it. Insert the 1401 support for Windows disk and press the *Have Disk* button.

**Add New Hardware Wizard**



**Add New Hardware Wizard, cont. >**



The following devices will be found and listed:

*CED 1401 ISA interface*

*CED 1401 PCI interface*

*CED 1401 USB interface* (not in Windows 95)

Select the ISA device driver and press *Finish*.

**ISA card jumpers** There are jumpers on ISA interface cards that set the interrupt vector, DMA channel and 1401 address. If you have changed the address from the standard 300 (see page 29) you will also need to set the address in the Device Manager.

**ISA interface settings** You can view the 1401 ISA interface settings by selecting *Start, Settings, Control Panel, System*.

A window opens with four tabs; select *Device Manager*. The *1401* icon will be seen among the installed-devices tree. The boxed + on the 1401 node means a device is present: click on it to reveal *CED 1401 ISA interface*. Select this, then click on the *Properties* button at the bottom of the window. A new window opens, with more tabs; select *Resources* to view interrupt settings and I/O block usage. The *Settings* tab provides for editing the base address in case you have altered the interface-card address jumpers. There is no provision for manual editing of clashes in *Resources*.

**Other tabs in Properties** You can reset the  $\mu$ 1401 from the *Settings* tab. *General* provides overall device status, and allows for enabling/disabling the device. *Driver* lists device driver usage and version information. It has the *Change Driver* button, used to load device driver upgrades.

**Windows NT 2000** After the 1401 ISA interface card has been fitted, switch the PC on. Windows NT 2000 will not automatically detect the 1401 ISA card. This is how you proceed:

Select *Start, Settings, Control panel*, and double-click on the *Add New Hardware* icon. Select the “Add/troubleshoot device” button on the window that opens. Windows NT 2000 will now insist on searching for Plug’n’Play hardware, which the 1401 ISA interface is not. Press *Next* to start the search anyway. Having failed to find it, it will now give you the choice of its searching for “legacy hardware” or your choosing hardware from a list. Choose the list. From the list, select “Other devices”, and press *Next*. Ignore the new list that opens, and press the *Have Disk* button.

**ISA driver installation,  
Windows NT 2000**



**The I/O base address** The installer sets a default I/O base address of 300. This matches the default address set by links on the interface card (see page 28 for details.) If you are using this default address, simply press *Finish* to complete the installation. If your card's address has been altered, e.g. to avoid clashes, the software I/O address must be set to the correct range before installation. Changes to interrupt and DMA channel are dealt with automatically.

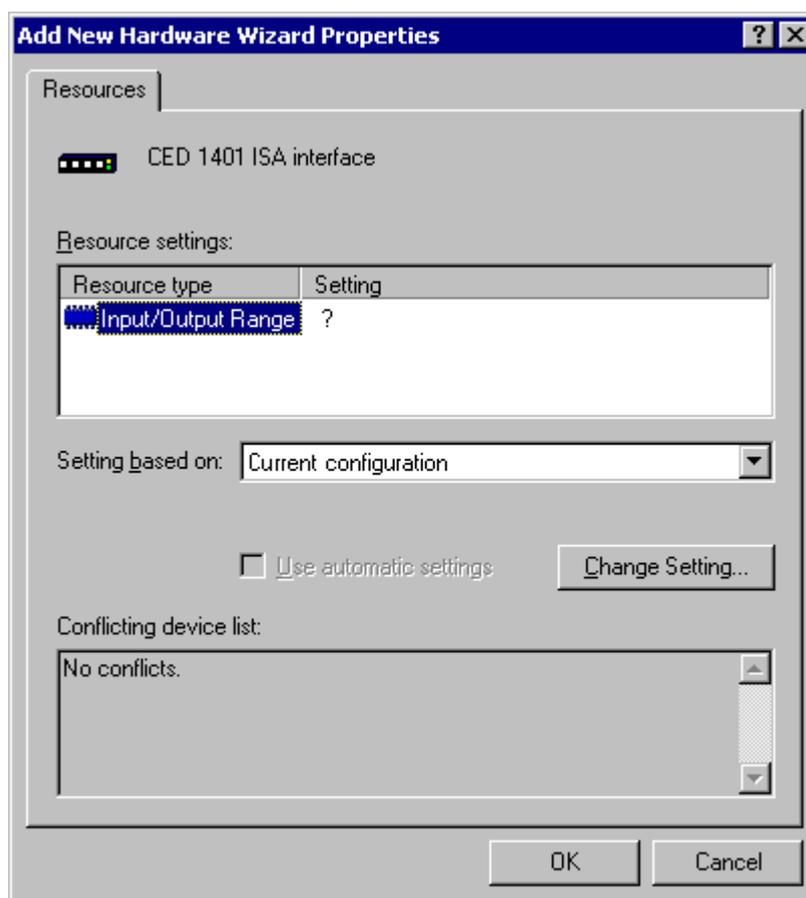
**Editing I/O base address on installation** If you have altered the I/O base address on the card, press the *Resources* button to inspect the base address. Now click on *Set configuration manually*. Select "Current configuration" from the drop-down list. This initially is empty; select "Input/Output range" and then press *Change Settings*. Using the scroll buttons, step the address range to the value set by the jumpers. Press *OK* as required, and *Finish* to complete the installation.

**In case of failure** If the device driver fails to install, it may be that there is a resource conflict, i.e. the resources assigned in software do not match the hardware, or else the hardware settings are already in use. You will need to check the link settings on your hardware (see details on page 26 onward) and your system resource settings, before adjusting the jumpers and changing the Input/Output address range as required.

**Viewing resource settings in Windows NT 2000** You can view the 1401 ISA interface settings by selecting *Start, Settings, Control panel*, and clicking on the *System* icon. Select the *Hardware* tab and click on the *Device manager* button. This reveals the hardware devices tree. The "1401 interface" icon will be on a node with a boxed +, indicating that a device is present. Click on this to display the "CED 1401 ISA interface" icon. If the installation has failed, this icon will be marked with a yellow warning spot. Opening the icon reveals the four tabs of the properties window, one of which is *Resources*. *If this tab is empty, or displaying an error message, it may mean that there is a resource clash!* You should inspect the resource usage of other devices, especially other ISA devices, and figure out a base address and interrupt that do not clash.

Two devices sharing a DMA channel, though undesirable, is not regarded as a clash (see *DMA channel*, page 28.) Note also that, for historical reasons, interrupt 2, one of the options on a CED ISA interface, is mapped onto and will be displayed as interrupt *request 9*.

### ISA resources, Windows NT 2000



**Resolving clashes** Switch the computer off, and adjust the ISA interface hardware, following the advice given on page 28. As mentioned above, interrupt and DMA hardware settings are accommodated automatically, but alterations to the base address have to be set manually in “Current configuration”. Go to Hardware Device Manager, 1401 Resources, as described above, and then proceed to “Set configuration manually” as described in *Editing I/O base address on installation*. All being well, the interface should immediately spring into life!

**Windows NT 4** After a 1401 interface card has been fitted, switch the PC on. Windows NT 4 will not detect the new hardware. You should therefore proceed as follows:

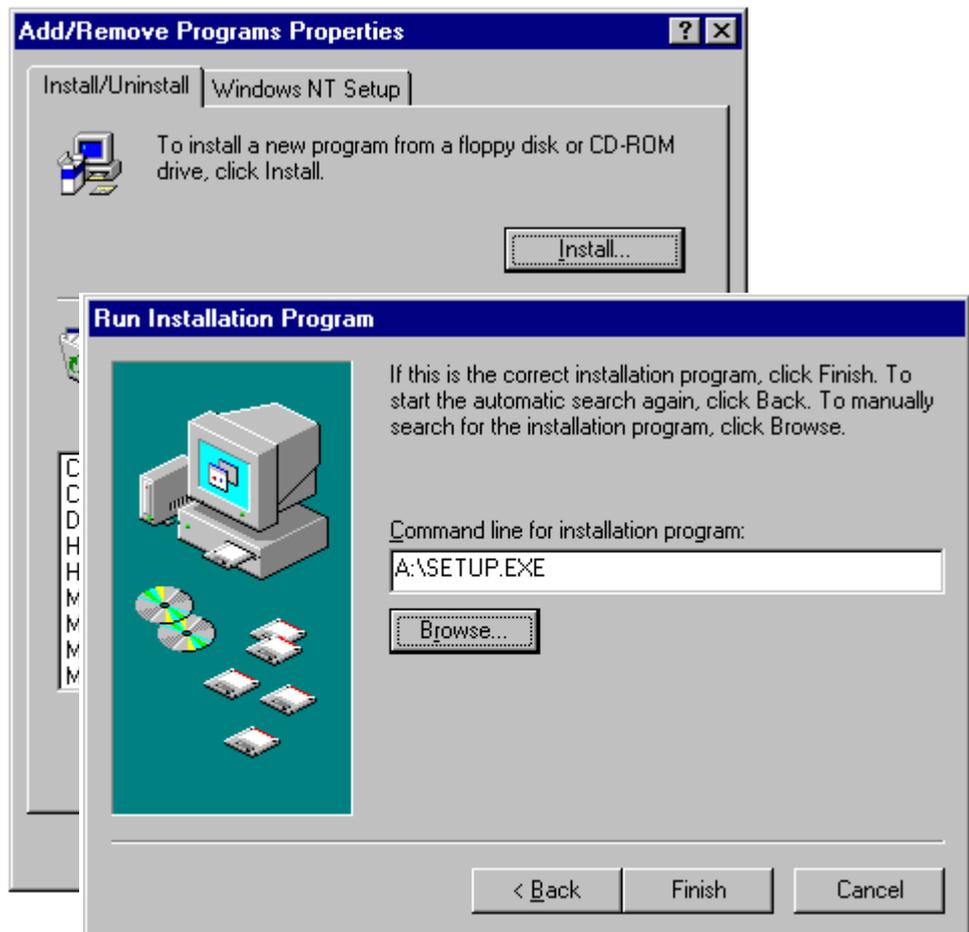
Select *Start, Settings, Control Panel*. Double-click on the *Add/Remove Programs* icon. Press the *Install...* button and select the *Install/Uninstall* tab. Windows NT 4 will invite you to insert a disk with the new software. Insert the 1401 support for Windows disk and press the *Next* button. Select *setup.exe*, browsing if necessary, then press *Finish*. If you prefer, you can start installation by selecting *Start, Run*, and typing

a:\setup.exe or d:\setup.exe

depending on which drive you are installing from.

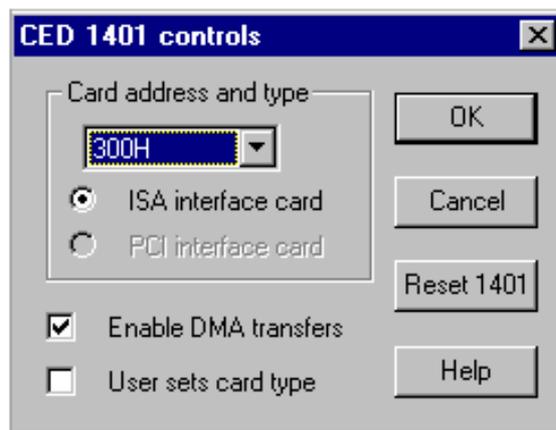
*Add/Remove Programs, Install/Uninstall tab*

*Run Installation Program* ➤



**1401 control panel** Setup will install the 1401 driver and any application software, and a Control Panel applet that is automatically run on installation. You must now tell the system that your 1401 interface is an ISA card: check the *User sets card type* box, then press the appropriate button. You can also set the base address if the address has been altered on the hardware. You can reset the Micro1401 from the Control Panel.

**1401 Control Panel Applet**

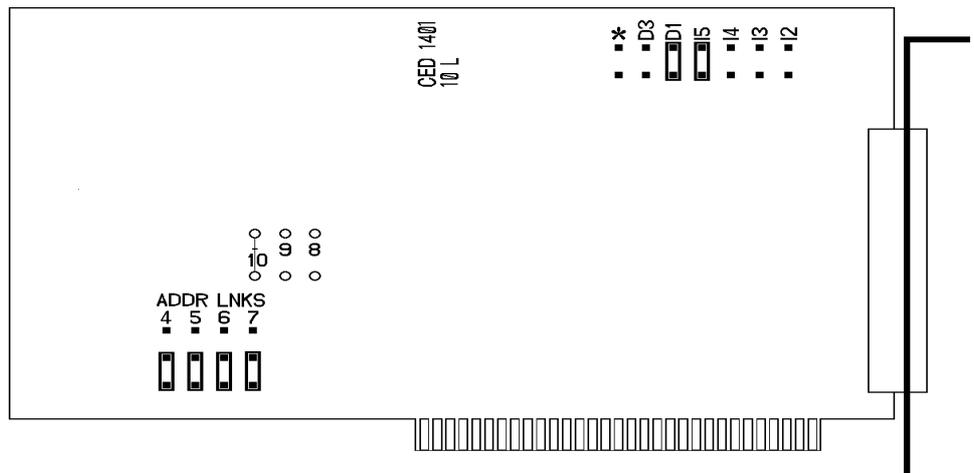


**Interface settings** To view the 1401 interface hardware settings, select *Start, Programs, Administrative Tools, Windows NT Diagnostics*.

A window opens with nine tabs; select *Resources*. This displays the I/O usage, DMA, interrupts etc. grouped in various ways. Press the *Devices* button at the bottom of the window. Select *ced1401* from the list that is displayed, then press the *Properties* button, also at the bottom of the window. The resource usage of the 1401 interface card is displayed.

**Types of ISA interface card** The standard interface for the ISA bus is the 1401-10; for faster ISA performance the quad rate 1401-50 may be used.

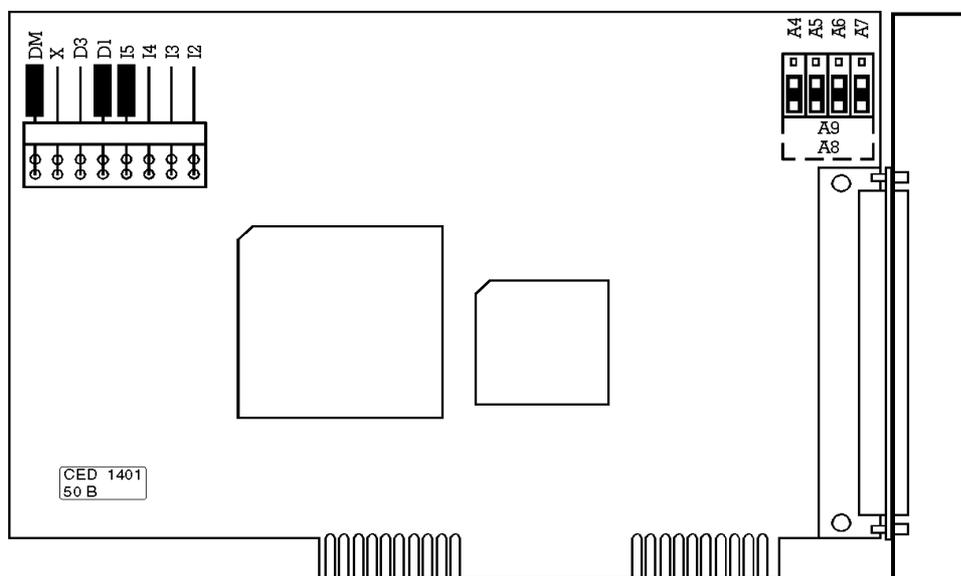
**1401-10L** The standard 1401-10 ISA interface card is currently at issue L. It is compatible with all PCs including Pentiums. There have been significantly slower earlier issues. If you ‘inherit’ one from an older system it is likely to fail to work correctly with a fast modern computer.



The interrupt vector and DMA channel are selected by jumpers at the top right of the card. A jumper in one of 12, 13, 14 or 15 selects an interrupt vector from 2 to 5. Similarly a jumper in one of D1, D3 or \* selects DMA channel 1, channel 3 or no DMA.

Bits 4 to 7 of the card address are set by jumpers on the ADDR LNKS field at lower left. The diagram shows jumpers set for address 300.

**1401-50B** The 1401-50 is a high-speed ISA interface card which can be used in place of the 1401-10. It makes use of the burst transfer Demand Mode available on the ISA bus.



The interrupt vector and the DMA channel are set by jumpers at the top left of the card. A jumper in one of I2, I3, I4 or I5 selects a vector from 2 to 5. A jumper in one of D1, D3 or X selects DMA channel 1, channel 3 or no DMA.

The DM jumper, when inserted, selects the high-speed Demand Mode on the ISA bus. The jumper should be left in, unless there are problems with the high-speed mode on your PC.

Bits 4 to 7 of the card address are selected by the jumpers at the top right. When the jumpers are in the lower position, as in the diagram above, the card is set for address 300.

**ISA interface hardware settings** The ISA interface cards are set at the factory to interrupt vector 5, DMA channel 1 and base address 300. Many systems will work correctly with these standard settings. You only need to read the following notes if you suspect these settings have caused a hardware resources clash.

**Interrupt vector** The 1401 software uses a hardware interrupt to make servicing the Micro1401 both fast and efficient. There are four vectors which can be used, numbered 2, 3, 4 and 5. The preferred vector is 5; see page 58 for advice if there are problems with this choice. Note that, for historical reasons, interrupt 2 is mapped onto and will be displayed as interrupt *request 9*.

**DMA channel** The 1401 device driver uses DMA transfers (Direct Memory Access) to move large blocks of data between Micro1401 and the computer efficiently. You can disable DMA if you do not have a free DMA channel. However, some CED applications, for example CHART and Patch continuous sampling, will not work without DMA. Other applications, including Spike2, work more efficiently with DMA. You can disable DMA by moving a card jumper, see page 26 onward.

You can use DMA channel 1 or 3. No standard hardware uses either of these. If you have special hardware in your computer (for example a tape streamer), check if it uses DMA. It is possible for two devices to share DMA channels so long as they do not use the same channel at the same time.

The Micro1401 only connects itself to the DMA logic in your computer when it transfers data, so it can share a DMA channel with the tape streamer so long as the tape streamer is also well-behaved. Ideally you should have a separate DMA channel for each device.

**Card address** It is unusual to need to change the address from the standard value of 300. The most common reason to change the address is to allow more than one 1401 to be connected to the same computer. Occasionally, an address clash with a different card can occur: beware of network cards and proprietary input cards.

**Changing the card address** The 1401 device driver can be configured to any of the 16 addresses of the form  $3n0$  where  $n$  takes any value from 0 to f. (This is a hexadecimal number, in which 10 to 15 are represented by the letters a to f.) Jumpers determine what value is added to 300 to form the base address. In the default position, they each have a value of zero. In the other position, jumpers 4, 5, 6, and 7 have the values 10, 20, 40 and 80, respectively. So, to set address  $3a0$ , for example, swap jumpers 5 and 7 from the default position to the other ( $300 + 20 + 80 = 3a0$ ).

Bits 8, 9 and 10 can also be altered, by cutting tracks and soldering links, but this is not supported in software.

If you must change the card address or the DMA channel, you will need to make adjustments to the software. Refer to earlier sections of this chapter for advice on how to do this under the various operating systems.

**Installing test & diagnostics** The Micro1401 installation disk includes utilities that verify correct installation of your  $\mu$ 1401, assist in re-calibrating the analogue system, and diagnose hardware problems. You must install the 1401 driver before installing the diagnostic software.

CED provides you with 1401 support for Windows, either as a CDROM containing two folders called `Disk1` and `Disk2`, or as two floppy disks labelled `Disk1` and `Disk2`.

If installing in Windows 9x or Windows NT 2000

- Insert either the CDROM or the floppy `Disk1`.
- Click on *Start*, *Run*, *Browse...* and choose the file `setup.exe` in `Disk1`.
- Click on *OK* and follow the screen instructions.

If installing in Windows NT 4

- The utilities were automatically installed at the same time as the driver.

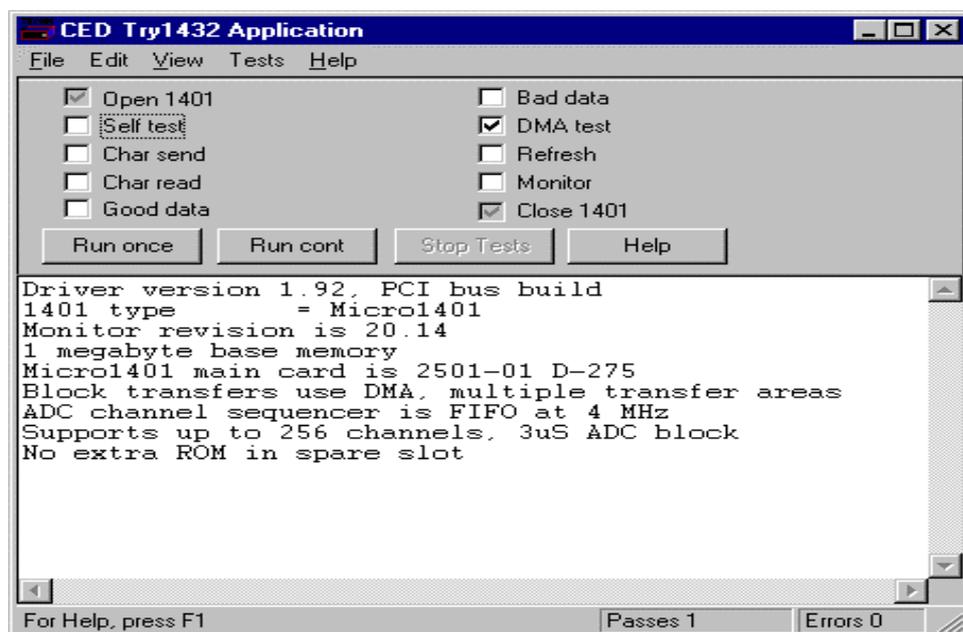
If the 1401 drivers on the 1401 support disk are newer than those on your system, `setup.exe` will update them.

**Location of software** You can choose where `setup.exe` copies the 1401 files. The usual destination is `c:\1401`. In this case, 1401 utilities are copied into the `\1401\utils` subdirectory together with a `readme.wri` file that lists all the new files. This manual assumes you have accepted that default. `\1401` itself is the directory where 1401 commands are installed.

**Windows diagnostics** The Windows installation copies several programs to \1401\utils that verify that your Micro1401 has been installed correctly, and to run diagnostic procedures.

**TRY1432** TRY1432 is the principal Windows 9x and Windows NT 2000 user test program. It is also installed as a utility in the program folders of CED applications such as Spike2 and Signal. It simulates a typical 1401 application program and exercises the host computer, interface card and Micro1401 in the same way.

*TRY1432 program screen*



To run TRY1432, select  
*Start, Programs, Test1401, Try1432.*

Running TRY1432 is self-explanatory. The check boxes allow different aspects of 1401 function to be tested separately. *Self test* causes the internal self-test hardware to run. Check this if the Test LED remains flashing after the  $\mu$ 1401 has been switched on. By clicking *Run cont*, the selected tests are run continuously, which can be useful for detecting intermittent faults.

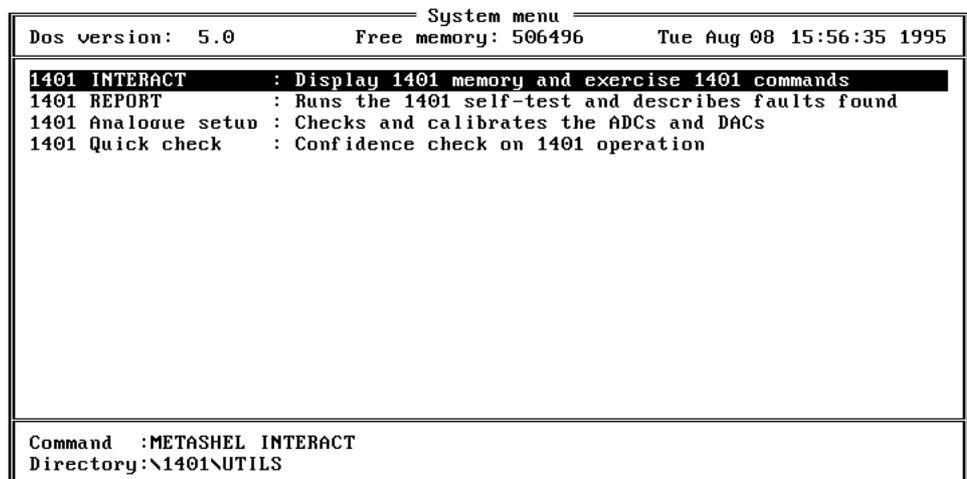
**TESTDAC** TESTDAC enables you to re-calibrate the Micro1401 analogue system and check the front panel connections, which the self-test cannot do. See page 52 for an overview of re-calibration.

**DOS diagnostics** The following DOS mode programs are also copied to the \1401\utils directory. They are there in case of dire emergency, such as your system crashing to the point where you have to run in DOS mode! Unless a CED technician asks you to run these DOS utilities, you should never need them.

**CEDMENU** CEDMENU is a DOS utility for running 1401 DOS mode test programs. Run CEDMENU by typing

```
cd \1401\utils <enter>
cedmenu <enter>
```

**CEDMENU screen**



Select a program with ↑↓, Enter to run or use Function keys  
F1 Help 2 [ ] 3 [ ] 4 Command 5 Path 6 Title 7 [ ] 8 [ ] 9 [ ] 10 Quit

**REPORT** *1401 REPORT* is the DOS mode equivalent of the *Self test* check box of the Windows TRY1432 application. To run REPORT, select it with the cursor keys and press <enter>. This program causes the  $\mu$ 1401 to run its self test and reports any failures. Satisfy yourself that the test runs several passes without error, then press <escape> to return to CEDMENU. If you encounter any problems, contact CED for advice.

**TRY1401** Select *Quick check* to run TRY1401. This utility simulates a typical 1401 application program and exercises the host computer, 1401 interface card and  $\mu$ 1401 in much the same way.

**Other diagnostic programs** The remaining programs on the disk, e.g. `testdig.exe` and `tevent.exe` are there to be run if CED asks you, to help diagnose any problems you may report.

## The DOS box

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**Running 1401 software in the DOS box** This installation manual does not cover application software written to run in DOS-only mode, or to run under DOS itself.

The final versions of old CED software written for DOS can usually access the 1401 while running in the DOS box under Windows. They detect the Windows environment and use the Windows 1401 device driver rather than the DOS driver. If you wish to run such applications in the Windows DOS box you must first install the Windows driver appropriate to your hardware, as described in previous sections of this manual.

Earlier versions of CED DOS software will generally not work in the DOS box or will work erratically. CED advises users to upgrade to the final version (often for free!) or purchase a newer product. Consult CED for details, in particular the *Updates* page on our website. Some CED software such as CHART and Patch continuous sampling will not operate correctly from the DOS box under any circumstances.

Compared with running under DOS, programs generally run more slowly in the DOS box in full screen mode, and much more slowly when run in a window, particularly if the programs use graphics mode.

**User programs in DOS** User-written DOS-mode programs that access the 1401 through CED standard libraries may operate in the Windows DOS box if they are rebuilt with the most recent library. Please contact CED for more information.

**Installing DOS drivers** If you need to run programs in DOS itself, you will have to install the DOS mode drivers. The program that does this is `install.exe`, which is stored on 1401 support for Windows floppy Disk2, or the `Disk2` folder of the CDRom. This manual does not cover DOS applications; please contact CED if you need more information.

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# Installing the Macintosh interface

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**Introduction** The CED Micro1401 is supported on Power PCs with PCI slots by the 1401-60 PCI interface card. On members of the Macintosh family that have a NuBus interface and a 68020 or higher processor, for example the Macintosh II family, most Quadra or Centris Macintoshes, and PowerMacs equipped with NuBus, it uses the 1401-30 NuBus interface card. The 1401-30 will also work with certain Macintoshes which have a PDS slot which, by means of a NuBus adaptor card, can take a 7 inch NuBus card, for example the Centris 660 AV, the Quadra 610 and the PowerMac 6100/66. Macintosh applications communicate with the  $\mu$ 1401 through a device driver and the interface card.

**Device driver** The device driver takes care of the low-level control of the  $\mu$ 1401. It is provided in the file `Driver1401PCI` or for the NuBus, `Driver1401`.

**1401 commands** When a  $\mu$ 1401 is powered up it runs a control program in an on-board EPROM. This holds some general purpose functions, called commands, which the host computer can tell the Micro1401 to run. Additional commands are stored on the host and are downloaded to the Micro1401 to provide new 1401 facilities, as required. The commands are stored in the host as Macintosh resources and are normally held in the file `1401Commands` in the system folder.

**Hardware installation** Turn off the Macintosh. Install the card. (Instructions can be found in the *Macintosh Owner's Guide* supplied with your computer.) Connect the 1401 data cable to the D-type connector on the back of the 1401 interface card. The other end of this cable plugs into the Host interface connector on the rear of the Micro1401. Hardware installation is now complete.

Particular care should be taken when installing a 1401-30 card into a NuBus adaptor card in a PDS slot, for example in a Centris 660 AV, a Quadra 610 and a PowerMac 6100/66. Plug the 1401 data cable into the interface card before you put the top on the Macintosh, and then ensure that the interface card is properly connected to the NuBus adaptor card. It can happen that when you plug in the data cable, the interface card comes out of its socket in the NuBus adaptor card.

**Software installation** There are two files on the 1401 Installation Disk for Macintosh that you must copy into the system folder before you can use the Micro1401. To install these files:

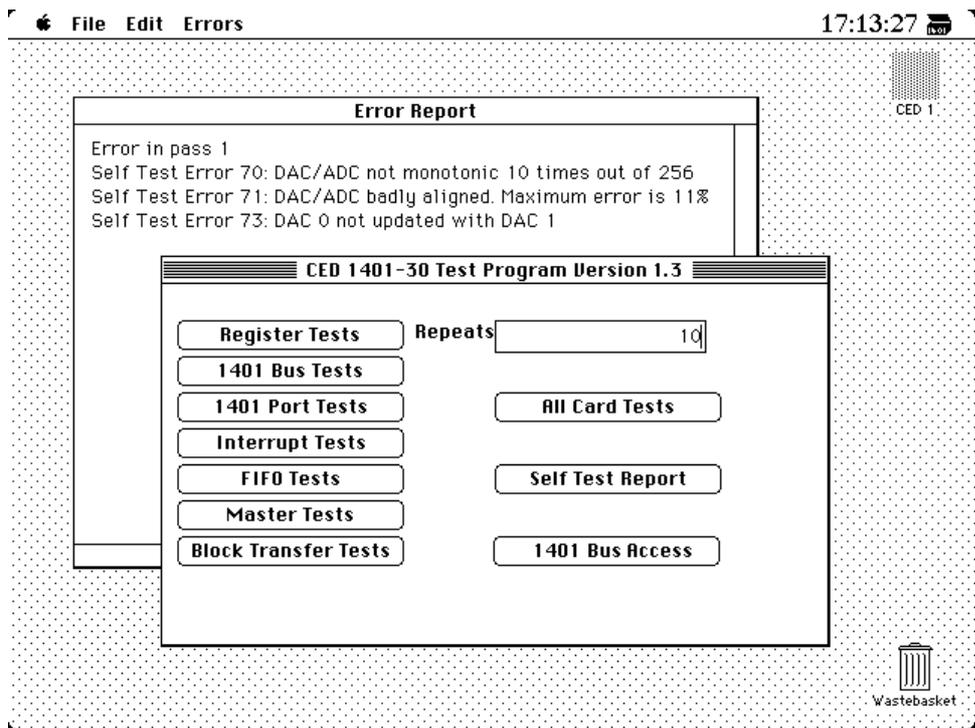
1. Insert the 1401 Installation Disk for Macintosh into the disk drive.
2. Drag the installation floppy disk icon to the icon of the hard disk containing the current System folder. This will copy all the files into a folder called `1401 driver` on your hard disk.
3. Open the hard disk icon, then open the `1401 driver` folder and the System folder.
4. Select the file `1401 commands` and drag it into the *open* System folder.
  - For PCI computers with the 1401-60 card, the driver is called `driver1401pci`. It must go in the `extensions` folder inside the System folder. Find the `extensions` folder and drag `driver1401pci` into it.
  - For NuBus computers with the 1401-30 card, the driver is called `driver1401`. It must go into the System folder. Drag the file into the System folder, NOT the System folder icon.
5. You must now re-start the Macintosh, which causes the driver to be loaded by the operating system, and makes it available to 1401 applications.

The `1401 Driver` folder should now contain a number of applications. You can double click the INTERACT icon to run your first 1401 application, to test the installation.

**TEST1401 interface test**

This application performs low-level hardware checks on the 1401 interface card to isolate installation faults and also can run the Micro1401 self-test to diagnose hardware problems. If you have a problem with your 1401 you may be asked to run this by our Hardware Help Desk to help them to isolate a fault.

*TEST1401 in use*



The program is intended to be self-explanatory. Select a test and run it. Any errors appear in the errors window. The picture shows the errors resulting from short-circuiting a DAC output to ground. These detailed error reports enable our staff to diagnose faults rapidly and accurately.

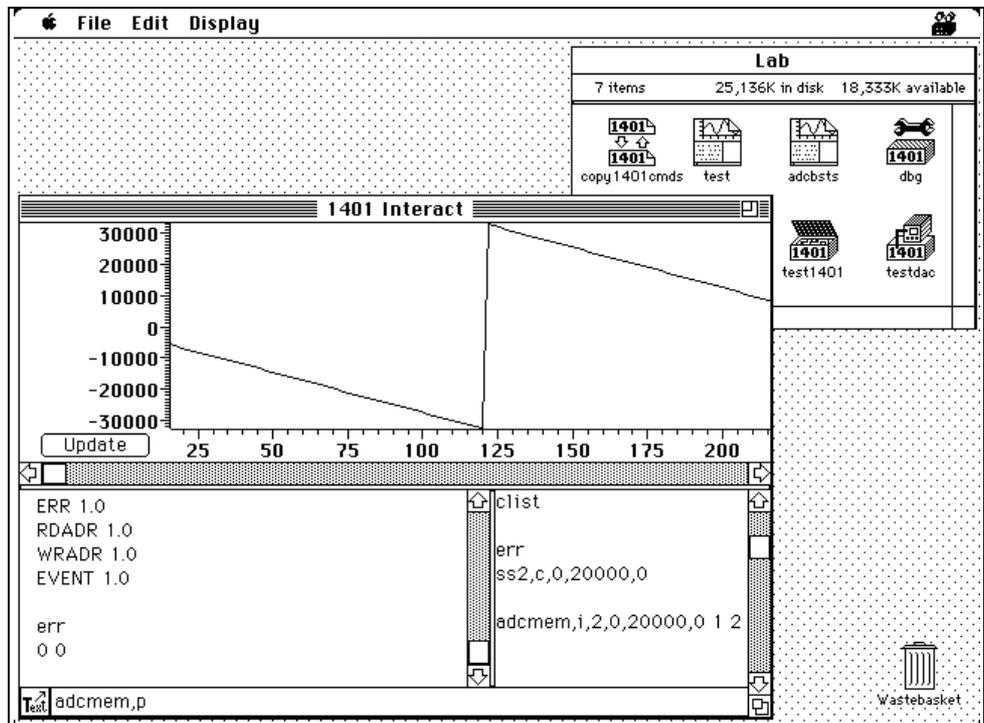
**The TESTDAC application**

This application is used to calibrate the ADC inputs and to align the DAC with the ADC. You do not need to open the Micro1401 to run this.

## The INTERACT application

This is a Macintosh application that allows you to load and run 1401 commands and to display Micro1401 memory. Application programmers may use it to try out ideas before writing them into a 1401 application.

### INTERACT in use



Text commands to Micro1401 can be typed in the bottom window of the screen (where the text `adcmem,p` is located). Press the `<enter>` key to send the text to the Micro1401. The window directly above this shows all text sent to the Micro1401 (for example `err`), and all responses (for example `0 0`).

The lower right-hand window is used to store commands to the Micro1401; here it holds `adcmem,i,2,0,20000,0 1 2`. Drag the Text icon at the lower left into this window to copy a command line to the store. Double click on the store to send the command to Micro1401.

Pull-down menu options allow you to configure the display of Micro1401 memory and load 1401 commands from disk.

# Inputs and outputs

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**General** These points relate to physical and electrical aspects of the Micro1401 connectors, rather than their electronic function.

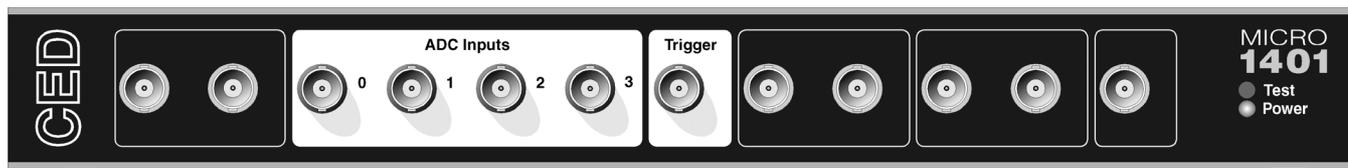
**Mains earth** The outer sleeves of the front-panel BNCs, and the metal shells of the various rear-panel connectors, are robustly connected to the metalwork of the case, and, via the DC-inlet earth pin and the earth lead of the power brick, to mains earth. All signal returns are tied to mains earth on the  $\mu$ 1401 PCB. Items of equipment connected to the  $\mu$ 1401 must not be regarded as isolated from mains earth, nor from each other.

**Front panel LEDs** All front-panel BNCs have adjacent yellow LEDs. These LEDs flash or blink to show appropriate activity, e.g. an ADC input LED lights when its channel is active; a DAC output LED flashes when its channel is updated; digital output LEDs will be lit when their bit is set. LEDs may light to prompt users to make connections. LEDs also flash in a characteristic manner on self test, see page 3.

The red Test LED lights to indicate self-test, and flashes if a hardware error has been detected. The green Power LED will turn off if any of the digital voltage rails drifts outside limits.

**Socketed chips** ICs connected directly to the outside world are susceptible to damage from electrostatic discharge or signal overload, though in practice this does not seem to happen very often. These ICs are fitted in sockets to allow you to replace them without recourse to unsoldering. All such chips are readily-available types; if ordering, remember to specify insertion, not surface-mount, style. See page 51 for opening the Micro1401 and page 53 for the location and identification of socketed chips.

**Connector diagrams** On the following pages, all rear-panel connectors are drawn as the user sees them, i.e. viewed from the outside. This is also the view of their mating connectors as seen while wiring them up.



**Waveform input** There are 4 waveform input channels on a standard Micro1401. These channels are available through front-panel BNC connectors, labelled ADC Inputs. The working input range of these channels is  $\pm 5V$ .

**Waveform channels** Waveform input channels are buffered through unity-gain amplifiers. Channels are then steered into the ADC (Analogue to Digital Converter) via a multiplexer. The input sample-and-hold is part of the ADC chip. The ADC converts an input voltage to a 12-bit digital value in approximately  $2.5\mu s$ . Conversions are inherently sequential, but channel 3 can be sampled simultaneously with any other channel if an optional second sample-and-hold has been fitted.

**Trigger** There is a front-panel input labelled Trigger. This can be set by software to be the external signal to start the ADC converting. The ADC external convert input is also permanently wired through pin 6 of the rear panel Events D-socket. Conversions are usually initiated by a high-to-low transition. External convert signals are used when the conversion time is determined by an external event, e.g. when synchronising conversions to the phases of a rotating machine. When operating in internally-triggered mode the ADC typically samples at a fixed rate set by one of the clocks.

**ADC LEDs** The front-panel waveform input channels each have an associated yellow LED. They are controlled purely by software command and turn on when the channel is in use.

**Trigger LED** The trigger-input LED flashes on detection of an active-edge transition at the Trigger input. The LED can be set by software to be either on or off during its quiescent state.

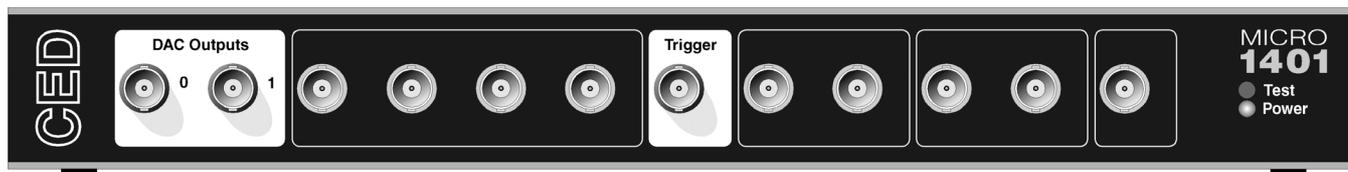
**Technical details:** The input impedance of the waveform channels is typically 1 M $\Omega$ . The waveform inputs expect to be driven from a low-impedance source (100  $\Omega$  or less); the output of most amplifiers is suitable. The maximum non-destructive input voltage range is  $\pm 15\text{V}$ . If you do overdrive the inputs, it is possible to damage the input buffer amplifiers. These chips are in sockets for easy replacement, see page 53.

**Analogue input**

**Trigger input** The front-panel Trigger input has diode clamp overvoltage protection and can safely accept signals in the range  $\pm 10\text{V}$ . This input is held internally to +5V by a 47 k $\Omega$  resistor and has input hysteresis: the low-going threshold voltage is set at 0.95V and the high-going threshold at 1.2V. To pull this input low, the driving device must be able to sink 100 $\mu\text{A}$ . Pulses driving the trigger input should be 1 $\mu\text{s}$  or longer.

The rear-panel ADC external-convert input responds to TTL and switch closure signals, and is held internally at +5V via a 10 k $\Omega$  resistor. Input pulses should not be narrower than 1 $\mu\text{s}$  and must fall below 0.8V for guaranteed recognition. This input is protected by a 100  $\Omega$  series resistor and diode clamps to +5V and ground; the safe range is 0V to 5V. Conversion is normally initiated on the high-to-low edge. Use of the other edge can be selected by switches, see page 54.

**The ADC** The input voltage is resolved into 4096 levels (12-bit precision); each step is approximately 2.5mV. Out-of-range voltages can cause amplifier saturation and should be avoided.

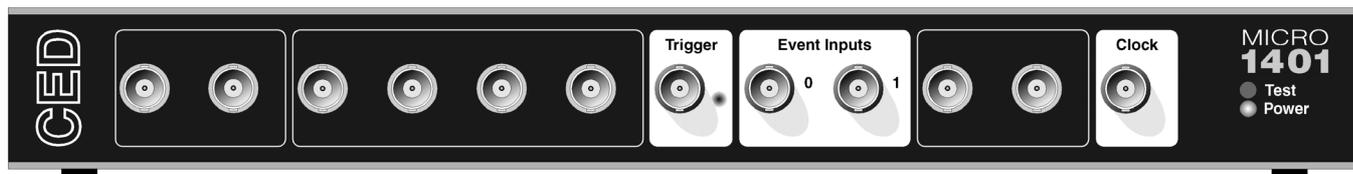


**Waveform output** There are 2 waveform output channels on the unexpanded Micro1401, available through BNC connectors on the front panel labelled DAC Outputs (Digital to Analogue Converters). The DAC waveform outputs produce voltages in the range  $\pm 5V$ , in steps of approximately 2.5mV.

The DACs can be set by program to update in response to an external signal, either the rear panel Event Clock F input, see page 45, or the front panel Trigger input, to synchronise the update rate to external equipment. When multiple channels of waveform are output, the  $\mu 1401$  can be programmed to update both DACs simultaneously. The maximum update rate is 250kHz.

**DAC LEDs** The front-panel waveform output channels each have an associated yellow LED. The LED turns on when the channel is in use.

**Technical details** The waveform outputs are designed for driving loads of 600 Ohms impedance or higher, and are short-circuit proof. For full accuracy, the load should not be less than 5 kOhm. The output amplifiers are fitted in sockets for easy replacement; see page 53.



**Clocks** The Micro1401 has five clocks, used for timing and counting external pulses (clocks 0 and 1), generating general purpose timing pulses (clock 2), controlling waveform output (clocks 3 and 4) and controlling the waveform input sampling rate (clock 4).

These clocks are managed automatically by the application software. You may need to drive a clock from an experiment, e.g. to trigger sweeps of waveform sampling. The front-panel Trigger input will be routed by software to the correct clock, to set it running on your signal.

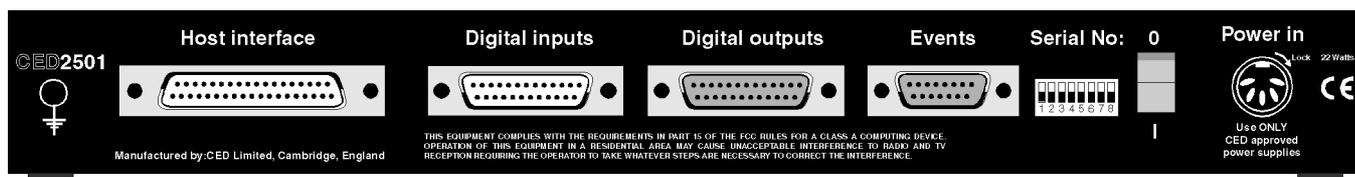
You may require the application to generate pulses to drive an experiment. The output of Clock 2 is available from the front-panel Clock BNC connector. The application manual describes this where it is relevant.

Where external signal pulses are to be timed or counted, the application program may use the front-panel Event 0 and Event 1 inputs. Pulses must be  $1\mu\text{s}$  or wider. If there are more than two such signals, the rear-panel Digital Inputs may be used, see page 48.

All clock frequencies are normally derived from an internal crystal oscillator. Users may sometimes need to take a timing source from outside the Micro1401 instead. All the clocks can be driven from an external frequency source via the Clock F input, pin 7 on the rear-panel Events socket (see page 45.) When you need to synchronise two 1401 machines, connect the 4MHz Clock output from one to the F input of the other.

**LEDs** The trigger and event-input LEDs flash on detection of an active-edge transition. These LEDs can be either on or off in the quiescent state, as set by software command, to indicate that the input is armed and expects to be used. The clock output LED simply indicates that Clock 2 is running, turning on whenever Clock 2 is enabled.

**Technical details** Event 0 and Event 1 have diode clamp overvoltage protection and can safely accept signals in the range  $\pm 10\text{V}$ . These inputs are held internally to +5V by 47 kOhm resistors and have input hysteresis: the low-going threshold voltage is set at 0.95V and the high-going threshold at 1.2V. To pull these inputs low, the driving device must be able to sink 100 $\mu\text{A}$ . Pulses driving these front panel inputs must be 1 $\mu\text{s}$  or longer. Clock is an output, driven by a 74HCT244 bus driver element which can source or sink 24mA; this chip is in a socket for easy replacement, see page 53.



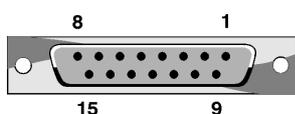
**Clock E inputs** More clock-related inputs, the Clock E series, are provided on the rear panel Events connector. These inputs provide close control of the clocks for people writing their own software. Full details are given in the *1401 family programming manual*, and the *μ1401 technical manual*. The front panel BNCs Event 0 and Event 1 are often assigned by software to the Clock E0 and E1 inputs.

**Technical details** Clock E and Clock F inputs respond to TTL or switch closure signals, and are held internally to +5V by 10 kOhm resistors. To pull these inputs low, the driving device must be able to sink at least 500μA; input pulses must fall below 0.8V to guarantee recognition. Clock E pulses should not be narrower than 100ns. Clock F frequency must not exceed 10MHz; pulses should be wider than 50ns. The working range of these inputs is 0 to +5V. They are protected by a 100 Ohm resistor in series with diode clamps to +5V and ground; the safe input range is ±10V. All chips associated with the Events I/O are in sockets for easy replacement, see page 53.

The 4MHz Clock output signal is buffered by a 74HCT14 Schmidt inverter element which can drive 10 LS TTL loads. 4 MHz Clock can be isolated from the rear-panel socket by a cuttable link, to help reduce EMI.

The sense of the Clock E and ADC external convert inputs may be inverted by a switch option, see page 54, but the inputs would all then be held active high if no input is connected.

**Events connector**



Pin	Signal	Pin	Signal
1	Clock E0 input	5	Clock E4 input
2	Clock E1 input	6	ADC external convert input
3	Clock E2 input	7	Clock F input for all clocks
4	Clock E3 input	8	4 MHz clock output
9 - 11	Ground	12 - 15	Ground



**Digital input and output** The Micro1401 has full 16-bit digital input and digital output available on rear-panel D-connectors marked Digital Inputs and Digital Outputs. Bits may be read or written singly, by low or high byte, or by the whole word. High-byte output bits 0 and 1 are also routed to the front-panel Digital Outputs, and, if enabled by software, high-byte inputs 0 and 1 are fed from the front-panel Event Inputs.

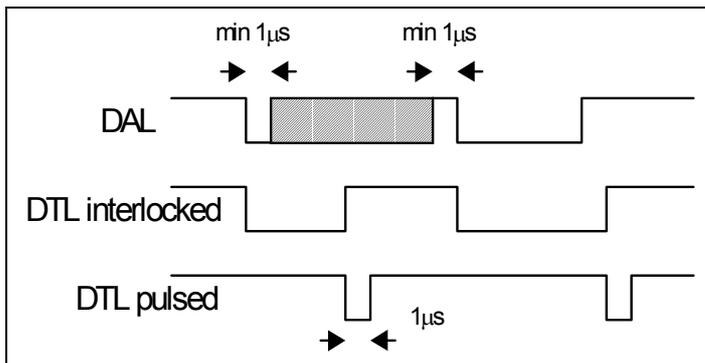
The input high byte can be programmed for detection and timing of change of state (i.e. any bit changing in either direction). Digital output can be gated with clock 2 so that it updates on clock 2 ticks. Digital output is normally permanently enabled, but if position 3 of the rear-panel switch is open (logic 1) the high-byte may be turned tristate-off by pin 11 of the output socket. If pin 11 is high or disconnected, the byte is disabled, i.e. tristate-off ; it is enabled if pin 11 is grounded.

**Digital I/O LEDs** Front-panel event-input LEDs flash on detection of active-edge transitions. The quiescent state is set by software command. Front-panel digital-output LEDs simply reflect the state of the bits, being lit whenever their bit is set (high).

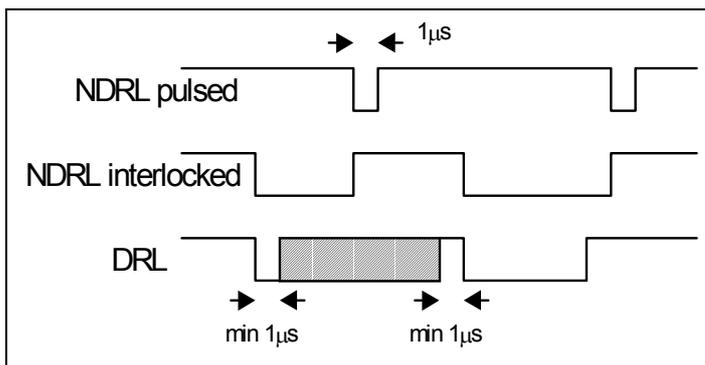
**Technical details** Outputs are buffered through a 74ACT373 (high-byte) or 74ACT374 (low-byte), which can source or sink 24mA. All digital I/O chips are socketed for easy replacement, see page 53.

Unconnected digital inputs read 1, being pulled internally to +5V by 4k7 (rear panel) or 47k (front panel). Input voltages of more than 2.0V will always read as a logic 1. To appear as logic 0, the input must be pulled down to below 0.8V for at least 1 $\mu$ s, which takes approximately 1mA (rear), 100 $\mu$ A (front).

**Digital I/O handshake protocol** Digital data transfer between the Micro1401 and external equipment can optionally be synchronised by pairs of handshake signals. There are separate pairs for each byte. The polarities of all signals can be independently set by software. The example that follows is typical.



When presenting data, an external device sends a pulse at least 1µs wide to the DAL (data available 0-7) input. When the Micro1401 reads the data the DTL (data transmitted 0-7) output line pulses for 1µs if in pulsed mode. If in interlocked mode, DTL is set by the Micro1401 read and cleared by the next DAL.



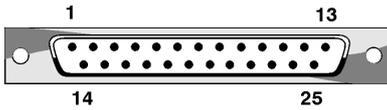
When Micro1401 writes data to the digital output, the NDRL (new data ready 0-7) output pulses for 1µs if in pulsed mode. If in interlocked mode NDRL is set by the data write and cleared by the answering DRL (data read 0-7) pulse, at least 1µs wide, from the external device.

**5 volt output and circuit breaker** There is a +5V output available on pin 25 of both the digital input and output ports. This output is internally protected by a 200mA circuit-breaker and is intended only to power one or two chips for interfacing purposes. The breaker is reset by removing power from the Micro1401.

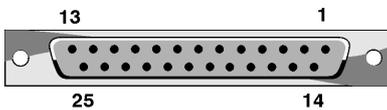
We have occasionally had problems with users who trip this protection very regularly. This is usually caused by a connector with a metal shroud being plugged into the digital input crookedly and the shroud touching pin 25, which causes overload. If you have this problem, the simple solution is to make this connection with Micro1401 switched off, or to use a connector with a plastic shroud.

**Digital I/O connectors**

**Digital Inputs**



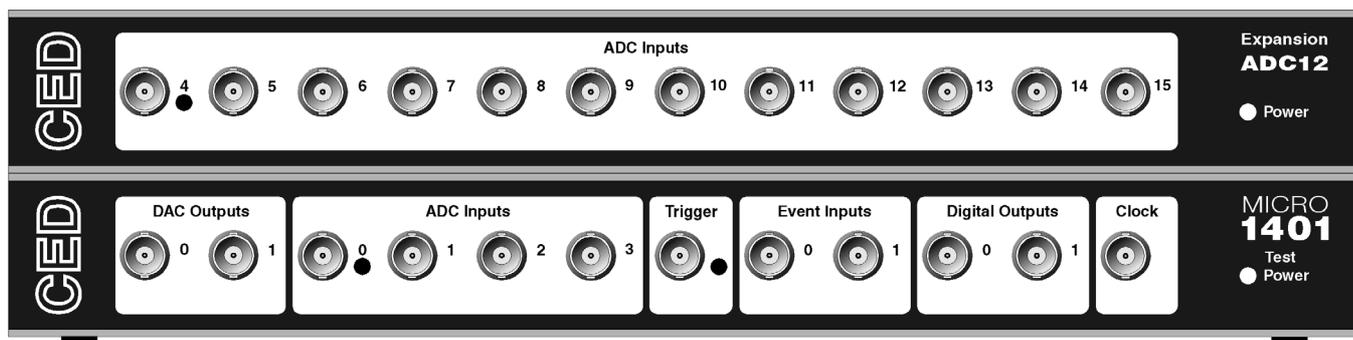
**Digital Outputs**



Pin	Output socket		Pin	Input plug	
	High byte out	Word out		High byte in	Word in
1	7	15	1	7	15
14	6	14	14	6	14
2	5	13	2	5	13
15	4	12	15	4	12
3	3	11	3	3	11
16	2	10	16	2	10
4	1	9	4	1	9
17	0	8	17	0	8
	Low byte out	Word out		Low byte in	Word in
5	7	7	5	7	7
18	6	6	18	6	6
6	5	5	6	5	5
19	4	4	19	4	4
7	3	3	7	3	3
20	2	2	20	2	2
8	1	1	8	1	1
21	0	0	21	0	0
9	DRH Data received 8-15	i/p	9	DTH Data transmitted 8-15	o/p
22	User i/p (buffered, reserved)		22	not connected	
10	User o/p (buffered, reserved)		10	not connected	
23	NDRL New data ready 0-7 o/p		23	DAL Data available 0-7	i/p
11	Output enable	i/p	11	not connected	
24	DRL Data received 0-7	i/p	24	DTL Data transmitted 0-7	o/p
12	NDRH New data ready 8-15 o/p		12	DAH Data available 8-15	i/p
25	+5V (200mA maximum)		25	+5V (200mA maximum)	
13	GND		13	GND	
Screen	Mains earth		Screen	Mains earth	

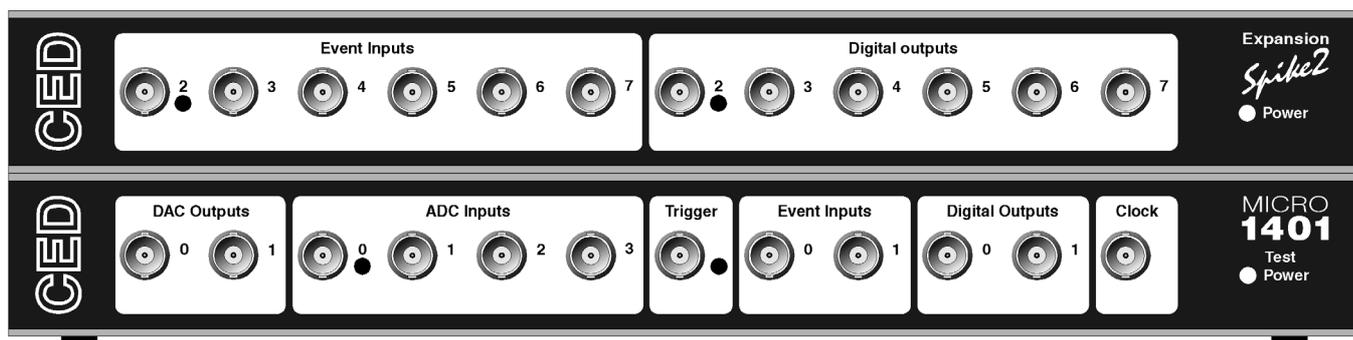
# Hardware expansion

**Introduction** The  $\mu$ 1401 is expanded by fixing similar-format cases on top of the main case, with hidden internal electrical links. Most of these top boxes are suitable for installation by end users, and are supplied with installation and operation instructions.



**Sets of 12 more waveform inputs** The set of waveform input channels may be expanded by adding top boxes with 12 extra channels each. Once the  $\mu$ 1401 is told about the extra channels by the installation program, the new ones may be freely used just like the basic set. Software that reads the extra channels will return data values of zero if the top box is not installed.

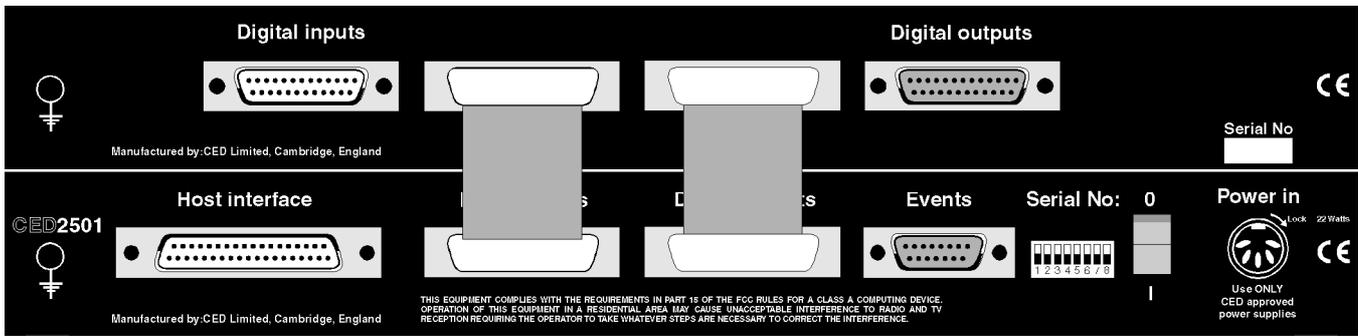
This top box, the 2501-03, is suitable for end-user installation, and is self-contained. All connections with the host  $\mu$ 1401 are internal.



## Digital BNC connections

In some applications, such as many uses of Spike2, the digital inputs and outputs are heavily used for signals. It is convenient to have more of these connectors available on the front panel as BNCs, which is achieved by the 2501-09 top box.

The safe working voltage range of the inputs is  $\pm 10$  volts, and they present an impedance of 47 kOhms, as with the front panel Event and Trigger inputs.



This top box has external connections to the digital input and output connectors of the main 1401, as well as internal ones, so the top box carries auxiliary connectors for these functions, which, to the user, are identical with the original ones.

### Simultaneous sampling

The  $\mu 1401$  uses a single ADC block to sample several channels. This means that the channels are sampled in sequence. There are two sampling modes; equal spaced (each channel is sampled in sequence at equal intervals) and burst (all channels are sampled as fast as possible on each clock tick). If it is important that two channels are sampled at exactly the same instant, a secondary sample and hold chip can be fitted to the main  $\mu 1401$  to allow simultaneous sampling on channels 0 and 3.

# Maintenance operations

---

**Introduction** In normal use, the Micro1401 requires very little maintenance. This chapter covers simple operations that may be required from time to time, such as removing the lid or fitting ROM upgrades. It also helps you to identify socketed components which you may need to change, for example if any of your inputs are damaged by high voltages. There are no hazardous voltages inside the  $\mu$ 1401.

**Taking the lid off** If your  $\mu$ 1401 has a top box, please read the section on page 54. The standard  $\mu$ 1401 top cover is held in place by the back panel. To free this, unscrew the four M3 socket screws at the corners with a 2mm hex wrench. Now remove the back panel. There is no need to detach the green & yellow earth wire. Slide out the  $\mu$ 1401 top cover.

You will now see the inner EMC (electro-magnetic compatibility) containment case. Slide this case out to the rear, undoing the screw-on earth wire half way along the side. The top of the inner case is released by unscrewing the six M3 cross head screws and gently pulling the lid up and off.

**Exchanging a 1401 ROM** ROMs may be exchanged through the mail, or, if you have an eraser/programmer, you can download ROM files free from our website: [www.ced.co.uk](http://www.ced.co.uk). Exchange ROMs are normally free of charge; please mail the old one back to CED as we can re-use them.

Remove power from your  $\mu$ 1401. You need access to the inside, so remove the covers, as described above. Identify the ROM to be exchanged. All CED ROMs are plainly labelled and it is likely the label on an exchange ROM will be identical to the ROM it replaces, except for the version number. You are most likely to need to change the Monitor ROM, see page 53.

ROMs can be damaged by static electricity. They are safe while plugged into their socket on a board, or while in the packing material used to ship them to you. It is a good idea to connect yourself and the packing material to the  $\mu$ 1401 ground (for example the outer connector of a front panel BNC socket) while exchanging a ROM.

To remove the existing ROM, prise it gently from its socket from both ends using a flat screwdriver blade, or use a chip extractor. Screwdriver users should make sure the blade is under the chip, not under the socket! It should come out easily.

You can now replace the old ROM with the new one (or reprogram it). Make sure the ROM goes back with the notch pointing in the same direction as the one that came out. If you put the ROM in backwards it will be destroyed when you apply power.

Check that all the pins have gone into the socket; they can bend up under the ROM. If you do bend a pin, remove the ROM and straighten it, then try again. You can only straighten pins a limited number of times before they snap off.

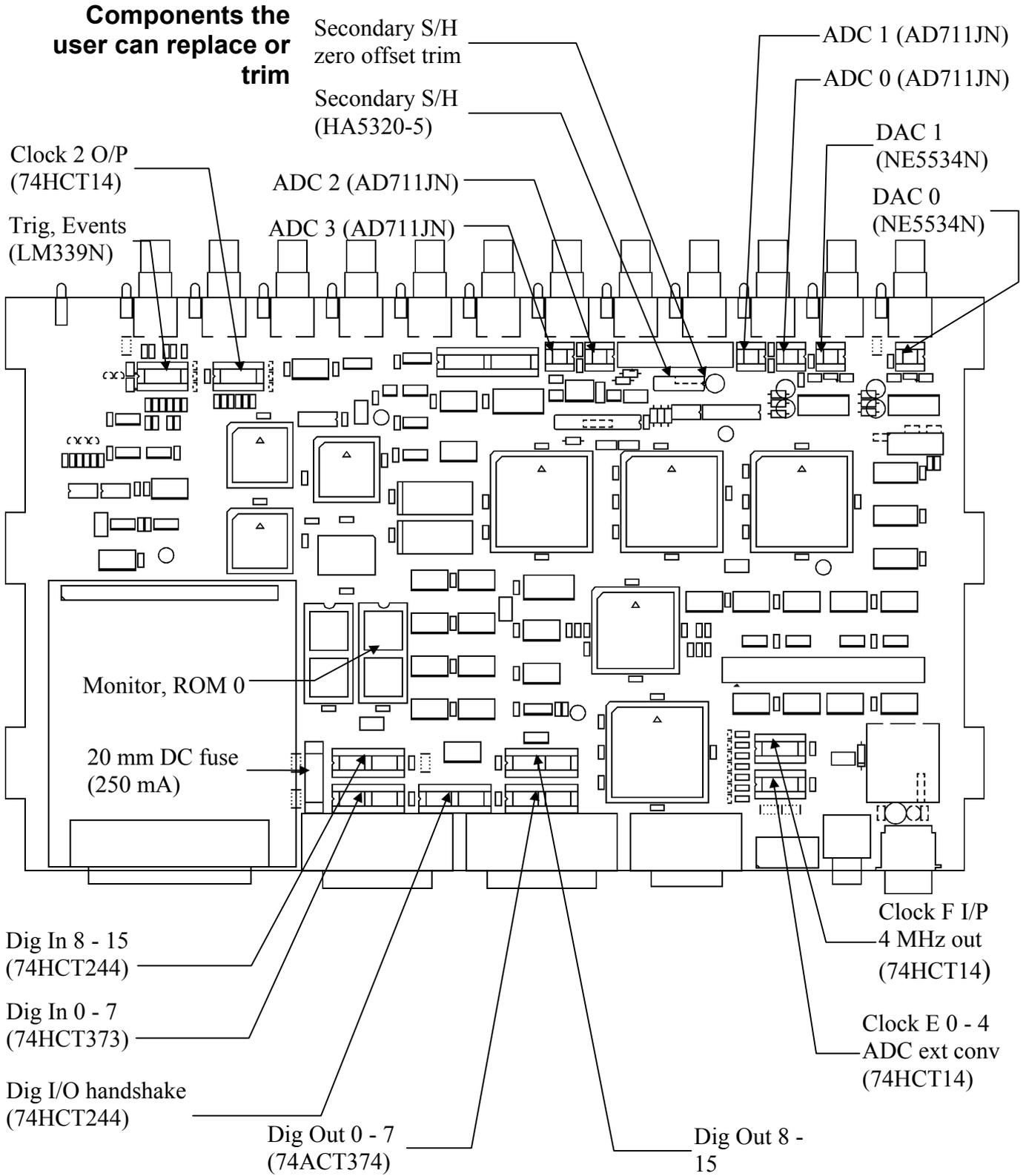
Check that your  $\mu$ 1401 operates correctly by reconnecting the DC power cable and running a power-up self-test. When you are satisfied, re-assemble the case and return the old ROM to CED.

### **Analogue calibration**

A calibration program TESTDAC is provided, for both the IBM and Macintosh systems, used to calibrate the ADC inputs. Before we ship your unit, we run this program and set the waveform system to better than half a bit accuracy. If accurate voltage measurement is important to you, we suggest that you check the accuracy once every six months. We find that most units drift by less than 2 bits (0.05%) over this period.

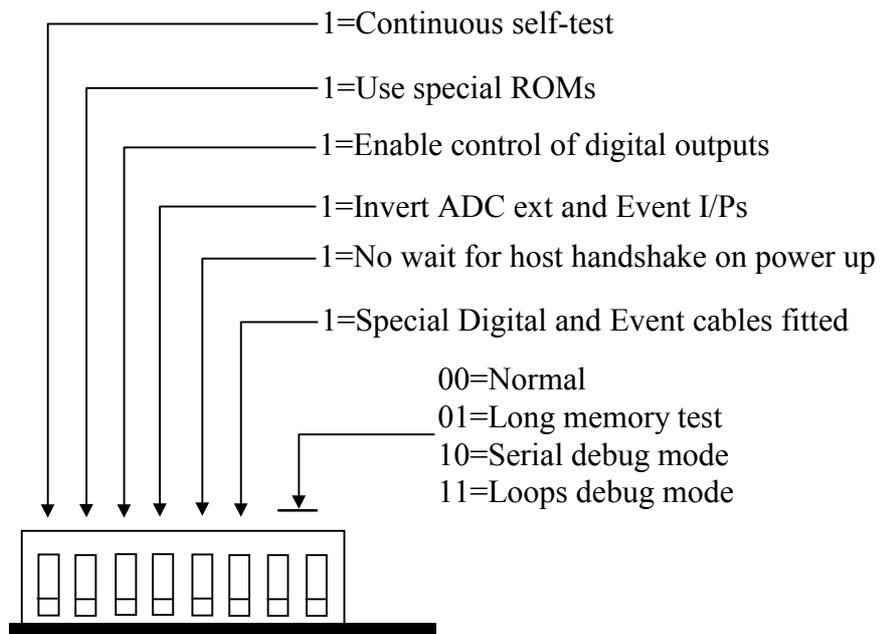
To make use of this program you will need an accurate digital voltmeter capable of reading to an accuracy of better than 1 mV over a  $\pm 5$  Volt range. It is most important that you allow the  $\mu$ 1401 to warm up with power on for at least 30 minutes before you start the calibration to allow the system to reach thermal equilibrium.

The main trimming controls are operated electronically. You will not need to remove the lid of the  $\mu$ 1401, or to find a screwdriver, unless you have a second sample and hold (see page 50).



**Switch settings** This diagram shows the rear panel Options switch settings on the standard  $\mu$ 1401. The host interface switch settings are described in the installation chapter for your specific system.

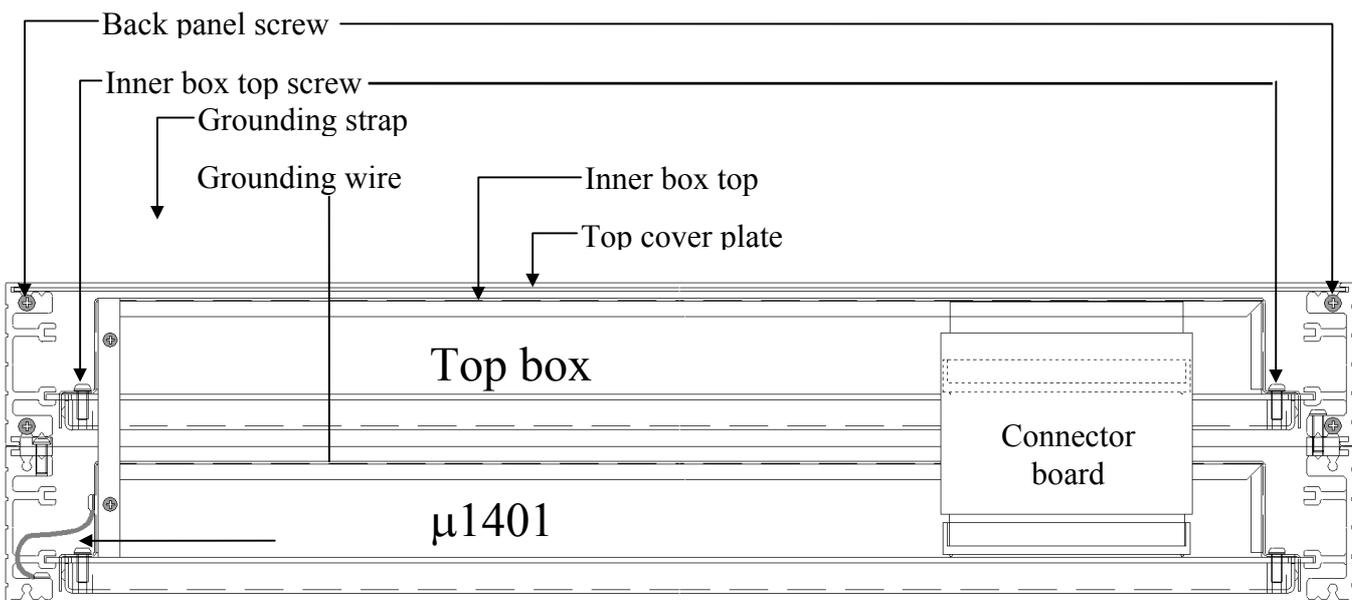
For normal use, all the switch poles must be On, physically down, as shown. In the diagram, 0 shows On, 1 is Off.



**Removal of top boxes** Expansion options for the  $\mu$ 1401 are fitted in boxes mounted on top of the standard case, with internal electrical connections to the section below. The boxes must be dealt with from the top, in sequence. In practice, the main structure can usually be left intact, and just the inner cans removed.

- Start by removing power and all cables from the  $\mu$ 1401.
- Free the back panel by unscrewing the four screws at the corners; remove the back panel, which lets you slide out the top cover plate. You can now see the metallic lid of the inner can.
- The lid of the inner can must be removed to gain access to the printed circuit card of the top box. The lid is retained by six screws along the sides, which should be removed. This will allow you to pull the lid upwards and away.

- This may be as far as you need to go, if you just need access to the top box, but if you wish to get to the lower cards, you must remove the internal electrical connections.
- According to the type of top box, there will be one or two connector boards, linking it with the card below. These are removed by pulling gently upwards.
- As the connector board comes free of its connector below, you will notice the connector attaching it to the top card by a flat flexible cable and a broad connector. Continue to pull the connector board up, which will free this connector to the top card.
- When all connector boards are out, you can slide out the top card with the inner can tray.
- The lower card can now be slid out, still in its inner can.



## Trouble shooting

---

**Overview** The Micro1401 has comprehensive built-in self-test capabilities which are backed up by a range of test and diagnostic programs to pin-point problems quickly. If you suspect that you have a hardware fault, you should follow the procedures below to obtain as much information as you can about the problem, then call the CED Hardware Help Desk for advice. Components in the  $\mu$ 1401 that are connected to the outside world are socketed for easy replacement, see the diagram on page 53. In many instances this avoids the need to return the  $\mu$ 1401 to CED.

**Stand-alone test** The simplest test of a Micro1401, which eliminates the possibility of a host computer or cable fault confusing the situation, is to disconnect the  $\mu$ 1401 from the host at the 1401 end of the data cable, remove all signal connections and then switch the  $\mu$ 1401 on. If all is well, the Power indicator should light and stay on. The Test indicator should flash for a few seconds, then turn off. The BNC LEDs will also flash. If the Micro1401 behaves as expected it is likely that the fault lies in the interface cable, the 1401 interface card in the host, in the host computer hardware or the host computer software.

If the Test indicator remains flashing, the internal Micro1401 power-up self-test has detected a problem. It is likely that one of the test programs will be able to diagnose the trouble. If you have not already installed the 1401 test and diagnostic programs, do so now (see page 30) and continue at the diagnostic section, below.

If the Power and Test indicators come on and stay on, the diagnostic programs may not be able to help. You should contact CED for advice.

**Diagnostics** If the Test indicator is flashing continuously, the most useful diagnostic program for Windows systems is the self-test option in TRY1432, (or TRY1401 in DOS) or the self-test report option of the TEST1401 application on the Macintosh. You will need to connect your Micro1401 to the host computer before running the test. This program forces the  $\mu$ 1401 internal self-test to run repeatedly, and interprets any errors discovered. Make a note of any errors reported and contact CED for advice on correcting the problem.

**Hardware resources clash** Some problems are not due to a fault, but caused by a hardware incompatibility, or an address, interrupt or DMA channel clashing with another device. This is more likely with ISA interfaces, which are not Plug'n'Play. If you suspect you have this type of problem, you can do a first-line check yourself, before contacting CED for advice.

If another hardware device is using the same interrupt, DMA or base address as the 1401 interface card, symptoms can be 1401 commands refusing to load, or the Test indicator turning on in the middle of an application. This can be checked by removing other cards one at a time, and re-trying the problematic operation.

Alternatively, run the various system diagnostics:

**Windows 9x** Select *Start, Settings, Control Panel* and double click on *System*. Select *Device Manager* and double click on *Computer* to see the IRQ (interrupt), DMA and address assignments. You can try to re-assign any clashes by double-clicking on the offender at the *Device Manager* level.

**Windows NT 2000** Select *Start, Settings, Control Panel*, and click on the *System* icon. Select the *Hardware* tab and click on the *Device Manager* button. Choose the "1401 interface" icon, open it, and select the *Resources* tab. You can now view resources by category (IRQ, DMA, bases address). If you discover a clash, you must edit the offending value by clicking on the scroll bars, until the clash disappears.

**Windows NT 4** Select *Start, Programs, Administrative Tools, Windows NT Diagnostics*, and select the *Resources* tab. Press the *Devices* button. Select *ced1401* from the list that is displayed, then press the *Properties* button. The resource usage of the 1401 interface card is displayed. Clashes cannot be sorted out automatically, but must be resolved by editing values by hand.

**Vector usage** On AT class machines and above, interrupt 2 is actually interrupt request 9, redirected to 2. You do not have a free choice of interrupt since other devices in your system may be using vectors, which cannot be shared on the PC or AT bus. These are common vector usages:

Vector	Other users of this vector
2	May conflict with VGA frame interrupt on AT or above. VGA interrupt can usually be disabled without any performance penalty; see your VGA controller manual.
3	Serial port 2 (COM2). Will only conflict if you are using serial line software which uses interrupts on COM2.
4	Serial port 1 (COM1). Will only conflict if you are using serial line software which uses interrupts on COM1.
5	Parallel port 2 (LPT2) and some mice. It is extremely rare for the parallel port interrupt to be used.

The preferred setting is interrupt 5. If you have a VGA card and interrupt 2 fails, a common cause is that VGA interrupts are enabled. Very little software uses the VGA interrupt and it can usually be disabled by a jumper on the VGA controller card.

**Calling the CED Helpdesks** If you cannot beat your  $\mu$ 1401 problems yourself, you are welcome to call our Helpdesk people. The telephone, fax and email details are on the first page of this book. To save yourself time, and improve the efficiency of the process:

- Please find the serial number of your  $\mu$ 1401, printed on the back.
- If the problem is with a program, please know the version number, announced on entry.
- It is often useful, for DOS users to have run TRY1401 and REPORT, for Windows users to have run TRY1432, or for Macintosh users to have run TEST1401, so you know about the hardware state.
- Print out your CONFIG.SYS and AUTOEXEC.BAT files, which are often the key to installation problems.

**If you need to send the  $\mu$ 1401 back to CED:**

- Please get a returns number from CED.
- If you are despatching from outside the UK, please call us for advice, which can speed the transit through Customs, and save you money.
- Include with the unit a paper description of the problem.
- Make the packaging adequate to avoid damage in transit!

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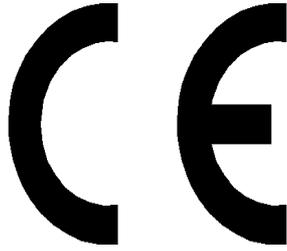
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# Specification

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<b>Waveform inputs</b>	Input impedance	1 MOhm	
	Active working voltage range	±5 volts	
	Safe voltage range	±12 volts	
	Maximum conversion rate	333 kHz	
	Resolution	12 bits	
<b>Waveform outputs</b>	Active working voltage range	±5 volts	
	Safe drive capability	600 Ohms	
	Full accuracy drive	5 kOhms	
	Maximum conversion rate	250 kHz	
	Resolution	12 bits	
<b>Front panel digital inputs</b>	Input impedance	47 kOhms	
	Safe voltage range	±10 volts	
	Shortest pulse-width	100 nSec	
	Low voltage	0.8 volts	
	Low current	0.5 mA	
<b>Rear panel digital and clock E inputs</b>	Input impedance	4.7 kOhms minimum	
	Safe voltage range	0 to +5 volts	
	Shortest pulse-width	1 µSec	
	Low voltage	0.8 volts	
	Low current	1.5 mA maximum	
<b>Digital outputs</b>	Drive capability	±20 mA	
<b>Power</b>	Voltage range	100 to 240 volts	
	Current	0.8 Amps	
	Frequency range	47 to 63 Hz	
<b>Case size</b>	µ1401	88 x 219 x 366 mm	3.0 kg
	Power brick	40 x 75 x 130 mm	0.45 kg
<b>Environment</b>	Temperature range	-5 to +50 °Celsius	
	Maximum humidity	95% Non-condensing	



## EC Declaration of Conformity

This is to certify that the:

**CED Micro1401**

Manufactured by:

Cambridge Electronic Design Limited  
Science Park, Milton Road, Cambridge CB4 0FE, UK  
Tel (+44) 01223 420186

conforms with the protection requirements of  
Council Directive 89/336/EEC,  
relating to Electromagnetic Compatibility,  
by the application of the following EMC standards:

### **Conducted and radiated emissions:**

EN55022:1987 Class B - COMPLIES  
Vfg1046/1984 - COMPLIES  
FCC CFR47 Part 15 Subpart J Class A - COMPLIES

### **EN50082-1:1991 Immunity standards:**

EN50082-1:1991 (Generic Immunity) - PASS  
IEC801-2 (electrostatic discharge) - PASS (8kV) Criterion A  
IEC801-3 (RF Field Immunity) - PASS (3V/m) Criterion A  
IEC801-4 (Electrical fast transients) - PASS (2kV - Heavy industrial) Criterion A

Signature

Peter Rice  
Technical Director

Date

25/12/95

25 December 1995