

# ***User & Programming Guide***

## **USB I/O Control Boxes**



USB-I/O-4D2R  
Two 24V outputs  
Four TTL/LVTTL outputs  
Connectors: 10 pin IDC;  
2x 3.81mm DC connectors



USB-I/O-16D8R  
8 buffered relays  
16 TTL/LVTTL input/output lines  
Connectors: 26 pin IDC;  
34 pin IDC:



USB-I/O-8DRV  
8 buffered relays  
8 TTL/LVTTL input/output lines  
8 High voltage digital inputs  
Connectors: 10 pin IDC;  
14 pin IDC;  
34 pin IDC:

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## Chapter 1 – General Information



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## 1.1 Scope of the User Guide

This Manual provides general introduction, setup and installation instructions, and operating information for Mini-Circuits' USB I/O control boxes.

## 1.2 Warranty

See Mini-Circuits website <http://www.minicircuits.com/support/ordering.html> for Warranty information.

## 1.3 Definitions

**Note:** A note advises on important information you may need to insure proper operation of the equipment. There is no risk to either the equipment or the user.

### CAUTION

A caution advises about a condition or procedure which can cause damage to the equipment (No danger to users).

### WARNING

A warning alerts to a possible risk to the user and steps to avoid it. **Do Not** proceed until you are sure you understand the warning.

## 1.4 General safety precautions

There are no general Safety precautions for using Mini-Circuits USB&RS232 Digital Step Attenuators.

## 1.5 Introduction

Mini-Circuits has developed a series of USB I/O (Input/Output) control boxes. These control boxes provide a simple and effective means of controlling switches or other analog devices, multiple TTL/LVTTL devices, and even reading high voltage digital signals, all from a single standard PC or laptop computer.

Mini-Circuits provides support for the USB I/O control boxes in Windows and Linux Operating Systems, in a variety of programming environments including most lab test software using .NET assembly or ActiveX® controls which allow the user to write customized applications.



Figure 1: USB-I/O-8DRV

## 1.6 **Service and Calibration**

The USB-I/O control box models do not require any periodic service or calibration. The only user service possible for the models is external cleaning of the case and connectors as needed. Do not use any detergents or spray cleaning solutions to clean the control box. To clean the connectors use an alcohol solution, and to clean the case a soft, damp cloth.

## 1.7 **Contact Information**

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General Fax: 1-718-332-4661  
Sales / Customer Service Fax: 1-718-934-7092  
[sales@minicircuits.com](mailto:sales@minicircuits.com)  
For regional offices and tech support see  
<http://www.minicircuits.com/contact/offices.html>

## 1.8 **Model Description**

- Mini-Circuits' USB I/O control boxes are USB HID devices, no driver installation required.
- ActiveX and .Net objects allowing the units to be used with almost any standard control software are supplied on a CD along with a demo program to test your setup and programming samples.
- The supplied software allows the control boxes to be operated from almost any 32 or 64 bit Windows computer.
- The USB I/O control boxes can be controlled by a Linux computer which supports the use of USB HID.

### 1.8.1 **Intended Applications**

Mini-Circuits series of USB control boxes are intended for indoor use in:

- Lab and test equipment setups for both manual and automated measurements.
- Control systems

The models can be used by anyone familiar with the basics of electronics measurements or electronic control systems.



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## 1.8.2 Included Accessories and Options

Accessories Available	<a href="#">USB-I/O-4D2R</a>	<a href="#">USB-I/O-16D8R</a>	<a href="#">USB-I/O-8DRV</a>	
Software CD	Included with the model at no extra charge	Included with the model at no extra charge		
2.7 ft. USB cable				
24V power adaptor		Not used by this model		
1 ft. 10 pin IDC cable	Not used by this model	Not used by this model	Included with the model at no extra charge	
2 ft. 10 pin IDC cable			Available as additional accessories	
3 ft. 10 pin IDC cable			Included with the model at no extra charge	
1 ft. 14 pin IDC cable			Available as additional accessories	
2 ft. 14 pin IDC cable		Included with the model at no extra charge	Not used by this model	
3 ft. 14 pin IDC cable				
1 ft. 26 pin IDC cable		Available as additional accessories		
2 ft. 26 pin IDC cable		Included with the model at no extra charge		
3 ft. 26 pin IDC cable		Available as additional accessories		
1 ft. 34 pin IDC cable		Included with the model at no extra charge		
2 ft. 34 pin IDC cable		Available as additional accessories		
3 ft. 34 pin IDC cable				
4 position DC connector	Included with the model at no extra charge	Not used by this model		
6.8 ft. USB cable	Available as additional accessories			
11 ft. USB cable				
US standard power cord	When Ordering select one power cord to be included at no extra charge	Not used by this model		
EU standard power cord				
UK standard power cord				
AUS/China standard power cord				
IL standard power cord				

For additional details and ordering information, click on model P/N at the top of each column.

## 1.8.3 Conformity

Mini-Circuits Synthesized Signal Generators conform to all requirements for the following international standards:

RoHS – The models comply with EU directive for Restriction of Hazardous Substances for 6 substances.

USB 2.0 – The models meet the specifications of the Universal Serial Bus Ver. 2.0 communication standard as described by USB-IF.

USB HID – The models meet the requirements for Universal Serial Bus Human Interface Devices according to USB-IF's Device Class Definition for Human Interface Devices firmware rev. 1.11



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## 1.8.4 Supported Software Environments

Mini-Circuits USB I/O control boxes have been tested in the following operating systems:

32 bit systems: Windows 8, Windows 7, Windows Vista, Windows XP, Windows 98

64 bit systems: Windows 8, Windows 7, Windows Vista, Linux

The control boxes will work with almost any software environment that supports ActiveX or .Net including: C++, C#, CVI®, Delphi®, LabVIEW® 8 or newer, MATLAB® 7 or newer, Python, Agilent VEE®, Visual Basic®, AutoIT, Visual Studio® 6 or newer, and more

## 1.9 Individual Model Features

### 1.9.1 USB-I/O-4D2R Features

- Low cost solution for automatic relay control
- Easy installation and operation
- Two DC 24V/0.375A opto-isolated relay Outputs
- Four TTL outputs with a wide range of TTL voltage
- Noise reduction circuit on digital outputs
- 24V<sub>DC</sub> Power adapter included

### 1.9.2 USB-I/O-16D8R Features

- Low cost solution for automatic relay control
- Easy installation and operation
- 8 buffered relays (1A DC) with NC and NO outputs available for use
- 16 digital outputs (2 Bytes X 8 channels each) selectable as TTL or LVTTTL
- All required operating power drawn from USB

### 1.9.3 USB-I/O-8DRV Features

- Low cost solution for automatic relay control
- Eight DC 1A buffered relays with NC and NO output available for use
- 8 Digital HV inputs (32V max)
- 8 digital I/O lines selectable as TTL or LVTTTL
- All required operating power drawn from USB



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## Chapter 2 – Installation and setup

This chapter provides information on installing the operating software and setting up Mini-Circuits' Generators. System requirements for USB control are a computer (Pentium II or better) with support for USB HID.

To run the GUI program (described in chapter 3) a Windows operating system (either 32 or 64 bits) is also needed. The USB-I/O-4D2R additionally requires a power source of 110-220V (a power cord matching the required power supply should be selected when ordering the unit).

### 2.1 Software Setup



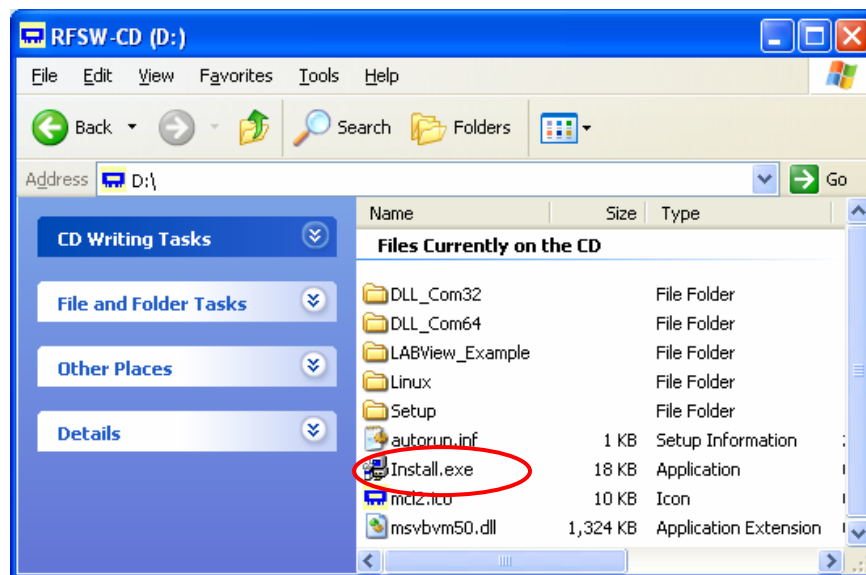
**If you have had any problems installing the software, we're here to help.**

Try following these complete step-by-step instructions. If you still experience problems, give us a call at Mini-Circuits Worldwide Technical support. It's (718) 934-4500 or e-mail [apps@minicircuits.com](mailto:apps@minicircuits.com) for North America or go to [minicircuits.com/contact/worldwide\\_tech\\_support.html](http://minicircuits.com/contact/worldwide_tech_support.html) for other regional numbers and addresses.

**2.1.1 First** save all work in progress and close any other programs that may be running.

**2.1.2 Next**, insert the *Mini-Circuits* CD into the CD-ROM drive, or download the Full CD software from [minicircuits.com](http://minicircuits.com). If installing from files downloaded from the web - unzip the downloaded files to a temporary folder on your desktop or C: drive, then open the file folder you created and double-click the "Install" icon.

**2.1.3 If installation from the CD does not start automatically, run *install.exe*** from the <CD drive> root directory.

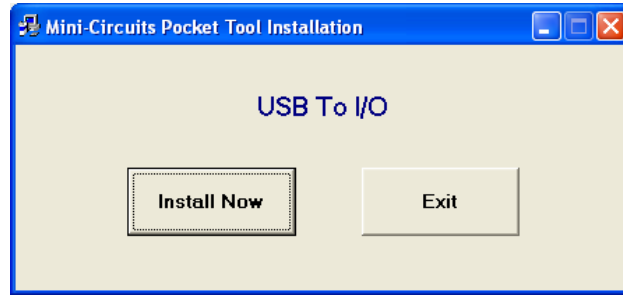


**Figure 2.1.3** CD file listing window



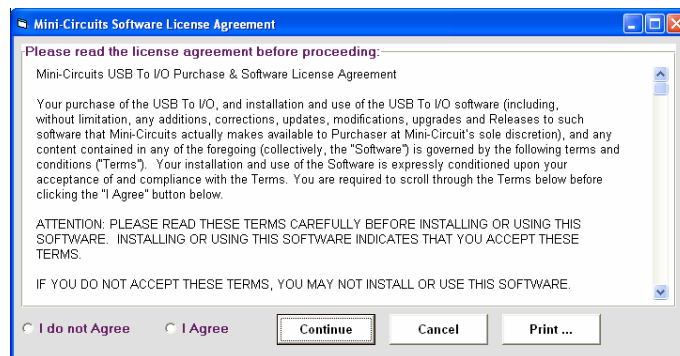
## 2.2 Installation

2.2.1 **The installer window** should now appear. Click the “Install Now” button.



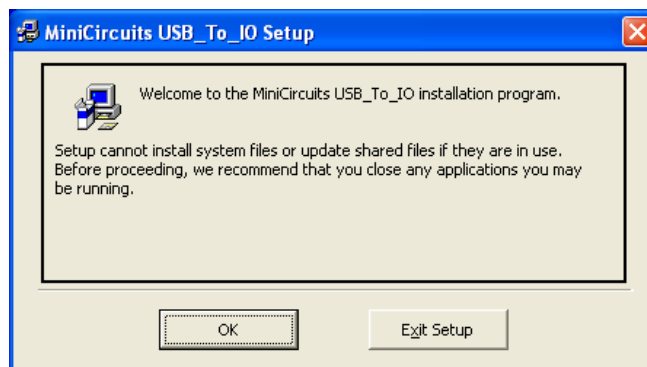
**Figure 2.2.1** Installer window

2.2.2 **The license agreement** should now appear. To proceed, click “I Agree” and the “Continue” button.



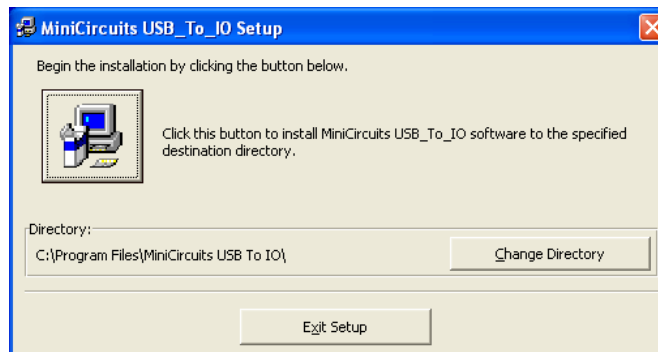
**Figure 2.2.2** License agreement

2.2.3 **The installation program will launch.** Click the “OK” button to continue.



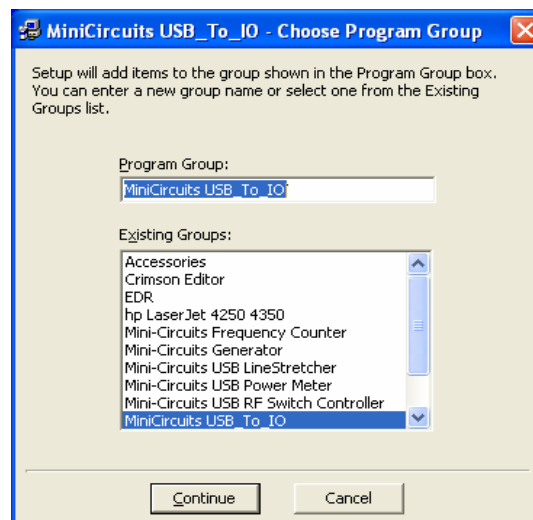
**Figure 2.2.3** Installation Program window

**2.2.4 The destination directory window** will appear. At this point it's a good idea to take a second and confirm the full destination address for the software. In most cases, the default will be your computer's hard drive (C:)program files\ Mini-Circuits USB To IO\. Click the large button at the top to continue.



**Figure 2.2.4: Destination Directory window**

**2.2.5 The Program Group window** will appear. This window allows you to select the program group under which the link for the Demo program in the Start Menu will be created. Click on "Continue" to proceed.



**Figure 2.2.5: Program Group Window**

**2.2.6 In a second or two, your installation will be complete.** Click "OK" to close the installer.



**Figure 2.2.6: Installation complete**

## 2.3 Control Box Physical Setup

### 2.3.1 USB-I/O-4D2R:

#### 2.3.1.1 Setting digital connections:

- a. Connect the FCBL-10-1+ wire ends, or a similar IDC cable to the digital devices to be controlled.
- b. Connect the IDC plug to the IDC connector on the front of the control box.
- c. Connect the AC/DC-5 or similar power supply of the value needed for logic '1' (2.7V to 5V).
- d. If Analog outputs are required, connect them before connecting the USB cable – otherwise use the supplied USB-CBL-AB-3+ cable (or similar) to connect the control box's USB socket to the computer's USB bus.

#### CAUTION

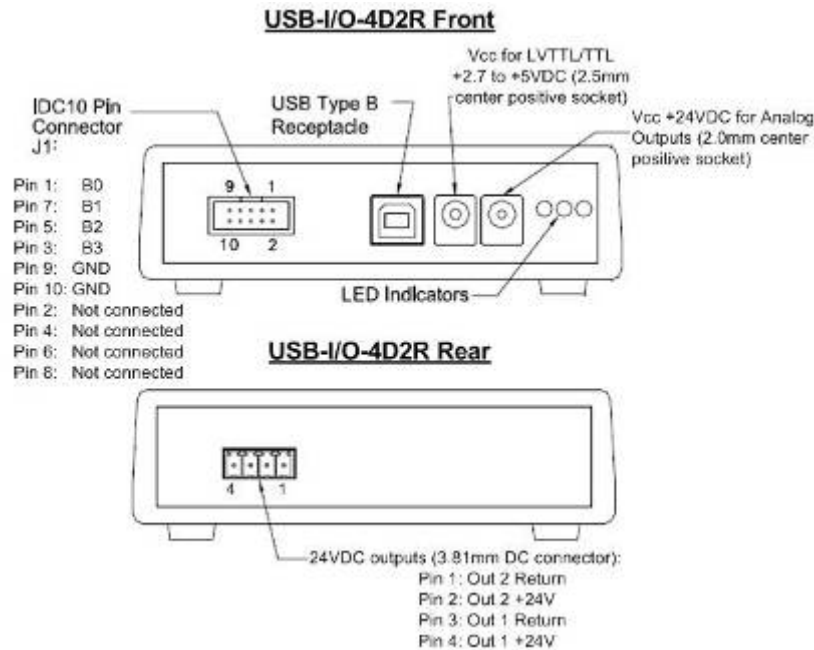
1. Attempting to connect 24V to the digital power (5 to 2.7V) socket when connected to USB bus may cause permanent damage to the unit.
2. Connect power to the I/O control box in the following order: digital power, followed by 24V, then USB.

#### WARNING

Insure the wall socket you use to power the 24V power supply is intact and connected to a proper ground.

#### 2.3.1.2 Setting analog connections:

- a. Assemble the cable you wish to use to connect to the 24V devices - using the supplied DC connector (TBLK-4+) and your choice of wires in gauge from 30AWG to 14AWG.
- b. Connect the assembled cable to the outputs at the rear of the control box.
- c. Connect the AC/DC-24-3W1 power adaptor (or similar power supply) to the 24V socket at the front of the control box.
- d. Use the supplied USB-CBL-AB-3+ cable (or similar) to connect the control box's USB socket to the computer's USB bus



**Figure 2.3.1: USB-I/O-4D2R connections**

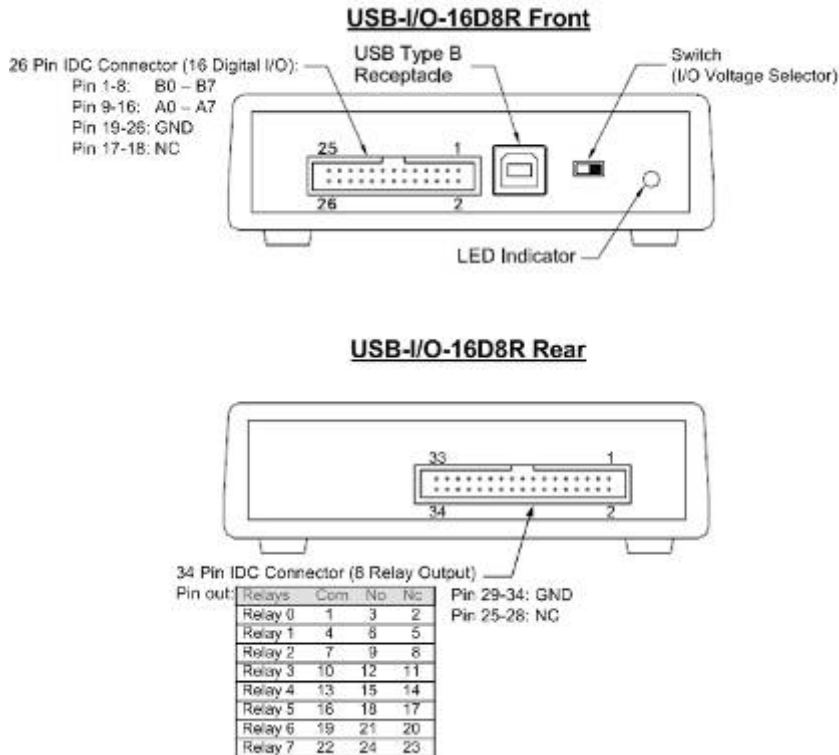
## 2.3.2 USB-I/O-16D8R:

### 2.3.2.1 Setting digital connections:

- Set the I/O voltage selector switch to the desired voltage LVTTL (3.3V) or TTL (5V).
- Connect the digital devices to the wire ends of FCBL-26-1+ or to similar IDC cable and connect the cable's IDC connector to the IDC connector in the front of the control box (note current limits specified per byte and per individual line).
- If Relay outputs are required, connect them before connecting the USB cable - otherwise use the supplied USB-CBL-AB-3+ cable (or similar) to connect the control box's USB socket to the computer's USB bus (note the LED indicator color matches your selected voltage, red=5V, yellow=3.3V).

### 2.3.2.2 Setting digital connections:

- Insure the power sources you are going to use are turned off.
- Connect the Analog devices to the wire ends of FCBL-34-1+ or to similar IDC cable and connect the cable's IDC connector to the IDC connector in the rear of the control box. Note that when unpowered, the relays pass current between the Common and Normally Closed contacts of each relay.
- Use the supplied USB-CBL-AB-3+ cable (or similar) to connect the control box's USB socket to the computer's USB bus.



**Figure 2.3.2: USB-I/O-16D8R connections**

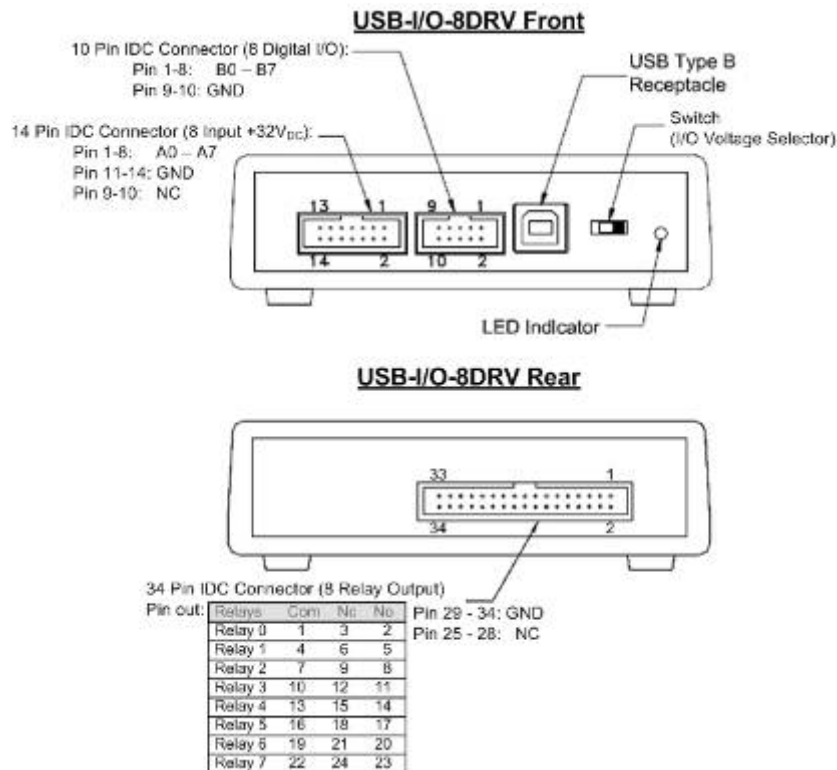
## 2.3.3 USB-I/O-8DRV:

### 2.3.3.1 Setting digital connections:

- Set the I/O voltage selector switch to the desired voltage LVTTL (3.3V) or TTL (5V).
- Connect the TTL or LVTTL devices to the wire ends of FCBL-10-1+ or similar IDC cable and connect the cable's IDC connector to the 10 pin IDC connector in the front of the control box (note current limits specified per byte and per individual line).
- Connect the high voltage devices to the wire ends of FCBL-14-1+ or to similar IDC cable and connect the cable's IDC connector to the 14 pin IDC connector in the front of the control box.
- If Relay outputs are required, connect them before connecting the USB cable - otherwise use the supplied USB-CBL-AB-3+ cable or similar USB cable to connect the control box's USB socket to the computer's USB bus (note the LED indicator color, red=5V, yellow=3.3V).

### 2.3.3.2 Setting analog connections:

- Insure the power sources you are going to use are turned off.
- Connect the Analog devices to the wire ends of FCBL-34-1+ or to similar IDC cable and connect the cable's IDC connector to the IDC connector in the rear of the control box. Note that when unpowered, the relays pass current between the Common and Normally Closed contacts of each relay.
- Use the supplied USB-CBL-AB-3+ cable (or similar) to connect the control box's USB socket to the computer's USB bus.



**Figure 2.3.3: USB-I/O-8DRV connections**

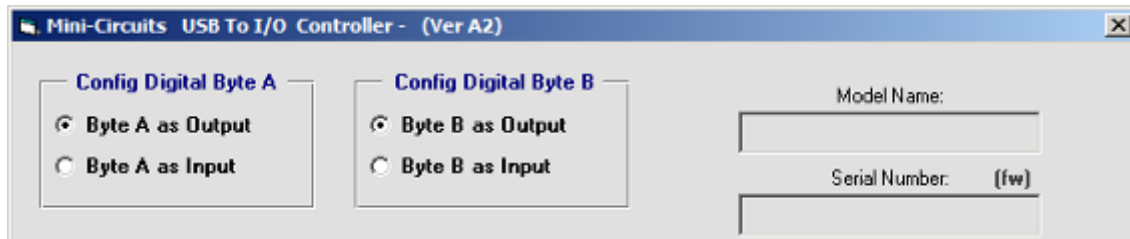
## Chapter 3 – Operating the Control Boxes

The USB I/O control boxes are supplied along with API programming objects (DLL files) to allow them to be easily controlled by most common lab test software (See Chapter 7 of the PTE Programming handbook for details) and with a Windows GUI program to transmit or receive data manually.

**To start the program go to the Start menu** and select All Programs>MiniCircuits USB\_To\_IO (default), or go to the other destination address you selected during installation (section 2.2.5). The “MiniCircuits USB\_To\_IO” icon should be waiting there for you. Click on it and get started!

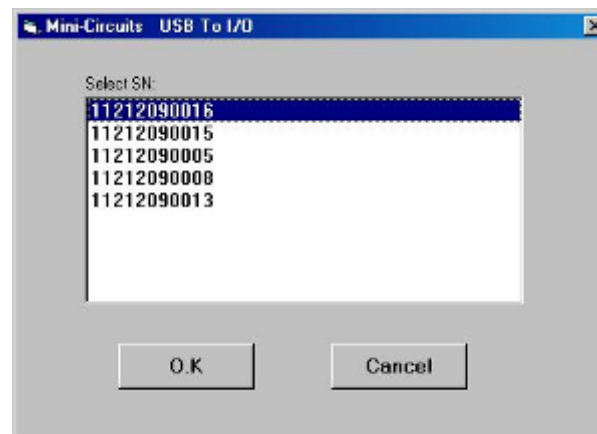
### 3.1 Starting the GUI program

**3.1.1 If no control box is connected to** the computer, or there is a problem with the data connection the program will open with no unit listed in the Model name and S/N fields.



**Figure 3.1.1: Device not found!**

**3.1.2 If multiple units are connected to** the computer, the initial screen will show a list of S/N for connected units. Select the unit you wish to start with and click OK, or click Cancel to exit the program. The program can handle up to 24 units connected simultaneously.



**Figure 3.1.2: Unit selection screen**



3.1.3 **Mini-Circuits USB to I/O controller software** will start for the unit you selected.



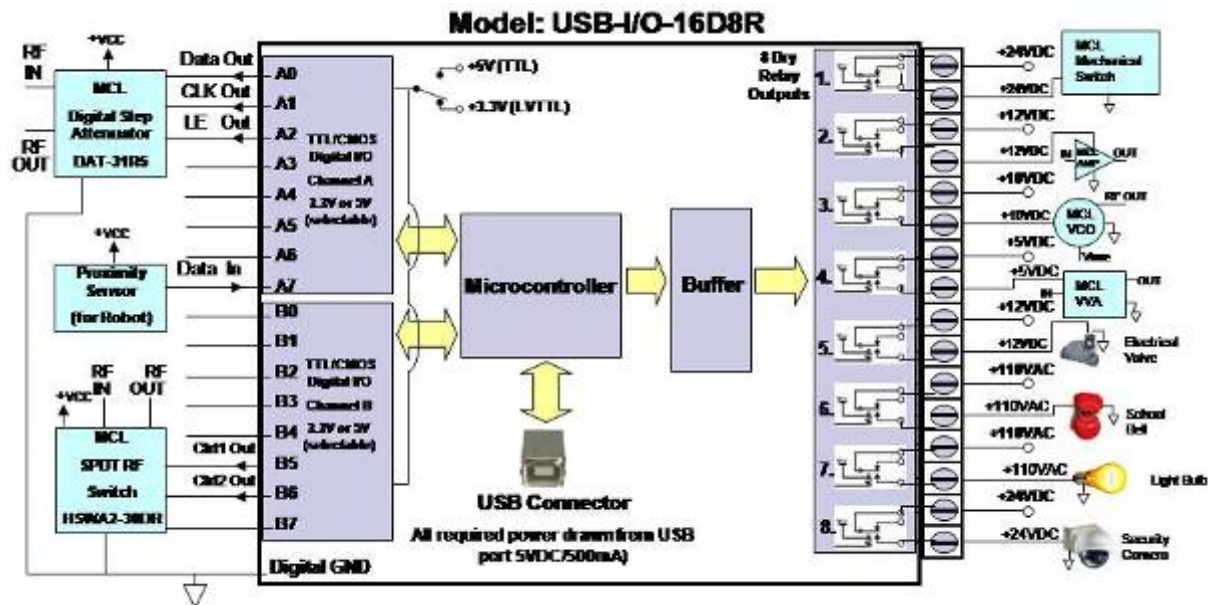
**Figure 3.1.3:** Initial screen(shown for USB-I/O-16D8R)

#### 3.1.4 Functions of the Mini-Circuits USB to I/O controller software

#	Name	Description
1	Config Digital Byte B	Sets Digital Byte B (pins 1-8) to either Input or Output mode
2	Config Digital Byte A	Sets Digital Byte B (pins 9-16) to either Input or Output mode
3	Set Relays	Allows switching each relay between "Common to NO" and "Common to NC"
4	Set Digital Byte A	When Byte A is in output mode allows setting each bit to '1' or '0'
5	Set Digital Byte B	When Byte B is in output mode allows setting each bit to '1' or '0'
6	Binary word to send	Specifies the binary word to transmit in SPI mode
7	Send	Transmit SPI string
8	Pulse width	Sets the pulse width for the SPI Data and Clock
9	Relay Status	Displays current status of the Relays
10	Byte A Status	When Byte A in Output mode displays status of Byte A, and when Byte A in Input mode displays received byte
11	Byte B Status	When Byte B in Output mode displays status of Byte B, and when Byte B in Input mode displays received byte
12	SPI bits	Selects bits to be used for SPI transmission (must be from byte in output mode)

3.1.5 **The USB I/O control models can also** be operated automatically using most common lab test software and the provided DLL files, or your own custom programs or in Linux using the supplied command codes. For more information on this see Mini-Circuits Programming Handbook on the included CD or download it from our website at [http://www.minicircuits.com/support/software\\_download.html](http://www.minicircuits.com/support/software_download.html)

## 3.2 Application examples



### 3.2.1 List of applications shown for USB-I/O-16D8R

#	Location	Description
1	Bit A0 – A3	When Byte A is set to output these bits control the serial controlled attenuator DAT-31R5-SP+
2	Bit A7	When Byte A is set to input this bit monitors the proximity sensor
3	Relay 1	Using 24V dc power supply this relay controls a mechanical switch (such as the MSP2TA-18XL+)
4	Relay 2	Using 12V dc power supply this relay controls an RF amplifier (such as the ZRL-400+)
5	Relay 3	Using a 10V dc power supply this relay starts and stops an oscillator (such as the ZX95-310A-S+)
6	Relay 4	Using a 5V dc power supply this relay toggles a Voltage Variable attenuator (such as the ZX73-2500+)
7	Relay 5-8	These relays start and stop various devices on command using external power supplies.

As the change between input and output modes is a software function for each byte both input and output lines can be connected to a given byte and the byte cycled between input and output modes