

Application Note:

XPort™ -485 Application Note

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Overview

The XPort-485 can connect to an RS-422/RS-485 transceiver for remote serial communications over long distances (up to 4,000 ft). Using RS-485 two-wire mode, you can also connect the XPort's serial interface to multiple devices in a multi-drop network.

Note: *The XPort-485 product does not include the RS-422/485 transceiver.*

The purpose of this application note is to provide enough information for an engineer to easily implement a design using the XPort-485. The application note provides the following information:

- ◆ Overview of RS-422/RS-485
- ◆ How to connect the XPort to an RS-485 transceiver
- ◆ RS-422/RS-485 network connections
- ◆ XPort-485 configuration details

RS-422 and RS-485

RS-232 is an EIA standard transmission system that has been around since 1962. RS-232 provides single-ended data communications between a transmitter and a receiver. It allows for data transmission from one transmitter to one receiver at relatively slow data rates (115k bits/second) and short distances (up to 50 ft at the maximum data rate).

While RS-232 is well known for connecting PCs to external devices, RS-422 and RS-485 are not as well known. When communicating at high data rates or over long distances in real world environments, single-ended methods are often inadequate. RS-422 and RS-485 provide data communications over longer distances and higher baud rates and provide better immunity to external electromagnetic noise.

RS-422 and RS-485 use differential data transmission (balanced differential signal). This type of transmission offers superior performance by canceling the effects of ground shifts and induced noise signals that can appear as common-mode voltages on a network. It also allows for data transmission at much higher data rates (up to 460K bits/second) and longer distances (up to 4000 ft).

Differences Between RS-422 and RS-485

RS-422: Like RS-232, RS-422 is for point-to-point communications. In a typical application, RS-422 uses four wires (two separate twisted pairs of wires) to transfer data in both directions simultaneously (full duplex) or independently (half duplex). EIA/TIA-422 specifies the use of one unidirectional driver (transmitter) with a maximum of 10 receivers. RS-422 is often used in noisy industrial environments or to extend an RS-232 line.

RS-485: This system is for applications where multiple devices want to share data communications on a single serial network. RS-485 can support up to 32 drivers and 32 receivers on a single two-wire (one twisted pair) bus. Most RS-485 systems use a master/slave architecture, where each slave unit has its unique address and responds only to packets addressed to it. However, peer-to-peer networks are also possible.

The Enable Signal

In a balanced differential system, a line driver produces the data signals. The line driver generates a voltage across a pair of signal wires that transmit the data signals. A balanced line driver can have an optional input signal called an *enable* signal. The purpose of the enable signal is to connect the driver to its output terminals. If the enable signal is off, the driver is disconnected from the transmission line. When a driver is disconnected from the network, it is referred to as being in the *tri-state* condition. Because there are multiple drivers (transmitters) on an RS-485 network, and only one transmitter can be enabled at a time, the enable signal is required on all RS-485 networks.

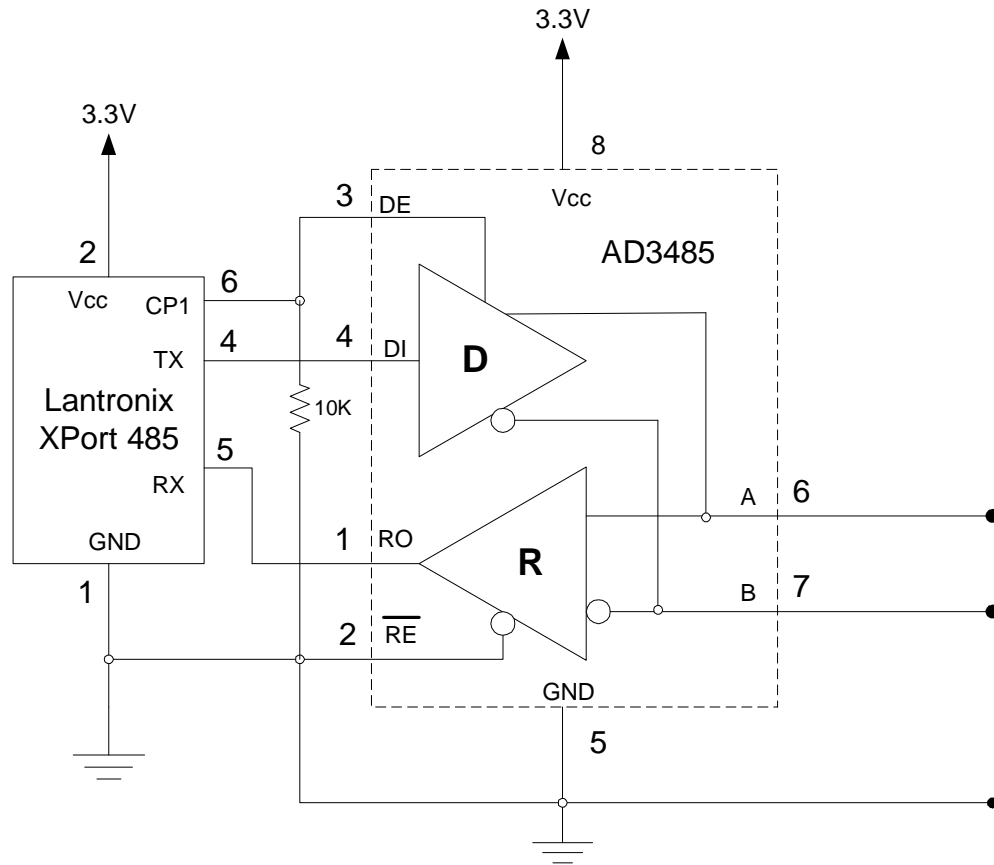
The XPort-485 provides this enable signal for RS-485 two-wire applications. When configured for RS-485 two-wire applications, the XPort automatically asserts the enable signal when it is ready to transmit data from its serial port. Once the data has been transmitted, the XPort automatically de-asserts the enable signal to allow other nodes to transmit their data.

Connecting an XPort-485 to a Transceiver

To use an XPort-485 in an RS-485 application, you must wire the XPort-485 to an external RS-485 transceiver. Figure 1 shows how to connect an XPort to an RS-485 transceiver for a two-wire network. The wiring for an RS-422 transceiver is similar. Please consult the data sheet for the individual transceiver.

Note: *The transceiver configuration in Figure 1 does not allow you to configure the XPort-485 through the serial port. To do so, you need a transceiver that supports both RS-232 and RS-485. The serial configuration is only possible through RS-232. (See [Configuring the XPort-485](#) on page 7.)*

Figure 1. XPort connected to an RS-485 transceiver for a two-wire network



In this schematic, the XPort-485 is connected to a generic AD3485 transceiver. Several manufacturers offer this part. Notice that the transmit enable (DE) is active high. The driver outputs are enabled by bringing the DE line high.

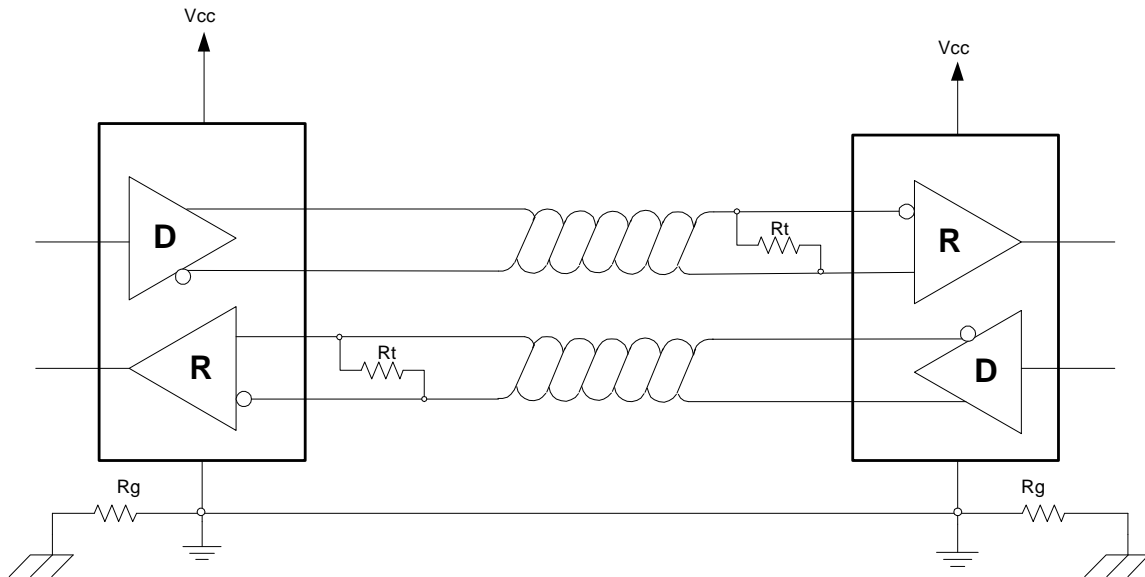
The XPort-485 can be configured to use any one of the three configurable PIO pins as the tri-state enable. You can also set the active state of the pins. For this example, the CP pin must be Active High. (See *Configuring the XPort-485 on page 7.*)

RS-422/RS-485 Network Connections

RS-422 Networks

A typical RS-422 application uses a four-wire interface (two twisted pairs) and a shield. RS-422 networks are often used in a half-duplex mode, where a single master in a system sends a command to a slave device, and the slave responds with data. Typically one device (node) is addressed by the host computer, and a response is received from that device. Systems of this type (four-wire, half-duplex) are often constructed to avoid *data collision* (bus contention) problems on a network. Figure 2 shows a typical RS-422 four-wire interface.

Figure 2. Typical RS-422 four-wire interface



Notice that five conductors are used (two twisted pairs and a ground wire). Also, when the cable lengths are long, or the data rates are high, you must terminate the network. To terminate the network, add a resistor R_t in parallel with the receiver's A and B lines. R_g is an optional resistor between ground and the shield. R_t and R_g should be 100Ω , $\frac{1}{2}$ -watt resistors.

RS-485 Networks

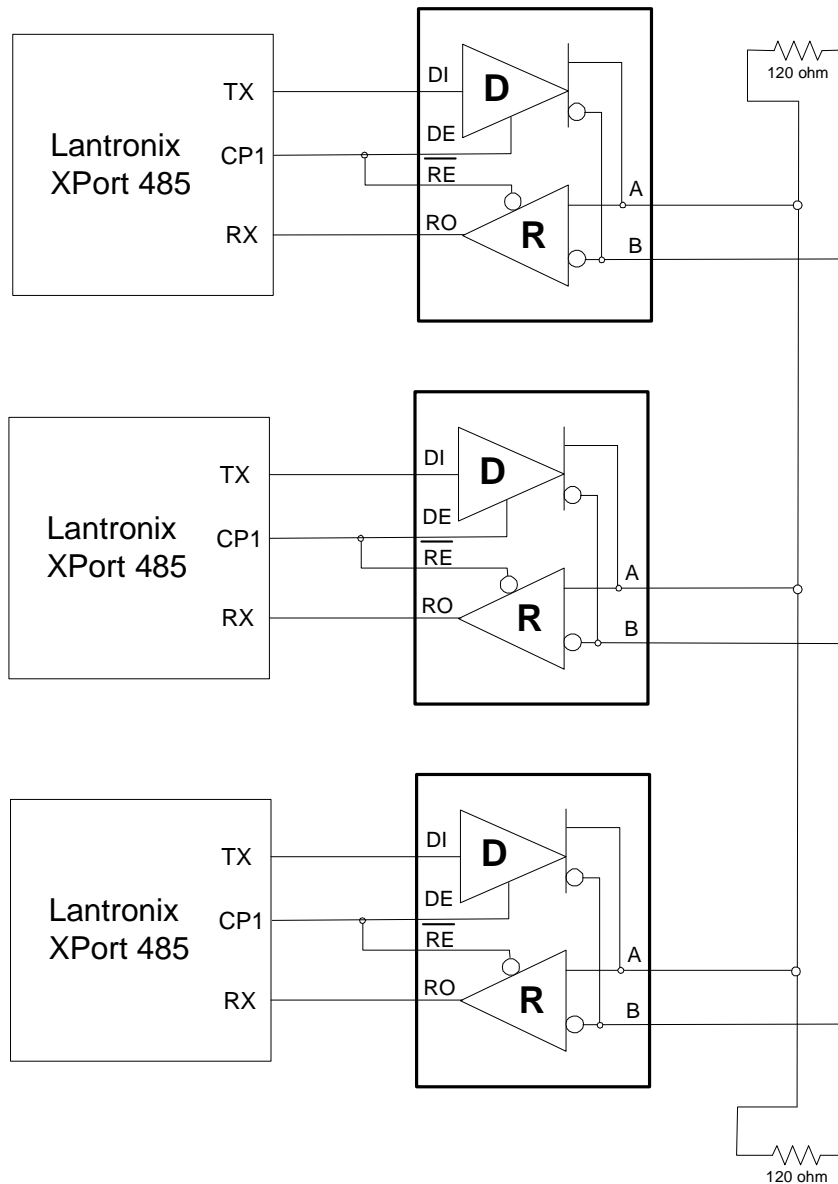
RS-485 permits a balanced transmission line to be shared in a party line or multi-drop configuration. As many as 32 driver/receiver pairs can share a multi-drop network on a single two-wire bus. The length of the network is limited to 4,000 ft between the first node and the last node. You can use RS-485 in two-wire or four-wire multi-drop network applications.

In an RS-485 four-wire network, one node must be a master node and all others slave nodes. The master does not have to have tri-state output.

Figure 3 shows a typical RS-485 two-wire multi-drop network. The tri-state capabilities of RS-485 allow a single pair of wires to share transmit and receive signals for half-duplex communications. The software, the communications protocol, and the tri-state enable signal prevent more than one device from transmitting at the same time. In this configuration, the driver output enable signal is also tied to the receiver output enable. This causes the receiver to tri-state (disabled) whenever the driver output enable signal is enabled (node is transmitting data).

Note that the transmission line is terminated on both ends of the line but not at drop points in the middle of the line. Termination is only required with high data rates or long wire runs.

Figure 3. Typical RS-485 two-wire multi-drop network



Configuring the XPort-485

Setting an IP address

Before you can use the XPort-485, it must have an IP address. The XPort-485 has a default setting for DHCP. On power-up, the XPort-485 tries to obtain an IP address from a DHCP server. If a DHCP server is available on the network, it assigns one to the XPort-485. If no DHCP server is available, the XPort eventually uses AutoIP to assign itself an IP address in the range of 169.254.xx.xx. If your application will use DHCP, then you are ready to go.

If you want to set a static IP address, you have two options:

- ◆ Device Installer, a free utility provided with the XPort-485 is the easiest method.
- ◆ Address Resolution Protocol (ARP) is recommended for those familiar with using it.

Note: On a standard XPort (non-RS-485 version), there is also an option to configure the unit through a serial connection. This does **not** work in an RS-485 two-wire application. The setup menu only works in RS-232 mode. If your application requires configuration through the serial port, then you must design your application to use a transceiver that supports both an RS-232 and an RS-485 connection.

To set the IP address using Device Installer:

1. Start the Device Installer program.
2. Click the **Assign IP** icon.
3. Enter the hardware address (00-20-4A-xx-xx-xx) of the XPort in the **Hardware** field and click **Next**.
4. Select **Assign a specific IP address** and click **Next**.
5. Enter the IP address, subnet mask and default gateway (the gateway parameter is optional) you want to assign the XPort, and then click **Next**.
6. Click **Assign**.

To set the IP address using ARP:

1. Open a Windows command prompt (**Start→Run**), and type **command** or **CMD**, depending on your operating system). Click **OK**.
2. At the DOS command prompt, enter the IP address and MAC address as shown below:


```
C:\ARP -S 192.168.xxx.xxx 00-20-4A-xx-xx-xx
```
3. Press **Enter**.
4. At the next command prompt, Telnet to the same IP address using port 1, for example:


```
C:\Telnet 192.168.xxx.xxx 1 (See Using Telnet on page 9.)
```
5. Press **Enter**. The “failed to connect” message displays within two to three seconds.
6. At the next command prompt, Telnet to the same IP address using port 9999, for example:


```
C:\Telnet 192.168.xxx.xxx 9999 (See Figure 4.)
```
7. Press **Enter**. The **Press Enter to go into Setup Mode** prompt displays.
8. Press **Enter** again as soon as you see the prompt to access the configuration choices. The prompt times out after about 3 seconds.
9. Select **0** for server configuration.
10. Enter the IP Address and press **Enter**. This permanently assigns the IP address,

11. Enter the gateway address (optional) and press **Enter**.
12. Enter the host bits for the subnet mask and press **Enter**. (See *Table 4.1 – Standard IP Network Netmasks* in the *XPort™ User Guide* for more information.)
13. Select **9** to save and exit.

Using Telnet

Telnet is provided with Windows on versions Windows 2000 and later. The Telnet utility runs from a command prompt. To start it, open a command prompt and enter:

```
C:\ telnet <IP address> <port number>
```

For example:

```
C:\ telnet 192.168.1.102 9999
```

opens a Telnet connection to the device with an IP address 192.168.1.102 at port 9999.

The following command displays a Help screen:

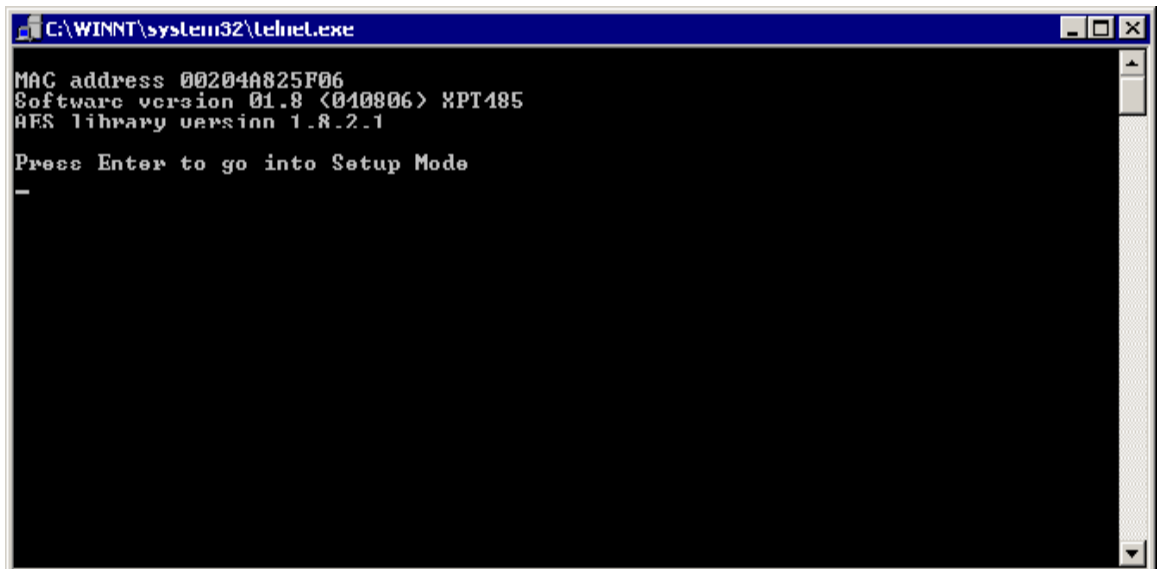
```
C:\ telnet /?
```

The XPort-485 can be configured using a setup menu that is available through a Telnet connection to the unit's IP address and port 9999. To access the setup menu of an XPort at IP address 192.168.1.102, enter the following:

```
C:\ telnet 192.168.1.102 9999
```

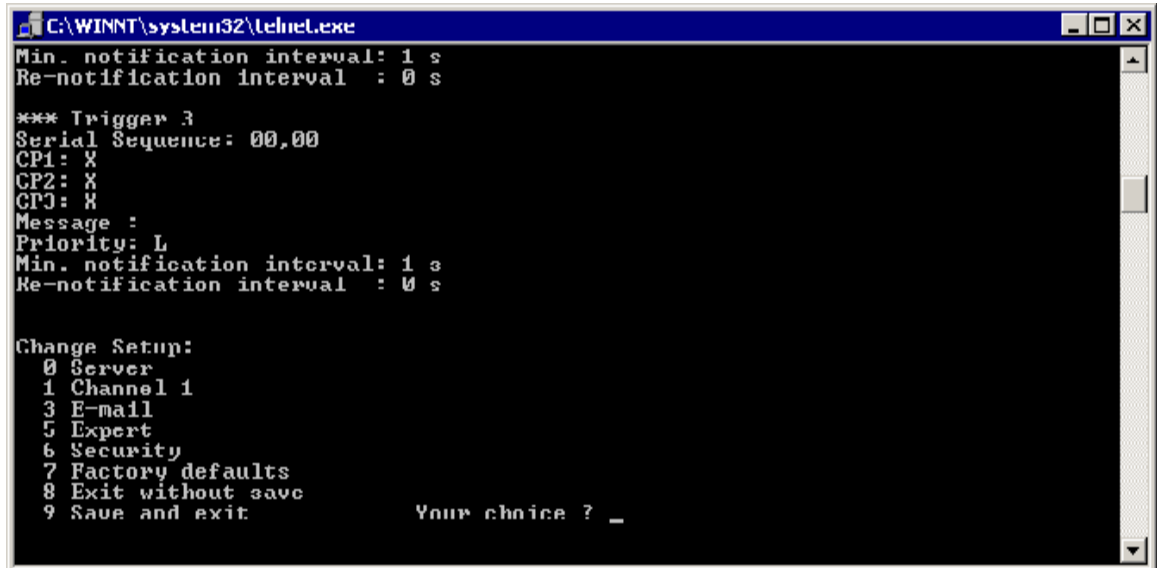
The screen in Figure 4 displays. Press **Enter** to go into setup mode within a few seconds or you will lose your connection.

Figure 4. Telnet screen



Once you press **Enter**, the **Change Setup** menu displays.

Figure 5. Setup Mode



The next section describes how to use this setup menu.

Setting the interface mode on the XPort-485

The serial interface provides several options. You can configure the unit for RS-232, RS-422/RS-485, or RS-485 two-wire. The interface (I/F) mode is a bit-coded byte that you enter in hexadecimal notation.

Table 1. Interface Mode Options

I/F Mode Option	7	6	5	4	3	2	1	0
RS-232							0	0
RS-422/RS-485							0	1
RS-485 two-wire							1	1
7 bit					1	0		
8 bit					1	1		
No Parity			0	0				
Even Parity			1	1				
Odd Parity			0	1				
1 Stop bit	0	1						
2 Stop bit	1	1						

The following table shows how to build some common interface mode settings.

Table 2. Common Interface Mode Settings

Common I/F Mode Settings	Binary	Hex
RS-232, 8 bit, No Parity, 1 Stop bit	0100 1100	4C
RS-232, 7 bit, Even Parity, 1 Stop bit	0111 1000	78
RS-485 2-wire, 8 bit, No Parity, 1 Stop Bit	0100 1111	4F
RS-422, 8 bit, Odd Parity, 1 Stop bit	0101 1101	5D

To set the interface mode, follow these steps:

1. Select **1** for Channel 1 configuration.
2. Press **Enter** to accept default baudrate, or enter new value.
3. Enter the desired I/F mode and press **Enter**.
4. Press **Enter** to accept the remaining default values or enter the desired settings until the **Change Setup** menu displays again.
5. Select **9** to save and exit.

Figure 6 shows an example of changing the I/F mode from 4C to 4F.

Figure 6. Changing I/F Mode from 4C to 4E

```

C:\WINNT\system32\telnet.exe
Re-notification interval : 0 s

*** Trigger 3
Serial Sequence: 00,00
CP1: X
CP2: X
CP3: X
Message :
Priority: L
Min. notification interval: 1 s
Re-notification interval : 0 s

Change Setup:
0 Server
1 Channel 1
3 E-mail
5 Expert
6 Security
7 Factory defaults
8 Exit without save
9 Save and exit          Your choice ? 1

Baudrate <9600> ?
I/F Mode <4C> 74f

```

Setting the RS-485 TX Enable Active Level

You can configure the RS-485 TX enable signal for Active High or Active Low signal levels. There are two ways to set this. One is through the configuration menu using Telnet. The second is through Device Installer. To set the RS-485 TX enable active level using Device Installer, see the next section.

Setting the RS-485 TX Enable Pin

The XPort-485 has three programmable I/O pins. You can configure the three pins for the following functions:

Table 3. RS-485 TX Enable Pin Functions

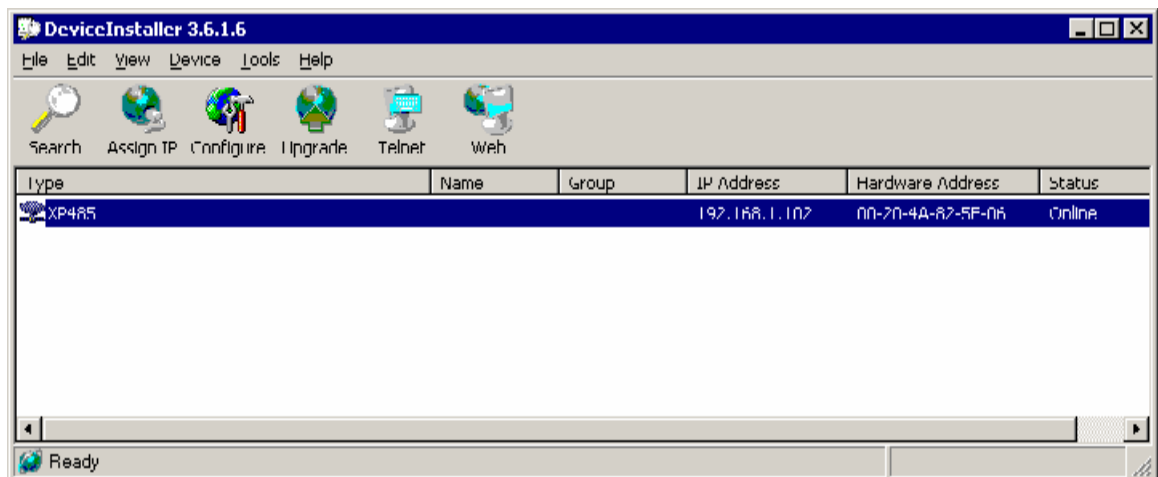
PI/O Pin	Function	Description
CP1	CTS	Clear to send (hardware handshaking)
	IN1	Set Pin as an input
	OUT1	Set Pin as an output
	LED1	Diagnostic mode
	RS-485_TXEN	Set pin as the RS-485 transmit enable
CP2	DCD	Carrier Detect signal
	IN2	Set Pin as an input
	OUT2	Set Pin as an output
	RS-485_TXEN	Set pin as the RS-485 transmit enable
CP3	RTS	Request to send (hardware handshaking)
	DTR	Data Terminal ready
	IN3	Set Pin as an input
	OUT3	Set Pin as an output
	LED3	Diagnostic mode
	RS-485_TXEN	Set pin as the RS-485 transmit enable

Any one of these pins can be used as the RS-485 TX-enable. For the XPort to work correctly, only one of the pins can be set to RS-485_TXEN. The easiest way to set the pins is through the Lantronix Device Installer utility.

Using Device Installer

You can use Device Installer to search for Lantronix devices on the network. Once the devices are found, you can configure them. Figure 7 shows a typical result of pressing the **Search** button.

Figure 7. Result of a search

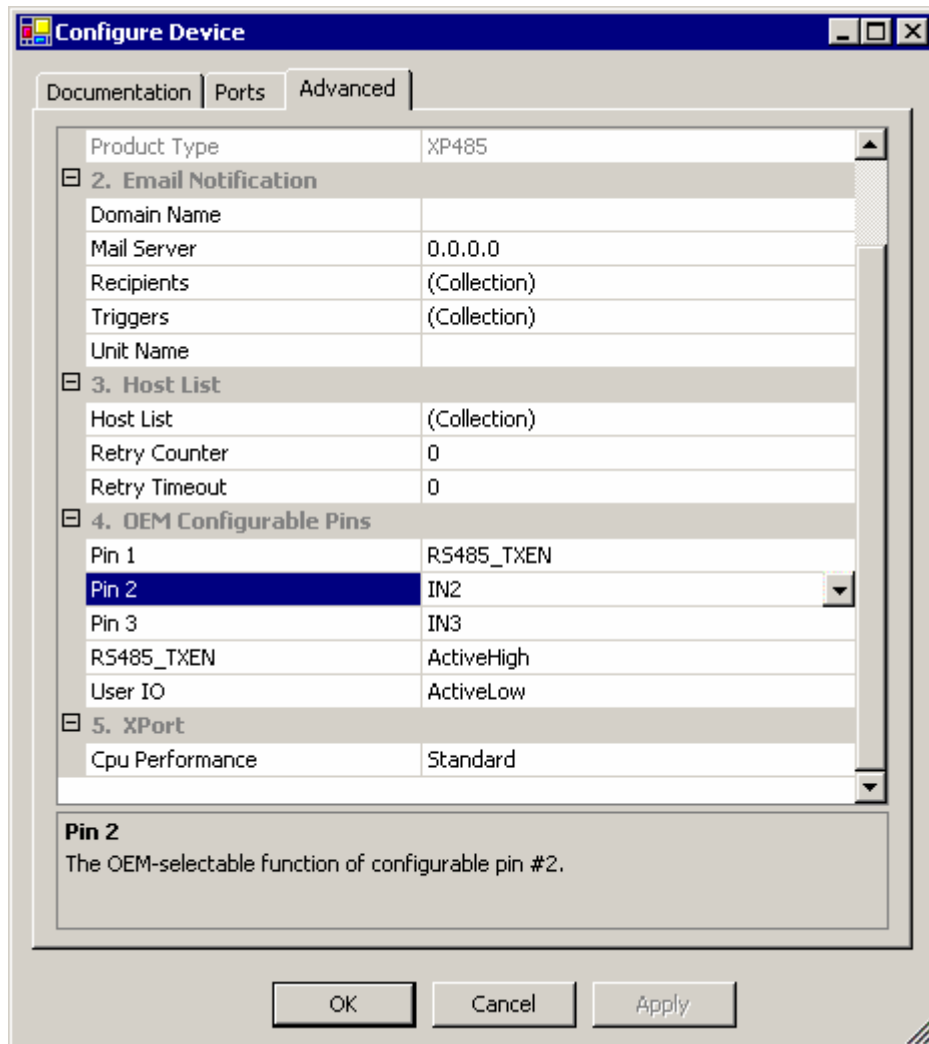


To select the unit and view current settings:

1. Double-click the highlighted **XP485**.

- Click the **Advanced** tab. Figure 8 shows the advanced configuration options. Below OEM Configuration Pins, you see the current settings.

Figure 8. Advanced configuration options



- Select **Pin 1**, **Pin 2**, or **Pin 3**. A drop-down list arrow displays to the right.
- To see a list of settings that are possible for the pin, click the **arrow**.

Note: Device Installer only allows you to set one of the pins to **RS-485_TXEN**.

To configure the RS-485 TX enable signal for Active High or Active Low:

- Click **RS-485_TXEN** on the left side of the list. A drop-down list arrow displays on the right side.
- Click the **arrow** and select **ActiveHigh** or **ActiveLow**.

To store the new settings in the XPort-485:

- Click the **Apply** button.
- Click the **OK** button. Device Installer writes the new configuration settings to the XPort-485.