

**ICP PANEL-TEC
PEX3000 II**

**MODBUS
PORT EXPANDER**

**INSTALLATION
AND
OPERATION
GUIDE**

REVISION HISTORY

Revision	Date	Author	Comments
000	29 Aug 2008	Keira Majors	Initial release.
001	16 Sep 2008	David Walker	Updated configuration information
002	13 Feb 2009	David Walker	Changed pn: 6003-0403 → 6003-403-100

TABLE OF CONTENTS

Revision History	2
Table of Contents.....	3
Introduction	4
Port Configuration	4
Power Supply.....	4
Ordering Information.....	4
Hardware	5
Serial Ports.....	5
Local Master Port (LCL)	5
Slave Port (SLV)	5
Remote Master Port (REM).....	5
Serial Port Pinouts	5
Serial Cables.....	6
232 Communications	6
485 Communications	6
PEX3000 II Power Supply.....	6
Wall Mount Power Supply	7
External Power Supply	7
LED Indicators	8
PEX3000 II Configuration.....	9
Configuration Cable	9
Default Configuration.....	9
Changing the Configuration	10
Local Port Configuration Settings	11
Frame Format	11
Gap Time	11
Timeout.....	11
Slave Port Configuration Settings	12
Frame Format	12
Gap Time	12
Remote Port Configuration Settings	13
Port Mode	13
Frame Format	13
Gap Time	13
Timeout.....	13
PEX3000 II Operation	14
Port Multiplexer Operation.....	14

INTRODUCTION

The PEX3000 II is a DIN Rail Mount version of the original PEX3000. It is a 3-Port device that allows two Modbus Masters to communicate with one or more Modbus Slaves. It is most commonly used as a multiplexer to prevent Modbus message collisions from the two masters. Each port on the PEX3000 is individually configured so the Modbus Master(s) and Modbus Slave(s) can have different port configurations. In addition, they can use different Modbus protocol formats (RTU/ASCII) and the PEX3000 will perform the necessary conversions.

Port Configuration

The PEX3000 II has 3 DB9 ports. All ports can be configured for either RS232 or 2-Wire RS485 communication. The first port is a DB9 female RS232 DCE port for connection of the Local Master. The second port is a DB9 Male RS232 DTE for connection of the Modbus Slave(s). The third port is a DB9 female RS232 DCE port for connection of a Remote (or second local) Master. The RS485 signals are located on the same pins on all three ports regardless of whether they are DTE or DCE.

The utility to configure the ports is built into the PEX3000 II. It is activated by connecting the RS-232 pins of any of the ports to the serial port of a PC running a terminal communication program such as HyperTerminal, and entering the correct key sequence within 5 seconds of powering up the PEX3000 II.

Power Supply

The PEX3000 II is powered by any DC voltage from 7 to 27 volts. A 3-position pluggable terminal block is used to connect the power supply. **Please note that the pinout of the 3-position plug is not compatible with the original PEX3000.** The terminal block plug must be re-wired if a power supply used with an older PEX3000 is being used to power a PEX3000 II.

Ordering Information

The part numbers for the PEX3000 II Modbus unit, power supply, and optional cables are shown in the following table.

Table 1 - Part Numbers

Part Number	Description
6003-403-100	PEX3000 II
4000-0202	PEX3000 II Power Supply
6000-RS232	PEX3000 II Configuration Cable Modbus Device Cable for any Port (Straight-Through DB9F to DB9M RS232 Cable)
6000-RS232N	Modbus Device Cable for any Port (Null-Modem DB9F to DB9F RS232 Cable)
6000-0003	Modbus Device Cable for Local and Remote Master Ports (DB9M to Stripped Wires, 2-Wire RS485 Cable)
6000-0006	Modbus Device Cable for Slave Port (DB9F to Stripped Wires, 2-Wire RS485 Cable)
6000-0008	Modbus Device Cable for Local and Remote Master Ports (DB9M to Stripped Wires, RS232 Cable)
6000-0009	Modbus Device Cable for Slave Port (DB9F to Stripped Wires, RS232 Cable)

HARDWARE

Serial Ports

The PEX3000 II has three serial ports with DB9 connectors. All ports can be configured for either RS232 or 2-Wire RS485 communication.

Local Master Port (LCL)

The Local Master port can be used to connect a local Modbus master device to the PEX3000 II. A DB9-Female connector is used for this port which requires the mating cable to have a DB9-Male connector on it.

Slave Port (SLV)

The Slave Port is used to connect one or more Modbus slave devices to the PEX3000 II. A DB9-Male connector is used for this port which requires the mating cable to have a DB9-Female connector on it.

Remote Master Port (REM)

The Remote Master port can be used to connect either a second local master or a remote master through an RF link. A DB9-Female connector is used for this port which requires the mating cable to have a DB9-Male connector on it.

Serial Port Pinouts

The pinouts for the serial ports are shown in the table below.

Table 2 - Serial Port Pinouts

Local & Remote Master Ports DB9-Female			Slave Port DB9-Male		
Pin	Label	Description	Pin	Label	Description
1	D+	RS485 D+	1	D+	RS485 D+
2	TXD	RS232 TxD	2	RXD	RS232 RxD
3	RXD	RS232 RxD	3	TXD	RS232 TxD
4	DTR	RS232 DTR	4		No Connect
5	GND	Signal Ground	5	GND	Signal Ground
6	D-	RS485 D-	6	D-	RS485 D-
7	CTS	RS232 CTS	7	RTS	RS232 RTS
8	RTS	RS232 RTS	8	CTS	RS232 CTS
9		No Connect	9	-	No Connect

Serial Cables

232 Communications

When a port is configured for RS232 communications, an off-the-shelf straight-through or null-modem is generally used to connect to other Modbus devices. The type of cable required and optional cable that can be purchased from ICP -Panel-Tec are shown in the following table.

Table 3 – RS232 Cables

PEX3000 II Port	Modbus Device Type	Recommended Cable
Local or Remote Master	RS232 DTE with DB9 connector	6000-RS232 (Straight-Through DB9/DB9)
Local or Remote Master	RS232 DCE with DB9 connector	6000-RS232N (Null-Modem DB9/DB9)
Local or Remote Master	RS232 DTE/DCE with terminal block	6000-0008 (DB9M to Stripped Wires)
Slave	RS232 DTE with DB9 connector	6000-RS232N (Null-Modem DB9/DB9)
Slave	RS232 DCE with DB9 connector	6000-RS232 (Straight-Through DB9/DB9)
Slave	RS232 DTE/DCE with terminal block	6000-0009 (DB9F to Stripped Wires)

485 Communications

When a port is configured for RS485 communications, the connector on the Modbus device(s) being connected to the PEX3000 II can vary significantly. Because of this, all optional RS485 cables offered by ICP Panel-Tec end in stripped wires to provide maximum flexibility. The cables available for both master ports and the slave port are shown in the following table.

Table 4 – RS485 Cables

PEX3000 II Port	Modbus Device Type	Recommended Cable
Local or Remote Master	2-Wire RS485 with any connector	6000-0003 (DB9 Male to Stripped Wires)
Slave	2-Wire RS485 with any connector	6000-0006 (DB9 Female to Stripped Wires)

PEX3000 II Power Supply

The PEX3000 II requires a 500 mA DC power supply with any voltage from 7 – 27 Volts DC. A pluggable terminal block is used for connection of the power supply. The format of the terminal socket on the PEX3000 II is shown in the following figure.

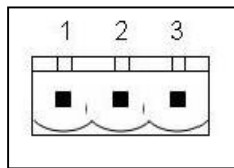


Figure 1 – Power Supply Connector

Wall Mount Power Supply

The following figure shows how to connect a wall-mount power supply to the PEX3000 II.

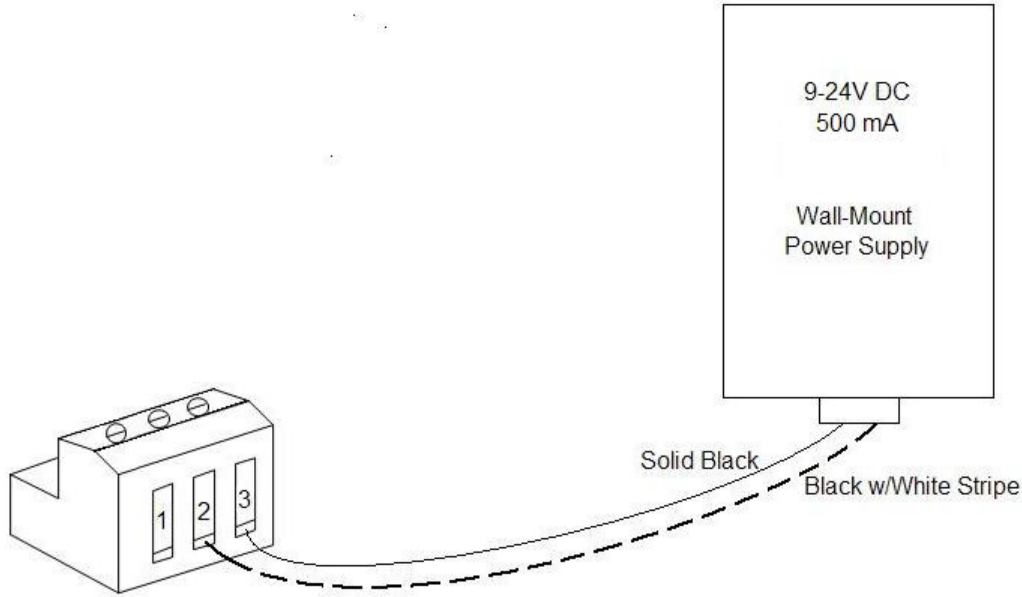


Figure 2 – Connecting a Wall-Mount Power Supply

External Power Supply

The following figure shows how to connect an external power supply to the PEX3000 II. The V- and V+ connections are mandatory but the Earth Ground Reference is optional.

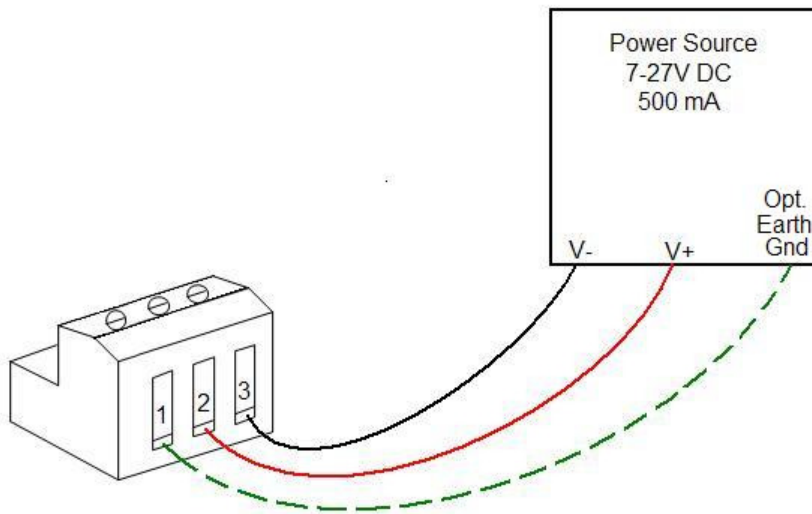


Figure 3 – Connecting an External Power Supply

LED Indicators

There are a total of 4 Bi-color LED indicators on the PEX3000 II. The APP LED displays the overall status of the PEX3000 II. The LCL LED displays communications activity on the Local Master port. The SLV LED displays communications activity on the Slave port. The REM LED displays communications activity on the Remote Master port.

Table 5 –APP LED Indications

For this state:	LED is:	To indicate:
No Power	Off	There is no power applied to the device.
Startup	Solid Green	The PEX3000 II is checking the ports for a valid configuration startup sequence prior to entering RUN Mode.
Run Mode	Flashing Green (250ms On, 250ms Off)	The PEX3000 II is operating normally in RUN Mode.
Configuration Mode	Flashing Green (1.5 sec On, 1.5 sec Off)	The PEX3000 II is in Configuration Mode.
Fatal Error	Flashing Yellow (any rate)	The PEX3000 II has experienced a fatal error and has halted communications.

Table 6 – LCL LED Indications

For this state:	LED is:	To indicate:
Receive Data	Red	The PEX3000 is receiving data from the Local Modbus Master.
Transmit Data	Green	The PEX3000 is transmitting data to the Local Modbus Master.

Table 7 – SLV LED Indications

For this state:	LED is:	To indicate:
Receive Data	Red	The PEX3000 is receiving data from a Modbus Slave.
Transmit Data	Green	The PEX3000 is transmitting data to a Modbus Slave

Table 8 – REM LED Indications

For this state:	LED is:	To indicate:
Receive Data	Red	The PEX3000 is receiving data from the Remote Modbus Master.
Transmit Data	Green	The PEX3000 is transmitting data to the Remote Modbus Master.

PEX3000 II CONFIGURATION

Configuration Cable

Any of the ports on the PEX3000 II may be used for configuration via the RS-232 signals on the port. A straight-through DB9 cable (Order Number 6000-RS232) can be used to connect the LCL or REM port on the PEX300 II to a serial port on a PC for configuration. A null modem cable (Order Number 6000-RS232N) is necessary to configure the PEX3000 II via the SLV port. The minimum pin connections for the standard configuration cable are shown in the following figure.

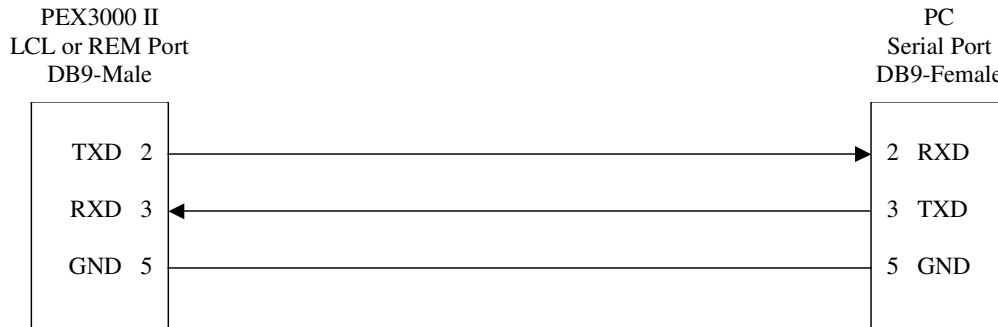
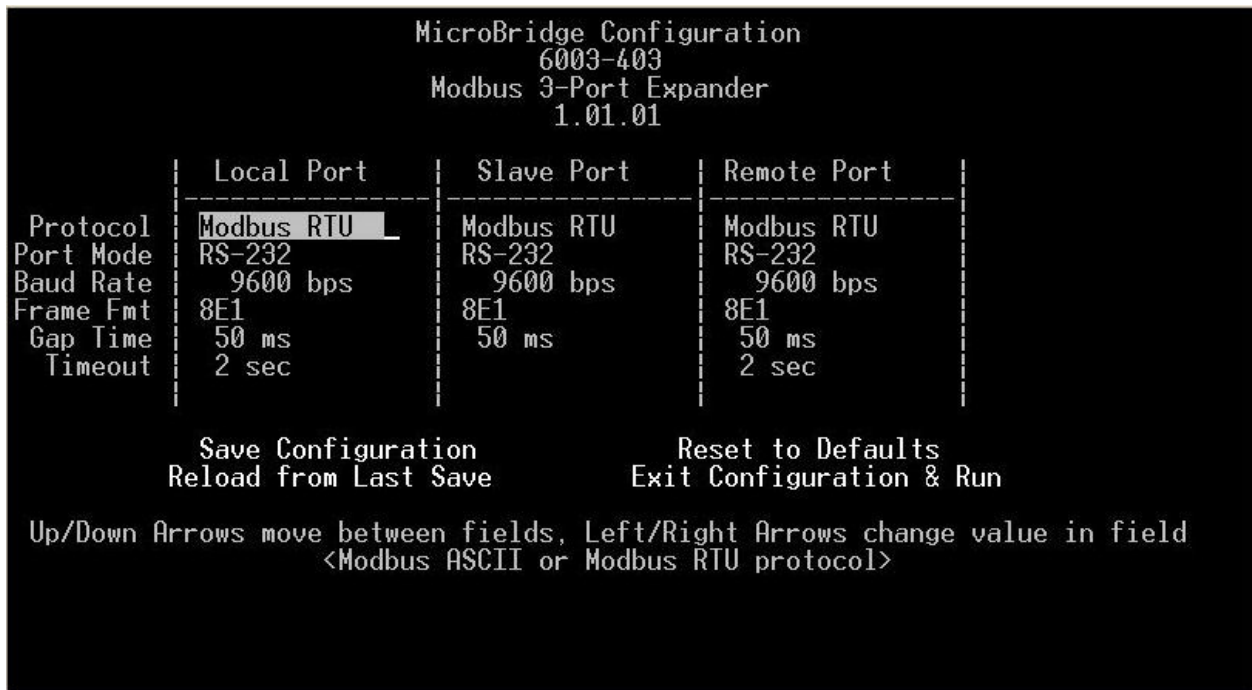


Figure 4 – Minimum Configuration Cable Pinout for LCL or REM port

Default Configuration

The default configuration is shown on the following configuration screen.



Changing the Configuration

The configuration stored in the PEX3000 II may be changed from the default configuration by entering Configuration Mode.

1. Power off the PEX3000 II.
2. Attach a configuration cable between any port on the PEX3000 II and a serial port on a PC.
3. Start a terminal program, such as HyperTerminal on the PC, and connect using the following settings:
 - Baud = 19200 bps
 - Data bits = 8
 - Parity = None
 - Stop Bits = 1
 - Flow Control = None
4. Apply power to the PEX3000 II, and send the configuration start sequence (“+++”) by pressing the **plus** key three times within 5 seconds of startup.

Once the PEX3000 II is in Configuration Mode, it will send its current configuration information to the terminal program, as follows:

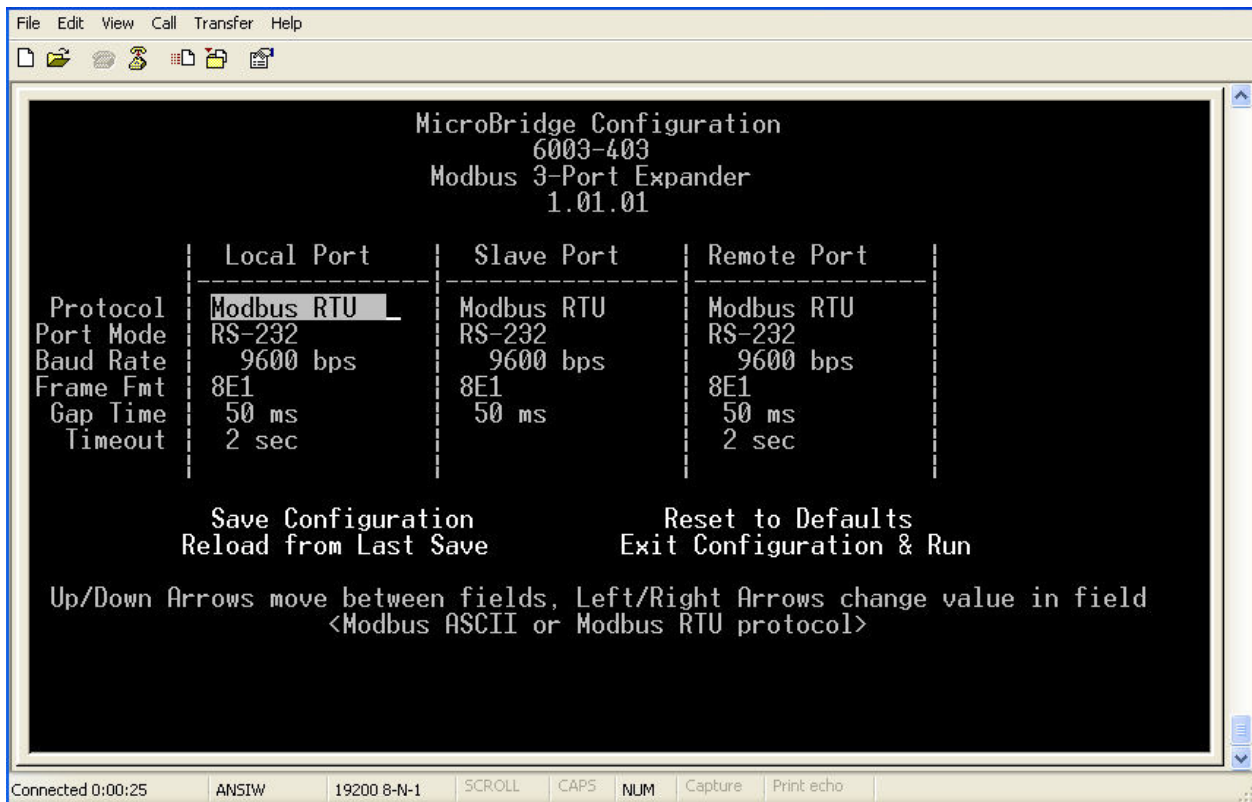


Figure 2 – PEX3000 II Configuration Display

Use the **up** and **down** arrows on your keyboard to navigate to the field you want to change, then use the **left** and **right** arrows to change the value in that field. When you are finished, navigate to “Save Configuration” and press the **Enter** key to save the configuration information to the PEX3000 II. If the configuration is invalid, a message will be displayed indicating the reason. If the configuration was successfully saved, a “Configuration Saved” message will be displayed.

Once the configuration has been saved, remove power from the PEX3000 and remove the configuration cable.

Local Port Configuration Settings

The Local port, labeled “LCL” on the front panel of the PEX3000 II, may be connected to a local Modbus master device. Any device that will initiate Modbus requests is considered to be a Modbus master device.

The following configuration settings may be changed for the Local port:

Setting	Values	Default
Protocol	Modbus RTU Modbus ASCII	Modbus RTU
Port Mode	RS-232 RS-485	RS-232
Baud Rate	9600 bps 19200 bps 38400 bps 57600 bps 115200 bps	9600 bps
Frame Format	7E1* 7O1* 7N2* 8N1 8E1 8O1 8N2	8E1
Gap Time	5 ms – 500 ms	50 ms
Timeout	250 ms – 10 sec	2 sec

*7 data bits not supported for Modbus RTU

Frame Format

Frame Format is listed by data bits (7 or 8), parity (Even, Odd or None), and stop bits (1 or 2) - i.e. 8E1 indicates 8 data bits, even parity, and 1 stop bit.

Note: Because Modbus RTU is encoded as 8-bit binary data, frame formats utilizing 7 data bits are not supported for Modbus RTU.

Gap Time

Gap Time is the maximum time allowed between received characters in a Modbus RTU message before “giving up” on that message. It is there to handle sudden loss of communications (power loss, cable unplugged or severed, etc.) smoothly. The default value of 50ms should be sufficient for most networks.

Timeout

Timeout is the maximum time that the Local port will wait for a response to be received on the Slave port before timing out on the current request and listening for a new request. The timer starts when the original request message is received on the Local port. For proper timeout handling, it **MUST** be set to a value lower than the timeout programmed into the Modbus master device. For situations where two masters are polling the same slave, the timeout value for the Local port should be set to about ½ the timeout value programmed into the master.

Slave Port Configuration Settings

The Slave port, labeled “SLV” on the front panel of the PEX3000 II (or “NET” for the first run of products), may be connected to a Modbus slave device. Any device that will only respond to Modbus requests addressed to itself is considered to be a Modbus slave device.

The following configuration settings may be changed for the Slave port:

Setting	Values	Default
Protocol	Modbus RTU Modbus ASCII	Modbus RTU
Port Mode	RS-232 RS-485	RS-232
Baud Rate	9600 bps 19200 bps 38400 bps 57600 bps 115200 bps	9600 bps
Frame Format	7E1* 7O1* 7N2* 8N1 8E1 8O1 8N2	8E1
Gap Time	5 ms – 500 ms	50 ms

*7 data bits not supported for Modbus RTU

Frame Format

Frame Format is listed by data bits (7 or 8), parity (Even, Odd or None), and stop bits (1 or 2) - i.e. 8E1 indicates 8 data bits, even parity, and 1 stop bit.

Note: Because Modbus RTU is encoded as 8-bit binary data, frame formats utilizing 7 data bits are not supported for Modbus RTU.

Gap Time

Gap Time is the maximum time allowed between received characters in a Modbus RTU message before “giving up” on that message. It is there to handle sudden loss of communications (power loss, cable unplugged or severed, etc.) smoothly. The default value of 50ms should be sufficient for most networks.

Remote Port Configuration Settings

The Remote port, labeled “REM” on the front panel of the PEX3000 II (or “USR” for the first run of products), may be connected to another local Modbus master device, or to a remote Modbus master device via a radio modem or other gateway. Any device that will initiate Modbus requests is considered to be a Modbus master device.

The following configuration settings may be changed for the Remote port:

Setting	Values	Default
Protocol	Modbus RTU Modbus ASCII	Modbus RTU
Port Mode	RS-232 RS-485 RS-232 RTS/CTS	RS-232
Baud Rate	9600 bps 19200 bps 38400 bps 57600 bps 115200 bps	9600 bps
Frame Format	7E1* 7O1* 7N2* 8N1 8E1 8O1 8N2	8E1
Gap Time	5 ms – 500 ms	50 ms
Timeout	250 ms – 10 sec	2 sec

*7 data bits not supported for Modbus RTU

Port Mode

In addition to RS-232 and RS-485, the Remote port also supports RS-232 with hardware flow control (RTS/CTS). In this mode, the Remote port will raise the RTS signal and wait for an answering CTS signal prior to transmitting a message.

Frame Format

Frame Format is listed by data bits (7 or 8), parity (Even, Odd or None), and stop bits (1 or 2) - i.e. 8E1 indicates 8 data bits, even parity, and 1 stop bit.

Note: Because Modbus RTU is encoded as 8-bit binary data, frame formats utilizing 7 data bits are not supported for Modbus RTU.

Gap Time

Gap Time is the maximum time allowed between received characters in a Modbus RTU message before “giving up” on that message. It is there to handle sudden loss of communications (power loss, cable unplugged or severed, etc.) smoothly. The default value of 50ms should be sufficient for most networks.

Timeout

Timeout is the maximum time that the Local port will wait for a response to be received on the Slave port before timing out on the current request and listening for a new request. The timer starts when the original request message is received on the Local port. For proper timeout handling, it MUST be set to a value lower than the timeout programmed into the Modbus master device. For situations where two masters are polling the same slave, the timeout value for the Local port should be set to about ½ the timeout value programmed into the master.

PEX3000 II OPERATION

Port Multiplexer Operation

The PEX3000 II waits until a complete Modbus message has been received on the Local or Remote port.. If the message is valid, it will buffer the message until the Slave port is free. At this point it will forward the message out the Slave port, converting between Modbus ASCII and RTU if necessary. It then waits for a response to be received from the addressed slave on the Slave port. If a response is received before the configured timeout value, the Slave port will forward the response to the originating port, once again converting between Modbus ASCII and RTU if necessary, and the originating port will transmit the response back to the originating Modbus master device.

Because the PEX3000 II actively buffers and converts messages on the fly, all of the ports can be configured for different protocols, port modes, baud rates and frame formats without affecting throughput.