

MMTCPBCONV

Serial/Ethernet Converter & Modbus Gateway



USER GUIDE



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TABLE OF CONTENTS

1. Description	4
2. Operating Modes.....	5
2.1 Mode 0.....	5
2.1.1 Modbus gateway – Using TCP.....	5
2.1.2 Transparent Mode – Using TCP	5
2.1.3 Modbus gateway – Using UDP.....	5
2.1.4 Transparent Mode – Using UDP	5
2.2 Mode 1.....	6
2.2.1 Modbus gateway – Using TCP.....	6
2.2.2 Transparent Mode – Using TCP	6
2.3 Mode 2.....	6
3. Application Example – Mode 0.....	7
4. Physical Dimensions	8
4.1 Grounding/Shielding.....	8
5. Technical Specification	9
6. Wiring	9
7. Configuration	10
7.1 Power Connections.....	10
7.2 Ethernet Connection.....	10
7.3 Indication LED'S.	10
7.4 RS485 Termination.	11
7.5 Setting the jumpers for the RS485 Termination (J5).	11
7.6 Connecting To a PC which is not Connected to a Network.	12
7.7 Connecting to a PC which is Connected to a Network.	14
7.8 Testing the Connection.....	14
7.9 Viewing Web Pages	15
7.10 Troubleshooting Guide.	17
7.11 Parameter Configuration	18
8. Conformity Certificate	21

1. Description

The Ethernet/Serial Boxed Converter enables serial devices, such as PROMUX modules, communicating on RS232/485 to be connected to a 10/100 Base-TX Ethernet network.

The Ethernet/Serial Converter can be configured to operate in a number of different modes depending on the application. It can be configured as a transparent data link or it can perform the gateway function of converting Modbus TCP messages to Modbus RTU messages.

Mode 0: Server with slave device connected to the serial port, multi socket.

Mode 1: Server with slave device connected to the serial port or to be used with a Client Converter for point-to-point, single socket.

Mode 2: Client to be used with a Server Converter for point-to-point, single socket.

The Ethernet/Serial Converter includes a web server which enables access to internal parameters for configuration. This allows configuration of IP address, serial data format and operating modes. The web server can be accessed by most web browsers.

The Ethernet/Serial Converter supports the FTP protocol which enables the web pages to be customized if required.

Each Ethernet/Serial Boxed Converter has a unique Ethernet IP address which must be programmed into the PC or PLC. The IP address in the converter is configured via the Web Server. Any standard Web browser such as Internet Explorer can be used to access the web pages where configuration is carried out. The converters are factory programmed with a default IP address of 169.254.111.111. This address must be changed before the converter is added to an existing network.

The web page address for viewing the setup parameters is <http://169.254.111.111/index.htm> The web page address for configuring the converter is <http://169.254.111.111/ip.htm>

The master device which is polling the modules must be configured with the IP address of the converter and with the modbus ID of the Modbus modules. As each RS485 network is separate, it is possible to have repeated Modbus ID's on the RS485 networks. The IP address differentiates between the different RS485 networks. Consequently, many hundreds of PROMUX modules may be added to a Ethernet network.

2. Operating Modes

2.1 Mode 0

Mode 0 is the standard server configuration for most ethernet/serial converter applications. This mode has been designed to service multiple sockets which enables up to 4 masters to communicate with the slaves which are connected to the converter.

Each socket is serviced in turn, and any message in the socket is sent out on the serial port. The converter then starts a timer waiting for a reply. When a reply is received the message is put into the initiating socket and send out on the Ethernet network. The converter then checks the next socket. If no reply is received then the timer expires and the converter checks the next socket. This timer is configured on the ip.htm web page and is labeled" Serial Reply Timeout".

The converter can also accept messages on UDP instead of TCP. Operation is the same and does not need any special configuration.

There are a number of different configurations for this mode as follows:

2.1.1 Modbus gateway – Using TCP

When used as a Modbus gateway the client must be configured to use **Port 502**. This is a reserved port number for Modbus TCP applications and informs the converter that it must implement the protocol conversion from Modbus TCP on the Ethernet network to Modbus RTU on the serial network.

2.1.2 Transparent Mode – Using TCP

When used in transparent mode the client must be configured to use **Port 1234**. This port number informs the converter that any data that is received in a socket must be transmitted out the serial port without any protocol conversion.

2.1.3 Modbus gateway – Using UDP

When used as a Modbus gateway the client must be configured to use **Port 502**. This is a reserved port number for Modbus TCP applications and informs the converter that it must implement the protocol conversion from Modbus TCP on the Ethernet network to Modbus RTU on the serial network.

2.1.4 Transparent Mode – Using UDP

When used in transparent mode the client must be configured to use **Port 1234**. This port number informs the converter that any data that is received in a UDP datagram must be transmitted out the serial port without any protocol conversion.

2.2 Mode 1

Mode 1 is a server configuration and is similar to Mode 0 except that this mode only makes use of a single socket.

This single socket implementation waits for messages to come in on the Ethernet network and sends them out the serial port. Any messages being received on the serial port are sent out on the Ethernet network. As there is only one socket, there is no need for the timer as in mode 0.

There are a number of different configurations for this mode as follows:

2.2.1 Modbus gateway – Using TCP

When used as a Modbus gateway the client must be configured to use **Port 502**. This is a reserved port number for Modbus TCP applications and informs the converter that it must implement the protocol conversion from Modbus TCP on the Ethernet network to Modbus RTU on the serial network.

2.2.2 Transparent Mode – Using TCP

When used in transparent mode the client must be configured to use a **PORT** number chosen by the user. This port number informs the converter that any data that is received in a socket must be transmitted out the serial port without any protocol conversion and must not be one of the reserved numbers 21(ftp), 80(http), 502(Modbus). This is the mode that is used to create a transparent **point-to-point** serial-ethernet-serial **link** with a client converter.

2.3 Mode 2

Mode 2 is a Client configuration and is used to make a transparent link with a server converter. This mode only makes use of a single socket.

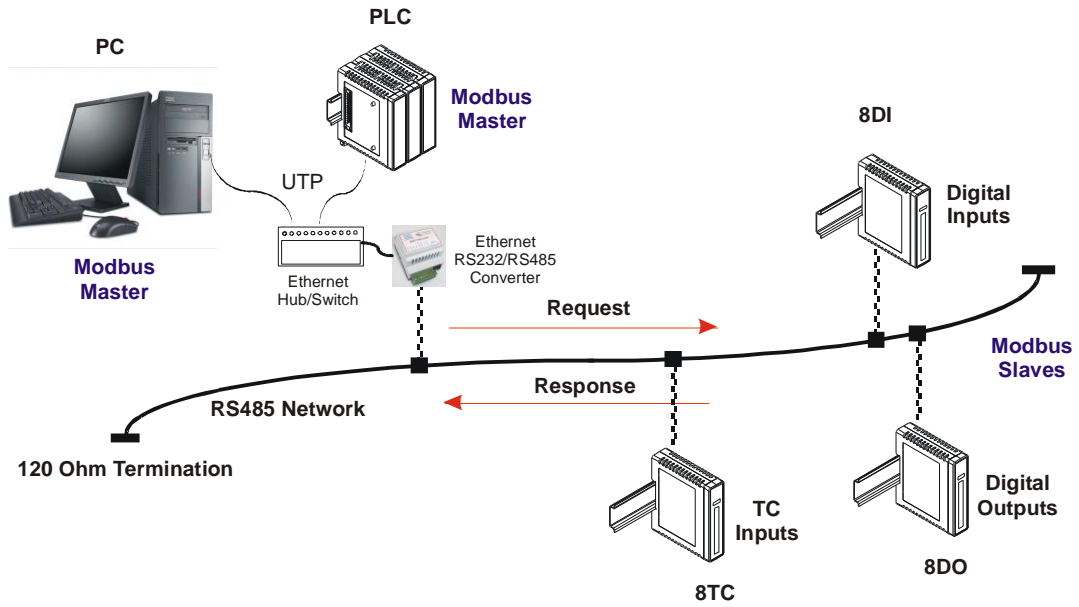
This single socket implementation waits for messages to come in on the Ethernet network and sends them out the serial port. Any messages being received on the serial port are sent out on the Ethernet network. As there is only one socket, there is no need for the timer as in mode 0.

When messages are received on the serial port they are sent out on the Ethernet network. Due to the fact that the Ethernet network is normally faster than the serial data being received, the serial message being received will get broken up into small blocks and then sent on the Ethernet network. This could result in the Ethernet network being flooded with many messages sending one or two characters at a time. To prevent this from happening, a timer is used. This timer starts when the first character is received on the serial port and when it expires any received characters in the serial port buffer are sent out on the Ethernet network. This timer is disabled if a value of 0 is programmed. The timer is labeled “ **Char Timeout** ” on the ip.htm web page.

The client converter must be configured to use a **PORT** number chosen by the user. This port number must be the same which is programmed into the server converter. This Port number informs the converter that any data that is received in a socket must be transmitted out the serial port without any protocol conversion and must not be one of the reserved numbers 21(ftp), 80(http), 502(Modbus). This is the mode that is used to create a transparent **point-to-point** serial-ethernet-serial **link** with a server converter.

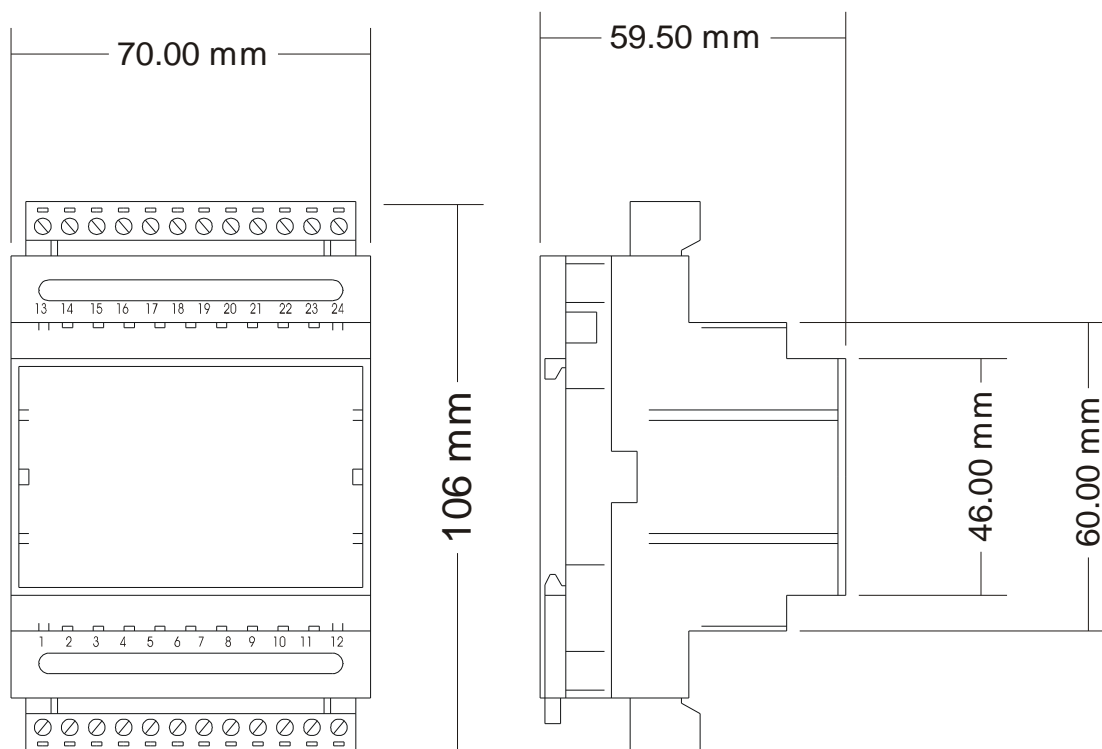
The Client converter has to open the socket with the Server converter. In order to do this, the IP address of the Server must be configured in the Client converter. This is done on the ip.htm web page and is labeled "Server IP".

3. Application Example – Mode 0



4. Physical Dimensions

The Converter enclosure is shown below. The module has been designed with a quick snap-in assembly for mounting onto DIN-rail's as per DIN EN 50 022.



4.1 Grounding/Shielding

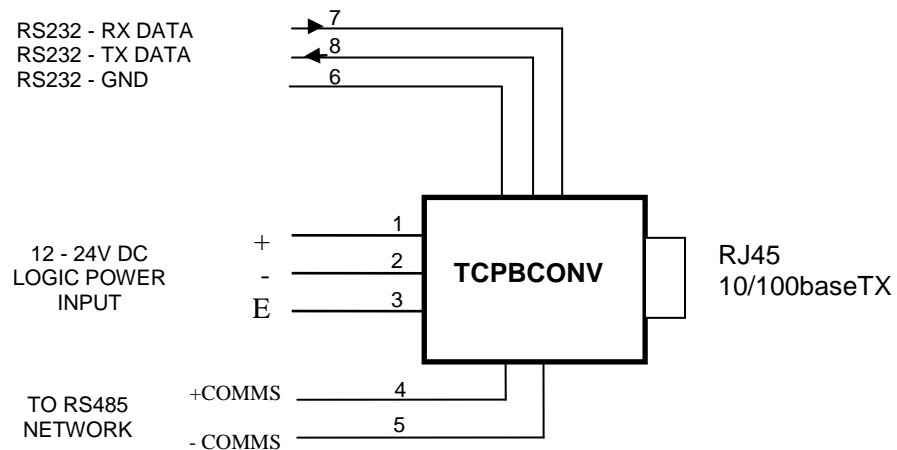
In most cases, the converter will be installed in an enclosure along with other devices which generate electromagnetic radiation. Examples of these devices are relays and contactors, transformers, motor controllers etc. This electromagnetic radiation can induce electrical noise into both power and signal lines, as well as direct radiation into the module causing negative effects on the system. Appropriate grounding, shielding and other protective steps should be taken at the installation stage to prevent these effects. These protective steps include control cabinet grounding, module grounding, cable shield grounding, protective elements for electromagnetic switching devices, correct wiring as well as consideration of cable types and their cross sections.

1. Screened twisted pair cable must be used with the screen grounded at one point only.
2. Use should be made of screened I/O, T/C, RTD cable with the screens grounded at one point as close to the Converter module as possible.

5. Technical Specification

Power Supply	MMTCPBCONV-VDC	90mA @ 10VDC / 40mA @ 26VDC
	MMTCPBCONV-110	1.5VA @ 110VAC 60Hz
	MMTCPBCONV-220	1.5VA @ 220VAC 50Hz
Ethernet	10/100 Mbits/s	10/100Base-TX
	Connector	RJ45
Serial	RS232	3 Wire , TX,RX,GND
	RS485	2 Wire Multidrop twisted pair + GND
	Baud Rate	2400, 4800, 9600, 19200, 38400, 57600, 115200
	Data Bits	5, 6, 7, 8.
	Parity	none, even, odd.
	Stop Bits	1, 2.
Temperature	Operating Temperature.	-20°C to + 75°C
	Storage Temperature	-40°C to + 85°C
Connectors	Power and Comms.	8 way screw connector
Humidity		Up to 95% non condensing.

6. Wiring



Please Note: You must select RS232 or RS485 on the ip.htm web page

7. Configuration

7.1 Power Connections.

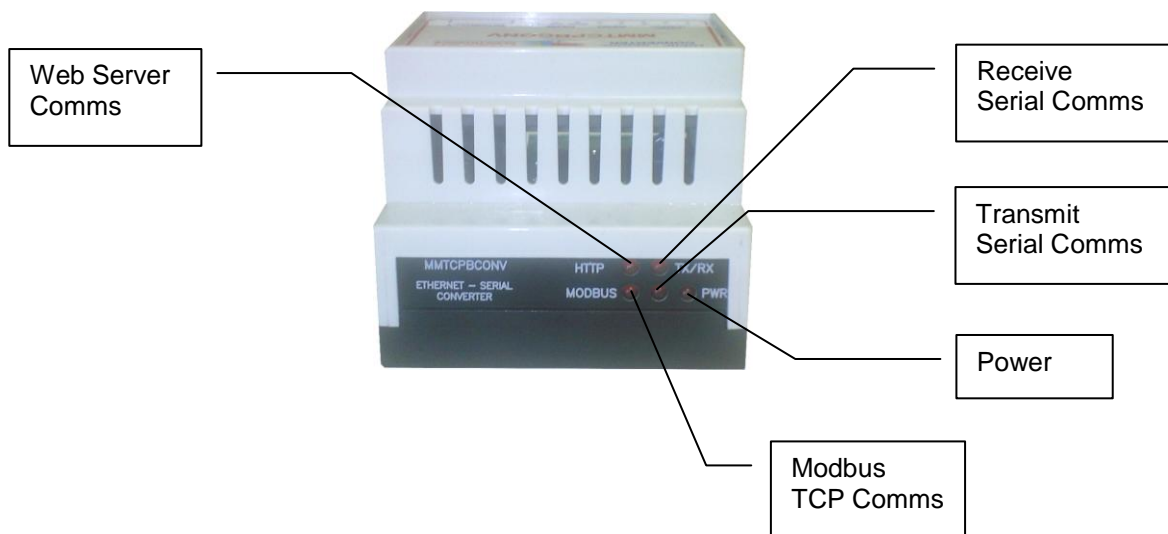
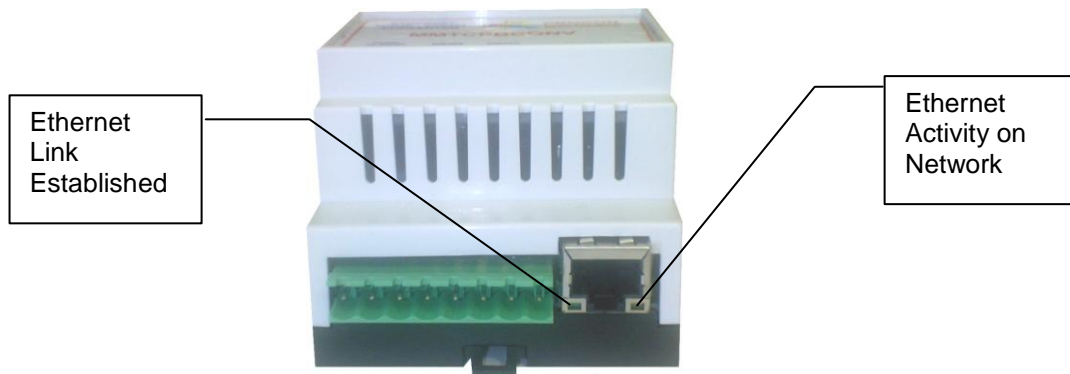
The Ethernet/Serial Converter Module must be clipped onto a DIN rail. Power for the MMTCPBCONV must be applied to terminal 1 (+12/24VDC) and terminal 2 (0V) or Power for the MMTCPBCONV-220 must be applied to terminal 1 (220VAC Live) and terminal 2 (220VAC Neutral). The power LED will illuminate and all LED's will be off.

7.2 Ethernet Connection.

Next the Ethernet connection is required, either through a network or directly to a PC. The Ethernet interface uses a standard RJ45 connector.

7.3 Indication LED'S.

The led's on converter module are used to indicate the operation of the module.



7.4 RS485 Termination.

Transmission line effects often present a problem on data communication networks. These problems include reflections and signal attenuation.

To eliminate the presence of reflections from the end of the cable, the cable must be terminated at both ends with a resistor across the line equal to its characteristic impedance. Both ends must be terminated since the direction of propagation is bi-directional. In the case of an RS485 twisted pair cable this termination is typically 120 ohms.

RS485 is designed to be used with a single twisted pair cable. One of the restrictions of this system is that the common mode voltages of the nodes on the network should not exceed -7V or +10V. In order to ensure that this condition is met, it is recommended that the 0V connections on the modules be connected together. For modules that are far apart, a second twisted pair should be used as the 0V link. On the MMTCPBCONV the terminal 6 (GND) is used as the 0V connection.

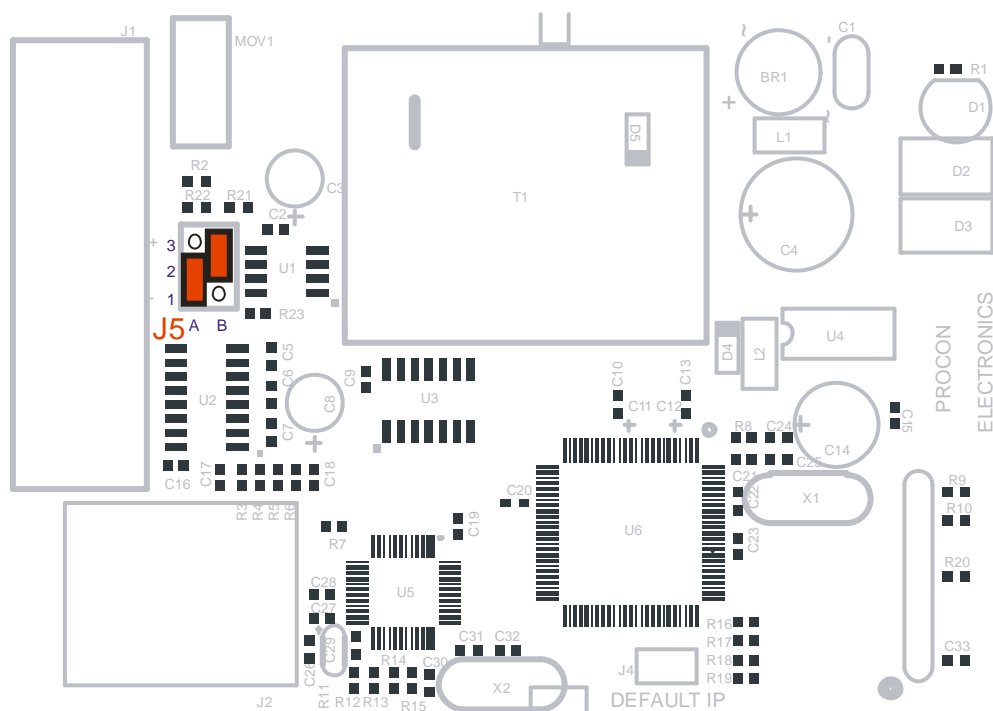
In certain applications where there are strong possibilities of an earth loop being caused by the 0V link, the link should be tied to the 0V terminal on each module through a 100ohm resistor, to limit the earth loop current.

Where earth loop problems exist, it may be necessary to isolate the RS485 network either using optical fiber or an isolated RS485 repeater such as the PM485REP module.

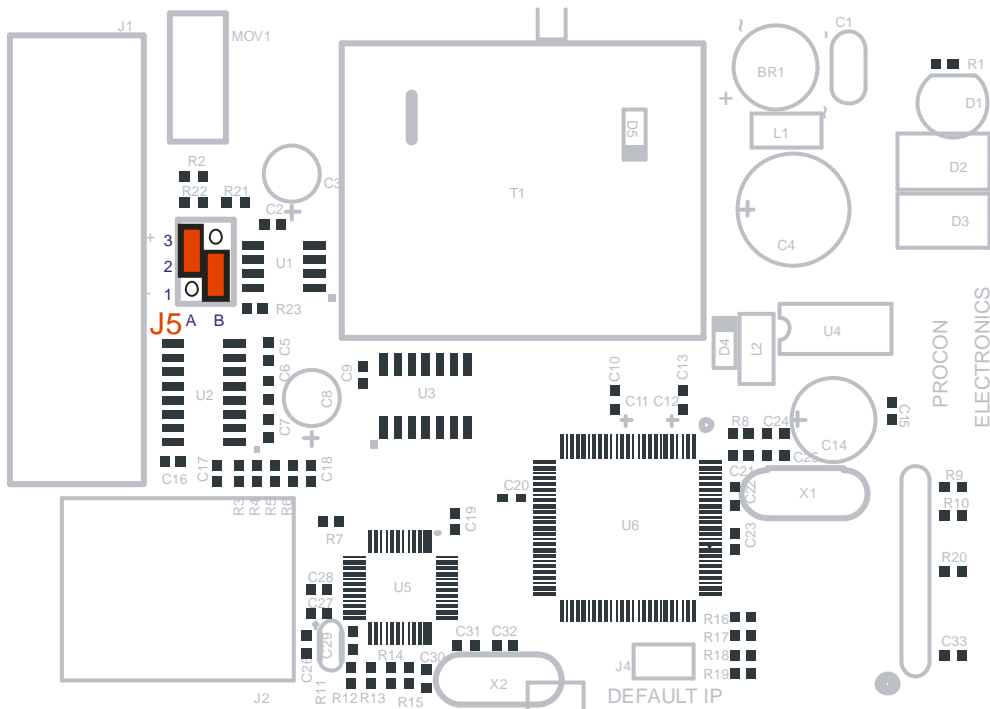
7.5 Setting the jumpers for the RS485 Termination (J5).

The circuit has got a set of jumpers that can be used to select the termination for the RS485 network. If the jumpers are removed from J5 then no onboard termination will be used and an external termination must be used.

If J5 is setup as shown below, with J5A(1-2) and J5B(2-3) then a 120ohm active termination with **High Line Idle** will be connected to the RS485 network. This is the most commonly used configuration for RS485 networks.

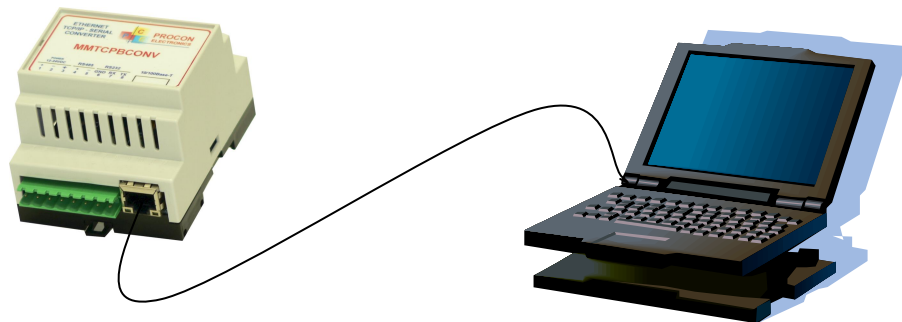


If J5 is setup as shown below, with J5A(2-3) and J5B(1-2) then a 120ohm active termination with **Low Line Idle** will be connected to the RS485 network.



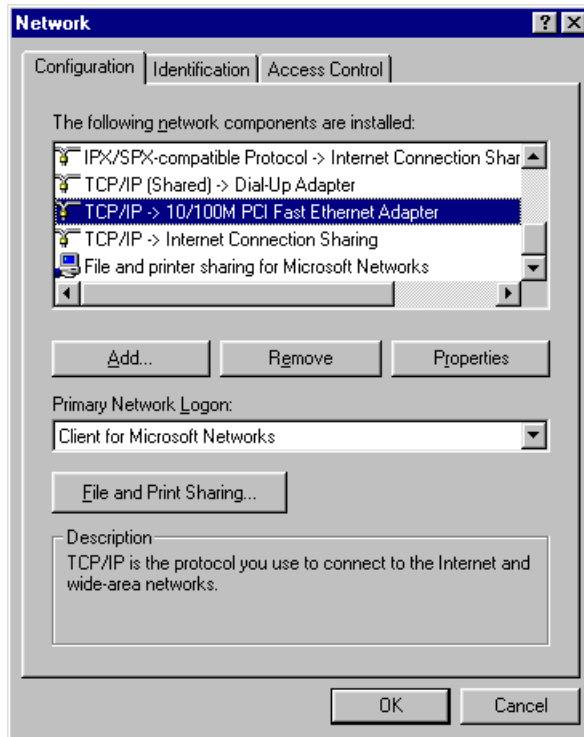
7.6 Connecting To a PC which is not Connected to a Network.

If the PC is equipped with an Ethernet card but not connected to a network, a local network address should be used for communication between the Converter Module and the PC. The Converter Module is shipped with a default IP address 169.254.111.111. This address is in the address area reserved for local networks not connected to the Internet. For direct connection between the PC and the Converter Module, a crossover Ethernet cable is required.

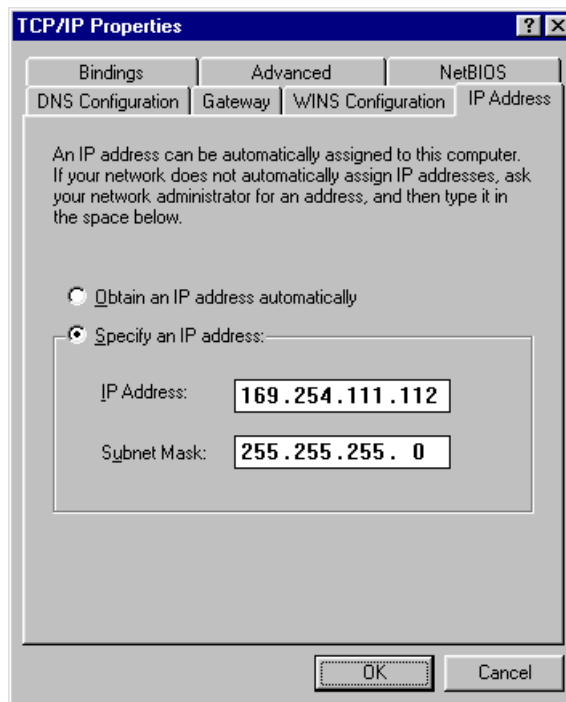


To setup your PC to connect directly to the Converter Module, an IP address in the same range as the Converter Module must be assigned to the PC. In Windows environments, this should be done as follows:

- Connect the PC and the Converter Module together using a crossover cable
- Open the Windows Control Panel
- Select Network
- Select TCP/IP -> the PC's Ethernet adaptor from the Configuration tab as shown below



- Click the properties button. A TCP/IP Properties box similar to the one below should appear

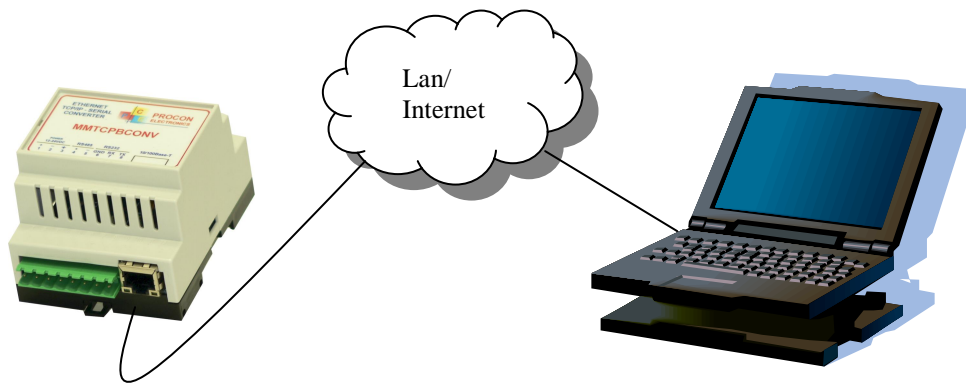


- Select the IP Address tab
- Choose to Specify an IP address as shown in the figure

- Insert the IP address 169.254.111.112 and the corresponding subnet mask as shown
- Save your settings by pressing OK in both TCP/IP properties and Network properties
- Reboot your PC

7.7 Connecting to a PC which is Connected to a Network.

If there is an Ethernet network available, the Converter Module can be connected to any Ethernet connection or hub belonging to the network. If the PC is connected to a network, there is a strong possibility that the default IP address of the Converter Module is outside the range of the network (the address doesn't belong to the IP subset of the network). If the Ethernet network is connected to the Internet, this is certain. In this case a new IP address for the Converter Module is required. Contact the local network administrator to be assigned a free IP address for the Converter Module. The new IP address is programmed into the Converter Module using a Web browser software such as Internet explorer. In this case the Converter Module must first be connected directly to a PC as described above.



In the remainder of this chapter, the IP address 169.254.111.111 is used as an example. Exchange this IP address with the IP address you have set up in all the occurrences.

7.8 Testing the Connection

To test the connection between the PC and the Converter Module, a simple program called *ping* can be used. *Ping* sends a number of messages to the specified IP address and displays the response. The ping program can be run from the command line or from a DOS window on the PC, as follows:

- Open the Windows Start Menu
- Click Run
- In the Open box, type: "ping 169.254.111.111"

If the network connection is OK, the program will respond with: "Reply from 169.254.111.111" and information about the response time.

If there is a problem with the network setup the program will respond: "**Destination host unreachable**". There may be two solutions to this problem:

- If the PC is connected in a network, change the IP address to an address accessible from the local network.
- If the Converter Module is connected directly to the PC(or through a hub), change the PC's IP address to one in the same address range as the Converter Module.

If there is a problem with the Converter Module the program will respond: "**Request timed out**", this means that the Converter Module can not respond to messages. Check the power connection. Check that the Link LED is illuminated when the cable is plugged into the RJ45 connector.

7.9 Viewing Web Pages


The Converter Module has built in web pages. These are used for checking the configuration and dynamic data, and for altering the configuration. To view these Web pages, a Web browser such as Internet Explorer or Netscape is needed.

To view the default Web page in Converter Module, start the Web browser and type "169.254.111.111" into the address line of the browser window. The main page of the Converter Module will now be displayed in the browser window.

If no Web page is displayed, go back to testing the network connection to the Converter Module by using the ping command. If the Converter Module replies to the ping messages, check the setup of the Web browser. If the Converter Module is directly connected to the same network as the PC, "direct connection to the network" or "bypass proxy server for local addresses" should be selected in the Web browser configuration menu. If the Converter Module is connected to the PC through a firewall, a proxy server should be selected in the configuration menu. Contact the local network administrator for information about the network configuration.

MODBUS TCP / RS485 Con. x

169.254.111.111



Serial/Ethernet Converter & Modbus Gateway

HOME PAGE

Module Name: MMTCPBCONV

Welcome to the Procon MODBUS TCP Converter home page. This converter is used to connect an Ethernet network to a RS485/232 network, and converts the Modbus TCP protocol to the standard Modbus RTU serial protocol on RS485/232.

MMTCPBCONV Configuration Parameters		
Software Version	<input type="text" value="9"/>	
MAC Address	<input type="text" value="50"/> <input type="text" value="c2c3"/> <input type="text" value="2000"/>	
Module IP	<input type="text" value="169"/> <input type="text" value="254"/> <input type="text" value="111"/> <input type="text" value="111"/>	
Default Gateway IP	<input type="text" value="169"/> <input type="text" value="254"/> <input type="text" value="111"/> <input type="text" value="1"/>	
Subnet Mask	<input type="text" value="0"/> <input type="text" value="0"/> <input type="text" value="0"/> <input type="text" value="0"/>	
Modbus Socket Time Out	<input type="text" value="90"/>	X 1 second
FTP Socket Time Out	<input type="text" value="30"/>	X 1 second
Communications Settings		
Baud Rate	<input type="text" value="9600"/>	
Data Bits	<input type="text" value="8"/>	
Parity	<input type="text" value="0"/>	0=None, 1=Even, 2=Odd
Stop Bits	<input type="text" value="1"/>	

For product information visit the **Procon Electronics** web site: www.proconel.com

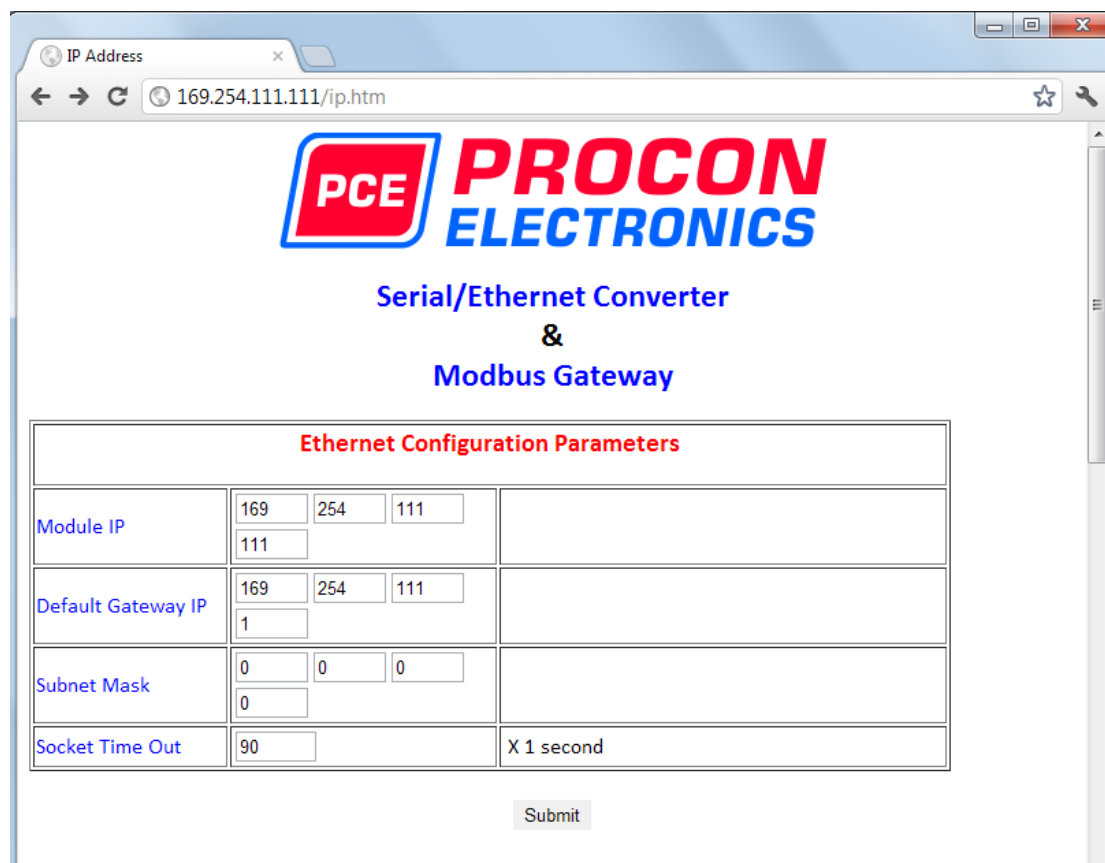
This Web Server is powered by Atmel ARM.

7.10 Troubleshooting Guide.

No	Checkpoint		Solution
1	Is the LINK LED on and is the ACTIVITY LED flashing with short pulses?	No	No network connection is detected. The Ethernet cable is either not plugged in or wrong type of cable is used. For connection to a network with a hub or switch, a normal network cable can be used. For direct connection to a PC network card, a twisted cable must be used.
		Yes	A network connection is detected, the Converter Module is connected to the network.
2	Does the Converter Module respond to PING requests?	No	<p>Either the PC or the Converter Module is setup with wrong IP address.</p> <p>To change the IP address of the Converter Module back to the default address, remove the power, open the Converter Module housing and remove the jumper labeled DEFAULT IP. Apply power to the Converter Module for a short while. Now replace the jumper and close the enclosure.</p> <p>To change the IP address of a PC, use the Windows "control panel -> network -> TCP/IP properties" and setup an IP address close to the Converter Module address. The Converter Module is shipped with a default IP address of 169.254.111.111, the PC can be setup with an IP address of 169.254.111.112</p>
		Yes	The PC and Converter Module are setup with a correct IP address and they are able to communicate with each other.
3	Can the default Web page be accessed in a Web browser?	No	<p>This is normally caused by the setup of the Web browser.</p> <p>In the "options" or "preferences" menu, check that the Web browser is configured for direct network connection or local area network and NOT using a proxy server.</p>
		Yes	No problems.

7.11 Parameter Configuration

The Web page address "169.254.111.111/ip.htm" is entered into the address line of the browser window to access the configuration page. This page allows you to change the IP address of the Converter Module, select serial timeout, to setup the baud rate of the Converter Module on the RS485 network, and to enter a Module Description Name for identification/maintenance purposes.



PROCON ELECTRONICS
Serial/Ethernet Converter
&
Modbus Gateway

Ethernet Configuration Parameters

Module IP	169	254	111	111	
Default Gateway IP	169	254	111	1	
Subnet Mask	0	0	0	0	
Socket Time Out	90				X 1 second

- **Module IP Address:** The new IP address can be entered into the web page as shown above. After this has been done, you must click the Submit button to send the values to the Converter Module. The screen will now be updated and if successful will continue to display the new IP address. The new IP address will only be effective after the Converter Module power has been switched off and on again. This feature allows you to check that the correct IP address has been entered before being activated. If the IP address has been entered incorrectly and the power has not been switched off, it is possible to re-enter the correct IP address. If the power has been switched off and back on again, the Converter Module will not communicate until you enter the new IP address into the address line of the browser window. An internal jumper is used to reset the module back to the default factory IP address.

Perform the following steps to reset the IP to factory default (169.254.111.111)

- a. Switch off the power.
- b. Remove the cover.
- c. Remove the jumper link labeled "DEFAULT IP".
- d. Switch on power for 5 seconds.
- e. Switch OFF the power.
- f. Replace the jumper link and the cover.

- **Default Gateway IP Address:** A **default gateway** is a node (a router) on a computer network that serves as an access point to another network. In enterprises, however, the gateway is the computer that routes the traffic from a PC to the outside network that is serving the Web pages. It is only necessary to configure the default gateway IP address if the PC that is accessing the Converter is on a different network.
- **Subnet Mask:** In computer networks, a **subnetwork** or **subnet** is a range of logical addresses within the address space that is assigned to an organization. The subnet mask is used to inform the Converter that it must send its replies to the gateway if the IP address of the PC is on a different network. When the subnet mask is set to "0.0.0.0" then it is effectively disabled and the default gateway is not used. A typical subnet mask would be "255.255.255.0".
- **Socket Timeout:** If a socket connection is broken, say due to a network fault, it must timeout to free it up so that it can be used again. This timer is triggered by activity on the converter, so if there is no communications activity for longer than the timeout period, the socket will close.

Communication Modes		
Converter Mode	<input type="text" value="0"/>	0 = Server - Standard Mode / Multi Socket 1 = Server - Socket Listen Mode / Single socket 2 = Client - Remote Socket Open Mode / Single socket
Char Timeout	<input type="text" value="0"/>	Time to wait before sending Rx Chars when using Port 30004 in Mode 0, or using Mode 1/2 X 10 milliseconds
Port Number	<input type="text" value="0"/>	Modbus TCP = 502 Mode 1&2 only
Server IP	<input type="text" value="0"/> <input type="text" value="0"/> <input type="text" value="0"/> <input type="text" value="0"/>	Mode 2 only
Modbus Comms Watchdog	<input type="text" value="0"/>	X 1 minute

- **Converter Mode:** These modes have been described in detail in a section 2. Enter 0, 1 or 2 as required.
- **Char Timeout:** This timeout has been described in detail in a section 2. Enter a value in 10millisecond increments.
- **Port Number:** The Port number used to tell the converter that the incoming TCP/UDP message must get sent to the serial port.
- **Server IP:** The client converter in mode 2 must connect to the server converter. Enter the IP address of the server converter in this field.
- **Modbus Communications Watchdog:** If a value other than zero is entered into this field, the watchdog will be enabled and will be reset every time there is a modbus message. If there is a break in the modbus message which is longer than the timeout value, then the module will be reset.

RS232/RS485 Communications Port Parameters

Baud Rate	9600	
Data Bits	8	
Parity	0	0=None, 1=Even, 2=Odd
Stop Bits	1	
RS232/RS485	1	0=RS232, 1=RS485
Modbus End of Message Timer	0	X 1 ms + 3.5 Characters
Serial Reply Timeout	30	X 10 milliseconds
RS485 On Delay	0	X 1 milliseconds
RS485 Off Delay	0	X 1 milliseconds

Module Name

- **Baud Rate, Data Bits, Parity, Stop Bits:** The configuration of the serial port can be configured by selecting the parameters from the pull-down menu. Click on the Submit button to load these values into the Converter Module.
- **RS232/RS485:** This field is used to select RS232 or RS485 on the serial port.
- **Modbus End of Message Timer:** The standard way of determining the end of a modbus message is to time 3.5 characters. (as per the modbus protocol specification) Some modbus slaves are not compliant with the modbus specification and have time delays between characters which would normally result in an error. This field enables the converter to have a longer end of message timeout to be able to function correctly with these slave devices.
- **Serial Reply Timeout:** This timeout is the time the module waits for a reply from a slave device. If a reply is received then this timeout is cancelled and the converter looks for the next TCP message. If the slave does not send a reply, then this timeout will expire and allow the converter to look for the next TCP message. This timeout must be longer than the turn-around time of the slave device or it will timeout before the slave replies. This timeout only operates in Mode 0.
- **RS485 On Delay:** This is the time the RS485 transmitter will be enabled before data is transmitted. This has no effect on RS232 communications.
- **RS485 Off Delay:** This is the time the RS485 transmitter will be enabled after data is transmitted. This has no effect on RS232 communications.

Note: The power must be cycled to reset the unit after the communication settings have been changed.

- **Module Name:** This field allows you to enter a module description name into the Converter Module. This is an identifier for diagnostic/maintenance purposes and is chosen to best describe the Converter Module in the system by name or number.

8. Conformity Certificate

DECLARATION OF CONFORMITY according to EN 45014		
Manufacturer's Name:	Procon Electronics CC	
Manufacturer's Address:	26 Wareing Park 2 Wareing Road Pinetown 3610 South Africa	
declares that the product		
Product Name:	MOD-MUX	
Model Number(s):	MMTCPBCONV-VDC MMTCPBCONV-220	
complies with EMC Directive 89/336/EEC and Low Voltage Equipment Directive 73/23/EEC and conforms to the following Product specifications:		
Safety:	IEC 950	
EMC:	IEC 61000-4-2-A1 Level 2 IEC 61000-4-3-A1 Level 2 IEC 61000-4-4 Level 3 CISPR 11:1991-A1 / EN 55011:1998 Group 1 Class A	
<u>Pinetown, SA</u> Location	<u>November 2006</u> Date	D.Ruddock