



PROGRAMMABLE COMMUNICATIONS
CONTROLLER AND MODEM
DAS-PMB-PCC Series

INSTRUCTION MANUAL

Technical Manual	Programmable Communications Controller and Modem
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<u>Part Number Description:</u>	
Manufacturer:	Axiomatic Technologies Corporation
Product Class:	Data Acquisition Systems
Packaging:	Powder Coated Metal Box
Function:	Programmable Communications Controller

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Contact Information

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Operation of Indicator Lamps (LEDs)

The communication co-processor contains eight externally visible lamps to aid in installation and debugging.

Three lamps indicate the state of the power supply (+5, +12, -12). These lamps do not monitor tolerance of the power supply.

The RS232, RS485 and ONLINE lamp will turn on each time a good character is received by a communications port. A good character means that it is free from all communications errors. Any characters that are received with errors are discarded by the com processor and not retransmitted.

The ONLINE lamp indicates the state of connection. If it is off, no connection exists. While the modem is on line this lamp will blink at least every half-second even if no data is being received.

System Status A and System Status B lamps indicate the progress or state of the control program. When the system is first powered on it will perform a self-diagnostic test. The progress of this test will be indicated by the lamps.

Test Sequence (System Status A, System Status B)

EPROM checksum test. Before this test begins it will set both status lamps off. If this test passed successfully both will blink on for a half-second and then go off for a half-second. The unit will then perform a lamp test to verify the correct operation of the lamps. Each lamp will light individually for a quarter second. This test will be performed twice. This test will only apply to the five upper lamps and not to the voltage indicators. The system status A lamp will then blink on to indicate that the device will go into config mode if it receives a "Y" on the RS232 Port. After a few seconds this lamp will extinguish and the unit will then perform modem diagnostics and initialisation. System status A will blink on when the communications processor transmits to the modem and off when the modem responds. A blinking systems Status A lamp and ONLINE lamp indicates that the modem and the communications processor are communicating correctly. The System status B will blink a code that indicates any error conditions.

It will blink on for a half-second and off for a quarter second. It will remain off for two seconds to indicate the end of an error code.

1 Blink	Modem failed to reset
2 Blinks	Modem not recognised.
3 Blinks	Modem failed self-diagnostics
4 Blinks	Modem failed to initialise

While the modem initialisation sequence is being performed, the RS232 or RS485 lamp will light as an indication of the current communication configuration of the device.

Shipping Configuration

The modems are shipped with the following configuration. Once the end user customizes this configuration the modem will **not** revert back to the shipping configuration.

AT commands:

EO L2 M1 N1 Q0 T V1 X4 &C1 &D3 &G0 &S0 &T5

General setup:

Default ComPort = RS485
DiagnosticsLevel = 2
RS485PreHoldTime = 3 mS
RS485PostHoldTime = 3 mS
RS232BaudRate = 9600
RS485BaudRate = 9600
ModemBaudRate = AutoBaud, default 9600
NewConnectLockOut = 0 Seconds
NumberRings/Enable = 1
PassWord = "ATCC"

Remote Configuration

The operation of the box is configured remotely via the RS232 or the Modem connection. To enter configuration mode from the RS232 port, reset the unit (cycle the power) after the power on self-test sequence completes, and then type *ATCC* (case sensitive). You will be presented with the main menu. The display will appear as follows:

Main Menu

ComPort		= RS485
DiagnosticsLevel	= 2	
RS485PreHoldTime		= 3 mS
RS485PostHoldTime		= 3 mS
RS232BaudRate		= 9600
RS485BaudRate		= 9600
ModemBaudRate	= AutoBaud, default 9600	
NewConnectLockOut	= 0 Seconds	
NumberRings/Enable	= 1	

- 0) **Select Primary ComPort**
- 1) **Configure Diagnostics Level Display**
- 2) **Configure Modem Parameters**
- 3) **Configure RS232 Port**
- 4) **Configure RS485 Port**
- 6) **Change PassWord**
- 9) **Save and Hardware Reset**

ESC or ENTER to Exit, Enter choice:

This menu will allow you to configure your modem as well as the state of the diagnostics. The current configuration of the modem is displayed in the menu (modems are shipped with the configuration described in the previous section). Choose the primary communications port by selecting choice 0. You will be presented with the following menu:

Menu – Primary Communications Port Selection

RS232 Currently Selected

- 1) **Select RS485 as Primary Communications Port**
- 2) **Select RS232 as Primary Communications Port**

ESC or ENTER to Exit, Enter choice:

Once the Primary Communications Port has been selected press ESC or Enter to return to the main menu. Next, configure the Diagnostics Level Display by selecting choice 1 from the main menu. The menu will be displayed as follows:

Menu - Diagnostics Level

Diagnostics Level set to 9

- 0) **No Display**
- 1) **Basic Menus**
- 2) **Verbose Menus**
- 3) **Not Defined**
- 4) **Not Defined**
- 5) **Function Entries**
- 6) **Function Exits**
- 7) **Function MileStones**
- 8) **Not Defined**
- 9) **All Messages Enabled**

ESC or ENTER to Exit, Enter choice:

This menu allows you to set what Debug information will be displayed. Once the Diagnostics Level has been set press ESC or Enter to return to the main menu. From the main menu select choice 2 and configure the modem parameters with the following menu:

Menu – Configure Modem Parameters.

Current Selection: BaudRate = 19200
Current Selection: NumberOfRings/Enable = 0
Current Selection: NewConnectLockout = 0 Seconds

- 0) No ComPort**
- 1) 1200**
- 2) 2400**
- 3) 4800**
- 4) 9600**
- 5) 19200**
- 6) Configure number of rings to answer on, or Enable/Disable Modem**
- 7) Configure new connection lock out**
- 8) Modem Console Interface**

ESC or ENTER to Exit, Enter Choice:

First select the baud rate you wish to use (choices 0-5), then configure number of rings (choice 6). This will display a new menu as shown:

Menu – Configure number of rings to answer on.

Enter 0 to disable test for Modem.

Current Selection: NumberRings = 0
Maximum 9, 0 for No Test, ESC or ENTER to EXIT, Enter Choice:

Enter the number of rings and then press ESC or Enter to return to the modem parameters menu. From the Modem Parameters menu, configure the new connection lockout (choice 7) as follows:

Menu – Configure New Connection lock out time

This is the amount of time that the system will ignore garbage characters received while the modem stabilizes.

If this value is non-zero then the system will only pass characters to the modem when the modem goes online.

Current Selection: New Connection LockOut Time = 0 seconds
Maximum 9, ESC or ENTER to EXIT, Enter Choice:

Enter a value between 0 and 9 and then press ESC or Enter to return to the modem parameters menu. In order to save your updates to the AT Command set, choice 8 must be selected and will display the following screen:

Menu – Modem Console Interface.

**ESC to exit, Save Updates using Hayes AT&W0 or W1 command.
The modem will be initialized with the ATZ1 command**

**This mode allows direct access to Modem command set.
Please refer to the reference manual for Modem AT commands (at www.axiomatic.com).**

Note: Modem updates must be saved here.

They will not be saved by the main menu config save.

**UartLineStatus expecting 60 got ED
Uart Enabled 16550A mode**

Return to the main menu by pressing ESC or Enter twice. Configure the RS232 Port if it has been selected as the primary com port by selecting choice 3 from the main menu. This will display the following menu:

Menu – Configure RS232 Port.

Current Selection: BaudRate = 9600
1) 1200
2) 2400
3) 4800
4) 9600
5) 19200

ESC or ENTER to Exit, Enter choice:

After selecting the BaudRate press ESC or Enter to return to the main menu. If RS485 has been selected as the primary communications port, configure this port by selecting choice 4 from the main menu:

Menu – Configure RS485 Port.

Current Selection: BaudRate = 9600
Current Selection: Pre-Transmit = 2mS
Current Selection: Post-Transmit = 10mS

1) 1200
2) 2400
3) 4800
4) 9600
5) 19200
6) Configure RS485 Line Pre-Transmit Drive Time
7) Configure RS485 Line Post-Transmit Drive Time

ESC or ENTER to Exit, Enter Choice:

Select the Baud Rate and then choose 6 to display the following menu:

Menu – Configure RS485 Line Pre-Transmit Drive Time

This is the amount of time that the RS485 transmitter will be enabled before the first character is transmitted, in order to stabilize the line.

The time should be a minimum of 1 character time plus a margin for error.

Suggested values would be 1.5 character periods + 1mS for N,8,1 characters.

300baud: 51mS, 1200baud: 13mS, 2400baud: 7mS

4800baud: 4mS, 9600baud: 3mS, 19200baud: 2mS

Current Selection: RS485BaudRate=9600

Current Selection: Pre-Transmit time = 2

3 characters, 000 – 255 MilliSeconds, ESC or ENTER to Exit, Enter choice:

Enter the desired Pre-Transmit Drive Time and then return to the RS485 Configuration menu and select Post-Transmit Drive Time (choice 7) to display the following:

Menu – Configure RS485 Line Post-Transmit Drive Time.

This is the amount of time that the RS485 Transmitter will remain enabled after the START of transmission of the last character.

This time should be a MINIMUM of 1 character time plus a margin for error.

Suggested values would be 1.5 character periods + 10mS for N,8,1 characters

300baud: 60mS, 1200baud: 22mS, 2400baud: 16mS

4800baud: 13mS, 9600baud: 12mS, 19200baud: 11mS

The above times are suggested minimums. The time should be longer than the inter-character delay to prevent the transmitter from turning around

between characters. If it does, the pre-transmit delay will reoccur.

It must not, however, be longer than the response time of the device being transmitted to, or it will block the return transmission.

Current Selection: RS485BaudRate = 9600

Current Selection: Post-Transmit time = 10

3 characters, 000-255 MilliSeconds, ESC or ENTER to Exit, Enter choice:

Enter the desired post-transmit time and then press ESC or Enter twice to return to the main menu. Selecting choice 6 from the main menu will allow the password to be changed:

Menu – Configure Pass Code.

Enter max 8 characters, or nothing to disable feature.

Case sensitive, ASCII 20 thru 126 hex.

ESC or ENTER to EXIT, Enter choice:

Type in a new password if desired and then press Enter. Press ESC or Enter to return to the main menu. The modem is now configured.

Remember to Save and Hardware Reset (Choice 9) if you want your changes to take effect. If diagnostics are turned on, the unit will transmit diagnostics information on the RS232 port. This may interfere with some RS232 connected equipment, but most equipment will simply ignore this information. The diagnostics will always be transmitted at 9600,N,8,1 regardless of the configured data rate of the port.

The configuration menu will also indicate the state of the system non-volatile memory. If the non-volatile memory should become corrupt or otherwise unavailable, the unit will default to RS485 communications, with diagnostics enabled on the RS232 port. If this should occur, the unit could still be remotely re-configured. If the non-volatile memory is still not functional then exit from the configuration *without* resetting the box. The configuration profile will now persist while the box is powered.

Re-configuration of the box can also be accomplished via the modem interface. The same procedure as above is followed. The only difference is that the opportunity to enter configuration mode is available immediately after establishing each dial-in connection. After the modems have finished negotiating and the session is established, the first transmission to the remote box must be *ATCC*. If the diagnostics level is set above 0 you will receive a password prompt, otherwise you will have to practice timing the entry of these characters. This is best done by turning the diagnostics level to 1 or above and timing the amount of time it takes for your system to prompt for the password. After you have become proficient, try it with diagnostics turned to zero. Diagnostics level zero will only be required in the rare circumstance that the remote systems protocol is too primitive to tolerate any unknown characters on the transmission line.

For further information, please contact the manufacturer.

Environmental Specification

0 to 90% relative humidity, non-condensing

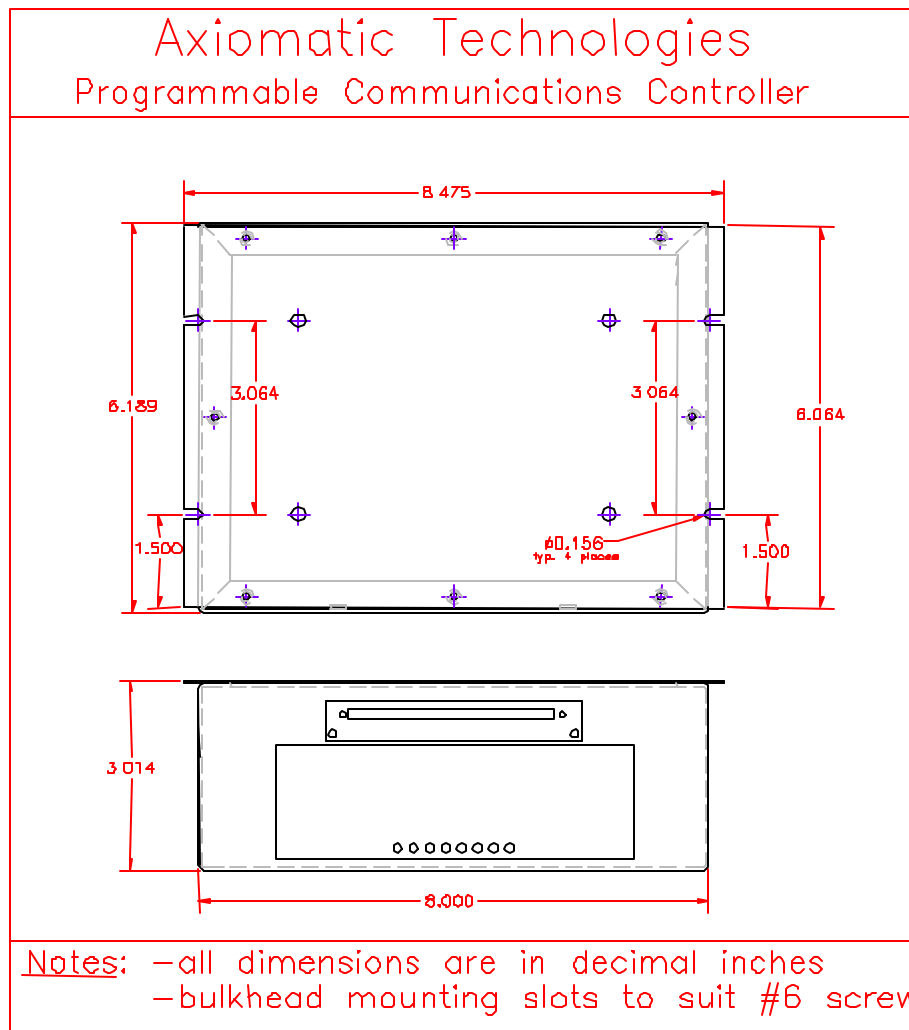
0° to + 50°C operating

-40° to + 85°C storage

By request the unit can be sealed and the internal components conformally coated. This will facilitate reliable operation in tropical or otherwise harsh environments.

Mechanical Size

The unit is enclosed in a rectangular metal box 8 inches wide by 6.2 inches deep and 3 inches high. It stands on four plastic feet and has four bulkhead mounting slots. Connection to the box is via a 16-pin pluggable screw terminal connector mounted on the 3 inch high side of the box (described in the next section). There are 8 status indicator lights above this connector.



System Connection

Mounting

The unit mounts on a wall using four #6 screws. Plastic feet with a cover are provided for using the Programmable Communications Controller and Modem as a freestanding unit.

Pluggable Screw Terminal Connections

DCP Modem

PIN 1	RS232 TXD
PIN 2	RS232 RXD
PIN 3	RS232 CTS
PIN 4	RS232 GND
PIN 5	RS485 SHIELD
PIN 6	RS485 D+
PIN 7	RS485 D-
PIN 8	PHONE TIP
PIN 9	PHONE RING
PIN 10	LINE TIP
PIN 11	LINE RING
PIN 12	SPARE
PIN 13	SPARE
PIN 14	LIVE
PIN 15	EARTH GROUND
PIN 16	NEUTRAL OR COMMON

RTU Modem

PIN 1	RS232 TXD
PIN 2	RS232 RXD
PIN 3	RS232 RTS
PIN 4	RS232 CTS
PIN 5	RS232 DTR
PIN 6	RS232 DCD
PIN 7	RS232 GND
PIN 8	RS485 D+
PIN 9	RS485 D-
PIN 10	PHONE TIP
PIN 11	PHONE RING
PIN 12	LINE TIP
PIN 13	LINE RING
PIN 14	EARTH GND/RS485 SHIELD
PIN 15	NEUTRAL OR COMMON
PIN 16	LIVE

The RS232 Interface

DCP Modem

The RS232 connection is not galvanically isolated from the unit. This connection should be limited to short distances (sub 50 feet) and should not be exposed to significant transients or ground shifts. This interface is implemented using standard 1488/89 type drivers/receivers and contains no additional filtering or hysteresis compensation. They are, however, series current limited and protected by MOVs. The “GND” ground connection must be connected as this provides the signal reference. “CTS” is not monitored by the internal micro-controller in this model. This interface is full duplex and no protocol is required.

RTU Modem

The RTU modem will operate precisely like a DCP modem with the following additions.

DCD - While a modem connection is established DCD will be asserted.

RTS/DTR - RTS and DTR will always be asserted.

***TXD, DTR, and DCD are not MOV protected.

The RS485 Interface

The RS485 interface is fully isolated (2500 Volts) and capable of interfacing to a minimum of 32 nodes plus two 120 Ohms termination resistors. This connection is good for a considerable distance. It is impossible to state definitively exactly how far an RS485 network will work reliably because of the numerous variables but the following will provide some guidelines.

The greatest length will be achieved at low baud rates (2400 - 9600), using Point to Point, critically terminated, high quality (consistent characteristic impedance) unshielded twisted pair data cable. Using this method and depending on the amount of ambient noise, reliable operation may be achieved for several kilometres. As ambient noise increases or additional nodes are connected to the bus, the maximum length of the bus needs to be decreased. A nominal system consisting of 6 devices on the bus, with termination within 90% of critical and utilising a decent data cable should work reliably for 1 kilometre. In noisy environments it is recommended that shielded cable be utilised. The shield will however, attenuate the signal and reduce the maximum allowable length. Straight-line bus topologies should be used exclusively if the system needs to work over a long distance. If the RS485 is being used as a small local area network (within 250 feet), less ideal topologies can be utilised. This would include stubs and loops. Stubs are random length wires (all should not be the same length), all connected randomly to the bus or source. Loops are good for redundancy; they would permit continued operation if any point in the loop becomes broken. It must be remembered however, that in the event that the loop becomes disconnected, it becomes two unterminated stubs. To test a loop for stability, break it in the centre and at both ends. This system utilises regular RS485 interface transceivers but with a superior isolation topology. It will be as good and probably better than other RS485 interfaces that the user may be familiar with.

Termination

Termination becomes more important as data rates increase or line length or loading increases. The line should be terminated as closely as possible to the characteristic impedance of the cable being used. Any time a signal (energy) is propagated down a transmission line, a portion of its energy will be reflected each time that an impedance anomaly occurs. This means that any inconsistency in the cable will cause some of the signal energy to be dissipated. The greater the anomaly, the more energy it will reflect. When the signal reaches the end of the cable it must be dealt with. If the cable is unterminated, this major impedance anomaly will cause the energy of the signal to be reflected back into the cable. This energy must now be considered noise, because we cannot predict how it will distort the original signal. If the line is properly terminated by a resistor, then no impedance anomaly exists and the energy is harmlessly dissipated by the resistor as heat. The termination is factory configured at 120 Ohms for the following models: DAS-PMB-PCC-012 (014/015/016) or PML-PCC-012 (015/016). The termination is factory configured differently for P/N: DAS-PMB-PCC-012A to allow for fixed differential termination as described in the next section.

The termination should be done on both ends of the transmission line. The shield is hard terminated to earth. The differential mode driver is protected by a tranzorb. The shield if used should only be connected at one end as this prevents ground loop currents from inducing noise.

Differential Termination in DAS-PMP-PCC-012A model **(also known as Power or Failsafe Termination)**

This form of termination is used for less sophisticated protocols that leave the transmission line undriven between message packets or in some cases, even between characters. It consists of an impedance network that maintains a slight bias on the communications line. This bias is designed to be sufficient to prevent noise on the undriven line from generating false data on the line without causing undue loading of drivers during communications. The nature of the termination will reduce the maximum length of the communications line by somewhere in the range of 20%. The termination in the DAS-PMB-PCC-012A model is factory installed. The differential termination consists of a parallel resistor of 130 Ohms and pull resistors of 750 Ohms. This form of termination should be used only on one end of the communications line. The other end of the line should be terminated with a standard 120 Ohms termination.

Telephone Line Connection

The “LINE TIP” and “LINE RING” are meant to connect to the telephone company central office “CO” termination point. Ring is the -48 volts central office battery connection and Tip is the 0 volt connection. Tip is typically a green wire or a white bodied wire with a coloured stripe and ring is typically a red wire or a coloured wire [blue, orange, green, brown, etc. (pair 1, 2, 3, 4, etc.)] with a white stripe. *(Tip and Ring refer to the physical “Phono” connector – similar to those used today for microphones and headphones that were once used by the operator to connect calls together manually.)*

The “PHONE TIP” and “PHONE RING” continues on to a local telephone handset, if so desired. When the internal modem answers an incoming call (seizes the line), a relay will disconnect the phone from the line. If these line pairs were to be reversed, no damage will occur, but the unit will appear to answer the line and then fail to connect.

Power connection - Please refer to the power supply section.

FCC Rules

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy. If not installed and used in accordance with the instruction radio commendations, operation of this equipment in a residential area will likely to cause harmful interference in which case the user will be required to correct the interference at his own expense. Changes or modifications to the product not expressly approved by the manufacturer could void the user's authority to operate the equipment.

The internal modem complies with Part 68 of the FCC rules.

Industry Canada CS-03

This Class A digital apparatus complies with Canadian ICES-003.

Warranty

The Programmable Communications Controller and Modem is guaranteed to perform as designed, based on the product specification, free of defects in material and workmanship for 6 months from the date of shipment.

The product will be replaced or repaired on a “return to factory” basis.

AT Command Set

Please view or download the AT Command Set Reference Guide (Texas Instruments Literature SPRA359A, June 1998 – 217 pages) from www.axiomatic.com.