



# BayPac BP-96A Packet Modem

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## Installation & Operation



### - INTRODUCTION -

The Model BP-96A is an enhanced version of the BayCom Team's 9600 Baud PICPAR modem, which is sold in Germany as a kit. The Tigertronics version of this modem employs "surface mount technology" and comes completely assembled and tested. This superior technology permits use of robotic assembly, resulting in a vastly smaller unit with enhanced reliability and lower cost. Power consumption has also been improved. In fact, power consumption is now so low, that the BP-96A can get all of it's operating power from your computers parallel port!

It should be noted that installation and setup of ANY High Speed Modem requires some technical expertise and access to the proper test equipment. Operation at 9600 baud is much less "forgiving" than 1200 baud, so proper adjustment of both receive level and transmit deviation is critical for reliable operation. You will need a radio that is "9600 baud ready" or one that has undergone appropriate modification for high speed operation. Normal "voice grade" radios will not work properly without extensive modification. These instructions assume that your radio is "9600 baud ready".

Installation of the BP-96A is a two-step process. The first step involves connecting the unit to your radio and computer. This document will help you through that process. The second step involves setting the transmit audio level. In addition, you will of course need to install BayCom compatible TNC emulation software on your computer.

Currently, only BayCom v1.6 supports 9600 baud operation. If you did not obtain Version 1.6 when you purchased your modem and do not already have a copy, you will need to purchase it separately from the authors or from Tigertronics. Note that previous (Shareware) versions of BayCom did not support 9600 baud operation and WILL NOT work with this modem.

### - WHAT YOU WILL NEED -

To run the software you will need a 10 MHz (or faster) IBM AT compatible computer, with a parallel interface port. Normally, the BP-96A should be plugged directly into the parallel port connector on the computer. If you wish to attach the BP-96 to a cable or switch box, you should use a cable that is FULLY SHIELDED and no longer than 3 feet. A cable is supplied with the modem for connecting to your radio. It has a DB-9 male connector on one end. You will need to install whatever connector is appropriate for your radio on the other. If your computer can not supply sufficient power to the modem, then you will also need an external power source of 8-14V DC at approximately 10ma.

### - BP-96A BLOCK DIAGRAM -

Figure 1 shows a block diagram of the BP-96A modem. The modem is connected via six signal lines to the Centronics interface on the PC. The transmission of the RX and TX data is done serially since the Centronics interface has only four input lines.

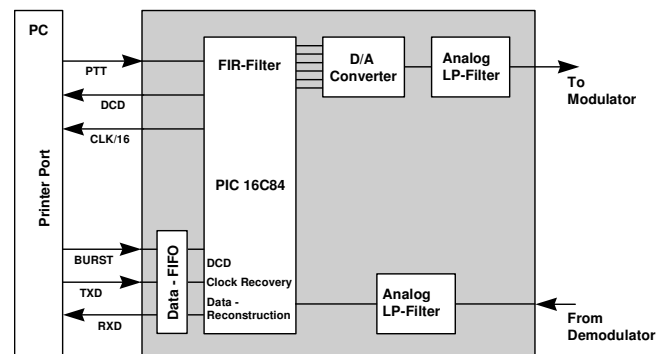


Figure 1 - Block diagram of the BP-96A modem.

The RX and TX data is transmitted in 16 bit bursts each via the interface. The sixteen bits of TX data are written via TxD into the modems TX buffer (shift register). This data transfer is controlled by the BURST line. Once in the TX buffer, the bits are clocked out by the TX clock and sent through a digital filter. An analog filter removes the unwanted sampling signals from the digital filter. Although necessary for a G3RUH-compatible signal, the data is not scrambled in the hardware. This is done in the software, such that the data reaching the modem is already scrambled and NRZI coded.

On the RX side, the demodulated AF from the receiver is fed into a low pass filter and then into a binary discriminator. The discriminator compares the signal with the average of the bit stream (which consists of approximately as many binary ones as zeros). The raw data bit stream now needs to be sampled at the right time, i.e., in the middle of each bit. To do this, the clock of the received signal is recovered by a digital phase locked loop circuit (implemented in the PIC16C84). The raw data bit stream is then sampled at this clock rate and fed into the RX buffer. The CLK/16 line then tells the PC that the RX buffer is full and should be read again by the BURST line.

**- THE INTERFACE -**

The buffering and the burst transfer of data between the modem and the PC is the most complex part of the modem. The interface circuitry is used for both TX and RX data. The direction of the data is determined by the PTT signal, so the modem will only support semi-duplex operation. Figure 2 shows a block diagram of the interface circuitry. The interface consists of two shift registers connected in series, and a control circuit which generates the clock signals for the shift registers and toggles the direction of data flow.

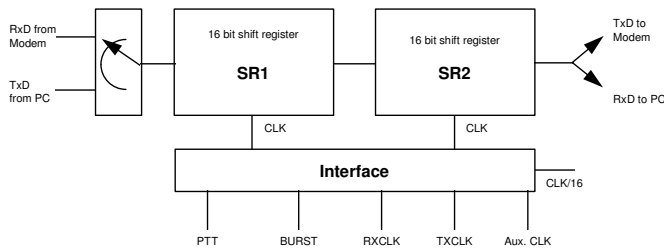


Figure 2 - Block diagram of the interface.

During transmission, the PC sends 16 bits of TX data into SR1 via a serial line, controlled by the BURST signal. At the same time, SR2 is being read bitwise by the modem at a rate determined by the modem's TX clock. Once SR2 has been emptied, the contents of SR1 are shifted into SR2 at high speed. Then, the CLK/16 line signals the PC that SR1 has been emptied and that another 16 bits of TX data may be written into SR1 with the burst signal.

During reception, the functions are reversed. The regenerated RX clock writes RX data into SR1. After 16 clock cycles, SR1 is full and its contents are transferred to SR2 at high speed. The PC is then signaled with the CLK/16 line that SR2 is full, and can be read using the burst signal.

The complete control circuitry is built using a PIC16C84 microcontroller. All control signals for the shift register toggling and the data transfer between the shift registers are derived from the RX and TX clocks as well as the BURST signal and an 1.228 auxiliary clock. A 4517 dual shift register is used for the RX and TX buffers.

**- THE TX BRANCH -**

During transmission, the TX data bits in SR2 are shifted into another 8-bit shift register. This shift register then makes the bits available to the PIC16C84 microcontroller. The PIC16C84 digitally filters the TX data bits and converts them from digital to analog. The analog signal is then fed into a low pass filter (IC5) which removes the high frequency components from the converters output. C16 then removes the DC offset (which can lead to an RX shift in some radios), and the signal is sent to the radio for transmission.

**- THE RX BRANCH -**

During reception, the received signal is passed through a low pass filter (IC4A), and then to IC4B, which acts as a discriminator. The output of IC4B is then passed to the PIC16C84 microcontroller (IC3), where the receive clock is recovered. The PIC16C84 then passes the raw data to the computer via the parallel port.

**- AUXILIARY CIRCUITS -**

The BP-96A can be powered by either the computers parallel port, or by an external power supply. If an external power supply is used, then the external power (8-14 V DC) is shunt regulated (by R1, R2 and D1) to a constant 4.5 volt level. Power obtained from the parallel port is not regulated, since the voltage levels on the parallel port are no more than 5 volts.

The radios PTT line is controlled by a FET transistor (Q4) capable of sinking about 75ma at 12 volts. This transistor keys the radio by shorting the PTT line through ground. If your radio needs some other keying arrangement (not likely), then you will need to provide it. If your radio is an older model with high voltage or high current on the PTT line, you will need to install a small relay to do the keying.

**- INSTALLATION -**

The installation of the modem is relatively strait forward. But, before you begin, be sure you have reviewed your radios documentation to verify that it is 9600 baud compatible and that you have the correct connectors on hand to interface to it. You will also want to check your computers manual to determine the address and interrupt number for the parallel port you intend to use. The BayCom software defaults to the "standard" parallel printer port (LPT1). Be sure that you have thoroughly read the BayCom v1.6 software documentation before proceeding.

### - CONNECTING THE COMPUTER -

The modem can be plugged directly into the PC parallel port connector or attached with a "Centronics" type extension cable (DB-25 male to DB-25 female). The cable should be as short as possible and under no circumstances should it be longer than 3 feet. Note that many "Serial" cables of this type DO NOT contain all the necessary lines. If you wish to construct your own cable, only the wires shown in Figure 3 need to be wired:

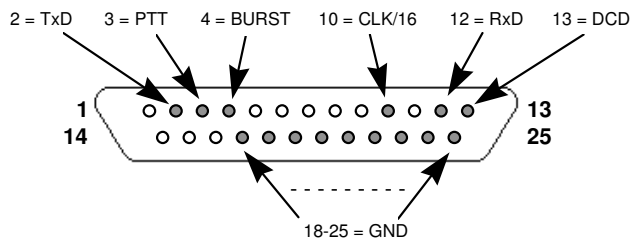


Figure 3 - Wiring of the Centronics cable.

The male DB-25 connector on the cable is plugged into the parallel port of the computer (like a printer would be).

### - CONNECTING THE RADIO -

All wires required for connecting the radio to the modem are available on the DB-9 connector on the front of the modem.

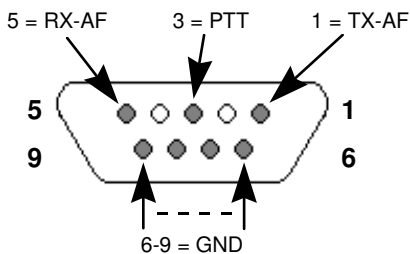


Figure 4 - Wiring of radio connector.

At this stage it is appropriate to mention that most radios must be converted for 9600 baud operation. So far (mid-1997), only a few radios are available commercially that allow for the direct connection of 9600 baud FSK modems. When choosing a radio, please keep in mind that the rx/tx switching time on most synthesized radios is very long and will therefore limit throughput since you will require a rather

long TX Delay setting. The PTT line is active low (grounded during transmit).

### - CONNECTING THE MODEM -

Connect the modem to the radio with the appropriate cabling. Next, turn on the computer. In rare cases, it is possible that the radio will go into transmit mode immediately. This is because sometimes the computers parallel port powers up without resetting it's output lines. If this happens, simply turn off the radio until BayCom software is installed and running.

### - SOFTWARE INSTALLATION -

Before you can operate the modem, you will need to install BayCom v1.6 (or higher) on your computer. To install the BayCom software, insert the program disk into your floppy drive and type A:INSTALL. Follow the on-screen instructions and the software will be installed and configured for LPT1. If you wish to install the modem on a different printer port, you will need to manually edit the SCC.INI file after installation is complete. Refer to the BayCom manual for instructions.

### - STARTING BAYCOM -

Start the program by entering L2 at your DOS-prompt (make sure that the BAYCOM directory is your working directory). There should be an all-English message and a flashing rectangle in the upper right corner of the screen. If this is the case, just enter SCC at the prompt and the familiar BayCom screen should appear. If a message appears whose last line is in German, it means that the software could not detect the modem. Exit and restart L2 again. If the modem still isn't detected, then you should recheck your cables and verify that you have selected the correct parallel port, interrupt and base address in the software.

Lets assume that all goes well and the BayCom screen appears. Turn on your 9600 baud radio and set it to a packet frequency. If there is traffic on the frequency you should now be able to monitor it in the bottom window.

### - ALIGNMENT -

A proper alignment will be easiest if you have an oscilloscope. But, if an oscilloscope is not available, you should have little difficulty doing the alignment without it. Before you start you will need to make a few changes to your station setup. IF your radio is a high-power synthesized radio (anything above 2 watts is high-powered), set your DWAIT on the channel in question to about 20 to allow for long switching times.

Set TXDELAY to 200 and switch to a monitor port by pressing F10. You can now send unproto packets by simple

pressing ENTER. Have another radio tuned to the transmit frequency and keep it unscquelched. Now adjust the Level control on the front of the modem so that the noise level of the test packets is just below the normal channel noise. If you have an oscilloscope or millivolt meter you can consult your radio manual for the signal level required to produce a 3KHz shift at the radios modulator. Adjust the level as required. This is best done with a deviation meter since the deviation is critical for reliable operation.

After you have adjusted the transmit audio level, you need to find a good station to connect to. If you see another stations packets on the monitor you probably will be able to connect to them. While still in the monitor window, enter

:c callsign

Now send an unproto test packet by pressing ENTER in an empty line. If the station receives your packet, the station will respond with a packet with a DM,F at the end. If you get no response, try again, a few times if necessary. If you get no response at all try it again with a slightly longer TXDELAY or a better antenna location. If the DWAIT (the time that your partner station will wait before responding if you have just transmitted - DWAIT is the relevant BayCom parameter for this) at your partner station is too low and you are using a synthesized radio, this could be a problem. If all (or an overwhelming majority) of your packets get acknowledged, your ready for the next step. Now, using the same method as above, try and lower your TXDELAY as far as you can without increasing the number of unanswered packets. Once you get the TXDELAY as low as you can (while maintaining good performance), record this value and enter it into your SCC.INI file.

#### - RF INTERFERENCE -

The BP-96A modem was designed with RF immunity in mind. Not only is its circuitry designed to minimize the generation of radio emissions, but it is also designed to suppress emissions from your computer. Nevertheless, if you operate the unit in the presence of excessively high RF fields (HF Kilowatts), you are probably going to have problems with both the computer (especially laptops) and the BP-96A. RF induced problems are easily identified since they generally cause the modem and/or computer to become totally inoperative (lock up) after transmitting. If this happens, you can reset either device by removing power and then restarting the program. WARNING: Excessively high levels of RF can permanently damage your equipment.

#### - QUESTIONS & ANSWERS -

**Can I run the BP-96A and a BP-2 at the same time?**

Yes, provided that your computer is fast enough. All that needs to be done is to enter the appropriate interface

numbers and parameters for each modem during the installation procedure.

**There is no flashing rectangle after starting the program with L2.**

This can occur because of various reasons. First make sure that the interrupt you are using is not being used by another device. Did you make the computer to modem interface cable? If so, check the cable for any crossed, shorted, or broken wires. Have you wired the right pin numbers?

**I see the flashing rectangle, but only after I start L2 a second time.**

This problem can occur on older computers that have "weak" parallel ports. When L2 starts, it switches on the computers parallel port (which powers the modem). If the parallel port doesn't turn on fast enough, then the modem isn't able to respond to the L2 program in time, and you get an error message. When you start L2 a second time, the parallel port is already switched on, so the modem responds and you get the flashing rectangle. This is not an issue if you are using an external power supply on the modem.

**My signals are not received properly by other stations.**

Such problems are frequently due to radios that are not suitable for 9600 baud operation. This often includes synthesized radios that have been converted. Please check the connections between the radio and the modem carefully. Other problems include too low of a TXDELAY, or incorrect deviation. Also make sure that you have enough DWAIT to allow other stations to go back to receive mode after they transmit. Under no circumstances should you simply scale the parameters that you have used for 1200 baud operation!

**The L2 rectangle flashes, but I cannot hear a signal, just a carrier.**

Verify that the Level control is not turned down all the way. See the ALIGNMENT section if the transmit audio level has not been adjusted yet.

**The L2 rectangle flashes, but I cannot receive.**

Are you sure there is traffic on the frequency? Check all connections to modem, radio, and PC. Make sure that you are on a 9600 baud frequency. Note that 9600 baud transmissions sound like bursts of noise (nothing like 1200 baud!).

#### - VISIT US ON THE WORLD WIDE WEB -

If you have Internet access, please visit our Page on the World Wide Web at: <http://www.tigertronics.com> This site contains the latest news about Tigertronics products, as well as a wealth of information of interest to all Hams and SWL's. This site is also your best source for the latest updates to all of our software.

#### - YOUR COMMENTS WELCOME -

Tigertronics has made every effort to make the BP-96A the best possible product. We believe it represents a major technological breakthrough in packet radio and hope we have anticipated your every need in using it. We welcome any comments or suggestions that you would like to make. Please drop us a note to let us know about your experiences, tips you would like to share with other users, or how we might do a better job.

#### - LIMITED WARRANTY -

Tigertronics warrants the BayPac Modem to be free of defects in material and workmanship for a period of 90 days from the date of shipment. Tigertronics will repair or replace, at its option, any parts found to be defective during the warranty period. This warranty does not include any unit which has been subject to misuse, neglect, improper installation or operation. This warranty is in lieu of all others, express or implied, and no person or representative is authorized to assume for Tigertronics any other liability in connection with the sale or use of this product. Tigertronics will not be responsible for any expense or loss of revenue or property incurred by the user due to operation or malfunction of this equipment. Tigertronics reserves the right to make circuit or component changes, or to incorporate new features, at any time, without obligation.

#### - RETURN POLICY -

A Return Material Authorization Number (RMA#) must be obtained from the factory before any product will be accepted for return or repair. Items received at the factory without an RMA# clearly marked on the OUTSIDE of the package WILL BE REFUSED. Items being returned must be sent prepaid. Returned items should have a note attached showing the RMA#, customer name, return address, phone number, and action requested. Units being returned for warranty repair must be accompanied by a copy of the original sales invoice showing the date of purchase.

Customers wishing to return a product for REFUND, for ANY REASON, must receive an RMA# within 15 days from the shipping date shown on the original sales invoice. Customers returning products for refund will be charged a Restocking Fee equal to 20% of the purchase price, to cover the cost of re-testing and re-stocking. Products which have been damaged or modified in any way, may not be returned. Contact our Technical Support department for the RMA#.

#### - TECHNICAL SUPPORT -

If you encounter problems that you cannot resolve with the BayPac (not software), you can reach our Technical Support Center at (541) 862-2639 any Monday, Wednesday, or Friday between 1:00 PM and 5:00 PM (PST). Be sure to have your equipment available for testing when you call.

Also, have a printout of your AUTOEXEC.BAT and CONFIG.SYS files available for review. Please DO NOT mail, email, or fax your technical inquiries to us. We realize that calling is a little more expensive, but more can be accomplished in a few minutes on the phone than can be done in hours of writing! We simply are not able to respond to written inquiries involving technical problems.

#### - SPECIFICATIONS -

Compatibility: G3RUH 9600 baud DFM  
PAR9600 / PICPAR / BP-96

Computer Interface: Centronics Parallel Port

Power: Computer Parallel Port (5ma) or external power source of +8 to 14 volts @ 10ma

Signals: PTT (active low) 75ma @ 12v (MAX).  
Rx Input 300mv p-p (nom)  
Tx Output 0 - 3v p-p

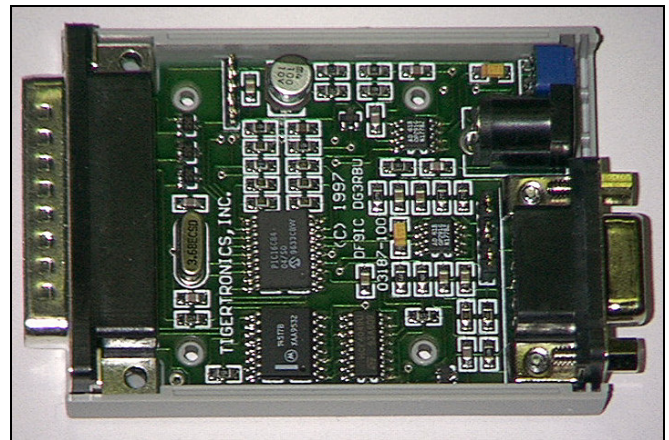
Connectors: Parallel Port - DB-25M  
Radio Port - DB-9F  
Power - 5.5 x 2.1 mm (Center +)

Size: 7/8" H x 2-1/4" W x 3" D

Case: Molded ABS - Gray/White

Construction: Surface Mount Technology (SMT)

Accessories: DB-9M radio cable  
5.5 x 2.1 mm power plug



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(Rev. 10/10/05)