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1 Introduction

With the presentation of the 9600Bd modem for the Centronics interface, one of the most elaborate developments in the history of the BayCom team has found its way from the designers' desks into the ham shacks. Starting with the first ideas in winter 1993, several hundred working hours were required until the finished product could be presented to the public in autumn 1994 and all major bugs had been ironed out.

The modem is in its principles based on the ”modern FSK modem” presented in 1991 by Henning Rech DF9IC. A direct feed of the modem signals into the PC, however, was impossible as each clock transition would have generated an interrupt. At 9600 Bd, that's an interrupt almost every 100 microseconds – even powerful PC would have their difficulties coping with that. Hence, a buffer had to be provided that would collect a few bits of data and hand them on to the PC. Eventually, this was achieved with two programmable logic chips and two external shift registers, leading to a fair amunt of extra hardware. However, some of the modem functions were shifted to the software, such as the scrambler and the DCD. Overall this means that the hardware requirements are not significantly higher than those of a standard DF9IC modem.

The designers would like to thank all those who have supported the development of this modem. In particular, we wish to thank Henning DF9IC again who made his modem design available as a basis to start from. He also contributed actively to the design by calculating a specially adapated FIR filter.

We wish all homebrew enthusiasts attempting the construction a lot of fun with the modem and always unimpeded data reception. Now that expensive TNC's and plug–in cards are no longer a basic requirement for running 9600Bd, the network of 9600Bd node digipeaters should hopefully be getting a few new impulses. That would set another milestone in the development of the amateur packet radio network.

The BayCom likes to thank Ulrich, ZL1DDL/DI1NDB for his excellent work to translate this manual and for his efforts to support the BayCom ideas ”down under”. When all this manual (except of this paragraph) sounds not too bad to all guys with english mother tongue, these are Ulrichs merits!

Barsinghausen/Freising, August/October 1994

Johannes DG3RBU Flori DL8MBT

as translator: Ulrich ZL1DDL (DL1NDB)

2 The Circuit

Picture 2.1 shows a block diagram of the modem. The modem is connected via six signal lines to the Centronics interface of the PC. The transmission of RX and TX data is done serially, as the Centronics interface has merely four input lines.

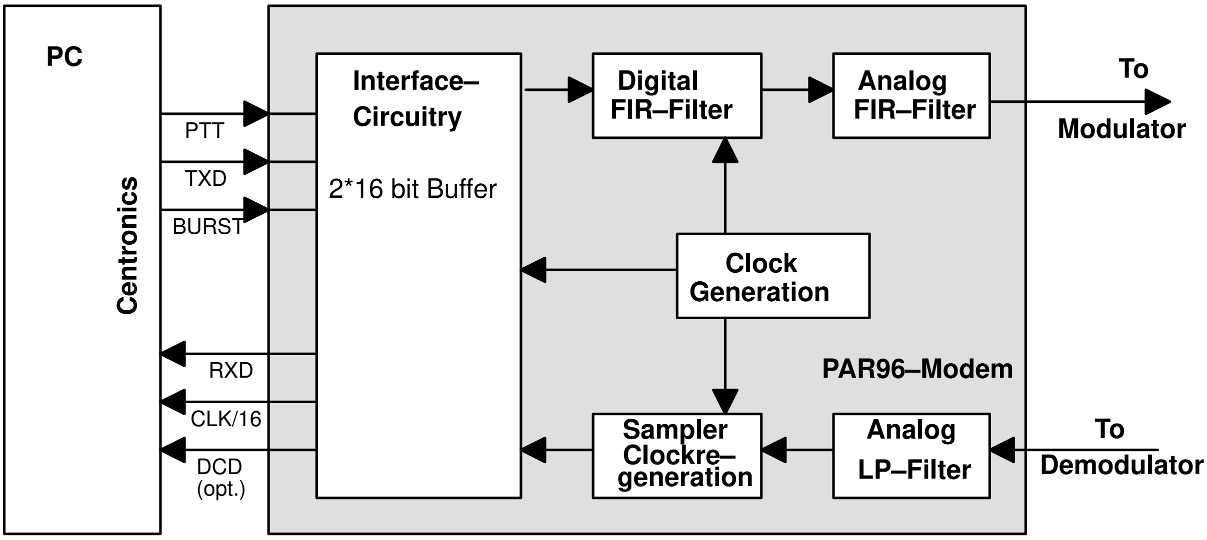


Figure 2.1. Block diagram of the PAR96–Modems

The RX and TX data are transmitted in bursts of 16 bit each via the interface. In the TX case, these sixteeen bits are written via TXD into the modem's TX buffer, controlled by the BURST line. From there, they are picked up in accordance with the TX clock. They are then filtered with a digital filter contained in an EPROM. A following analog filter removes the unwanted sampling signals of 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 low pass filtered and fed into a binary discriminator. It compares the signal with the mean of the bitstream (which consists of approximately as many binary ONEs as ZEROs). The raw data bitstream now needs to be sampled at the right time, i.e., in the "middle" of each bit. For this purpose, the clock of the received signal is recovered by a 32–stage digital phase locked loop (DPLL) circuit. The raw data bitstream is now sampled at this clock rate and fed into the interface buffer. The RX clock divided by 16 signals to the PC that the buffers is full and should be read, again using the BURST line.

If an external DCD signal is available, it can be fed into the PC via the interface to replace the software DCD. All clock frequencies required are generated on board of the modem.

Realization

The circuit diagram is shown on the following two pages in two parts. Figure 2.3. shows the TX branch and the interface circuitry, which is used for both RX and TX. Figure 2.4 shows the RX branch and the clock generator as well as auxiliary circuitry for power supply and PTT control purposes.

The Interface

The buffering and the burst transfer of the data between modem and PC represents the most complex part of the modem. The interface circuitry is used both for reception and transmission. The direction of the data is determined by the PTT signal. Hence the modem will only support semi–duplex operation. Figure 2.2 shows a block diagram of the interface.

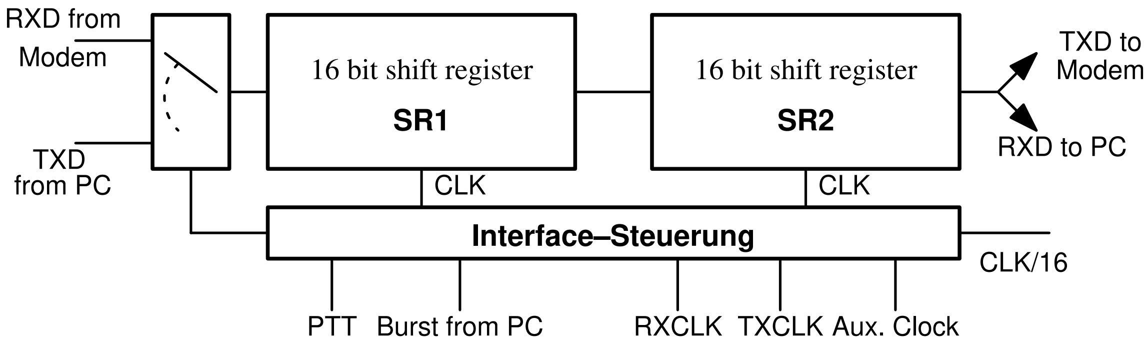


Figure 2.2. Block diagram of the Interface

In principle, the interface consists of two shift registers connected in series and a control circuit which genererates the clock signals for the shift registers and toggles the direction of the data flow. During transmission, the PC writes 16 bit of TX data into SR1 via a serial line, using BURST as an auxiliary control signal. At the same time, SR2 is being read bitwise by the modem, controlled 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 bit of TX data may be written into SR1 with the BURST signal.

Upon 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 now informed via CLK/16 that SR2 has been filled and that the data is ready for collection with the BURST signal.

The complete control circuitry is accommodated in the programmable logic arrays (GALs) PARSFT and PARCNT. 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. The GAL listings can be found in the appendix. The shift registers are implemented as two 4006 IC's.

Figure 2.3. Circuitry Transmitter branch and interface

Figure 2.4.   Circuitry receiver branch and clock generation

The TX branch

During transmission, the TX data bits in SR2 are shifted into another 8–bit shift register. It makes the bits available to the FIR filter EPROM (IC8). IC8 has 8 different frequency response curves available which can be selected with SW1 (see appendix). The EPROM's output controls a digital–to–analog converter (IC10). IC11 (C+D) is a DC coupled low pass filter which removes the high frequency components from the converter's output. Its output is DC with superimposed AF. C10 removes the DC offset as it can lead to a RX frequency shift in some radios.

The RX branch

IC11 A performs the low pass filtering with a three–pole Butterworth low pass filter and IC12 A works as the discriminator. IC 1, the third GAL IC, is used for clock recovery (it also generates the clock for the TX FIR filter). The raw data is then fed directly into the interface.

Auxiliary circuits

The modem power supply should be 8–12 V DC or AC. Polarity doesn't matter as the incoming supply voltage is rectified via D1–D4 and filtered with C12. A voltage regulator (IC 13) provides a constant supply voltage of +5V.

IC11C generates a voltage of about 2V, which serves as virtual ground for the anaolg filter.

The radio's PTT line is controlled via T1. A watchdog circuit, consisting of R4, C16, R3, D5 and IC4B makes sure that the transmitter is automatically turned off if the PTT has been continuously on active for more than about 30 seconds, e.g., after a program crash.

3 Assembly

The circuit is assembled according to the component diagram (Figure 3.1) and the component list after this section on a printed circuitboard (PCB) of size 98 mm x 100 mm. The components should be soldered into the PCB in order of their height above the PCB, such that the smallest components are soldered in first. Sockets with high–quality contacts should be used at least for IC1, IC2, IC3 and IC8, but ideally for all IC's in dual–in–line cases. If you want to burn your own GAL chips, you may use the 20V8 types in 24–pin cases that have some space left for future extensions. However, the present state of development also allows 20–pin 16V8 type GALs to be used, which are inserted exactly in the middle of the 24–pin sockets of their 20V8 big brothers (i.e. pin 1 of the 16V8 chip goes into pin 2 of the socket etc.). For this you will not need to change anything on the PCB.

The orientation of the IC's on the PCB must be strictly observed. Note that IC sockets have orientations too, the side of pin 1 is usually indicated by a notch or a dot. While this has no actual physical significance, mounting IC sockets with the correct orientation is good practice and results in a neat, easy–to–service PCB. When soldering the resistor network R25, the dot on its case must be next to pin 28 of IC8.

All foil capacitors and C12 should have 5mm lead spacing, all other capacitors 2.5 mm. SW1 is a standing 4 x DIL switch, which is later accessible through a hole in the front panel of the modem. When soldering the switch, it is advisable to ensure that the switch case itself does not extend beyond the PCB, as this may later interfere with the front panel, causing it to bend slightly. The two LEDs are mounted flat such that they fit into the holes in the front panel. It may be easier to solder them if the PCB is provisionally mounted in the case.

Eventually, the three sockets for power, radio and PC connections are soldered into the PCB and the IC's are inserted into their sockets.

The Case

The modem can now be mounted in a suitable case. The kitset already comes with a case that has the necessary holes and markings. For those who wish to build their own, a schematic in the appendix shows the location and size of the holes in the front panels.

3.1 Part List

IC1	GAL16V8 PARCLK	R13	12k	
IC2	GAL16V8 PARCNT	R14	2k2	
IC3	GAL16V8 PARSFT	R15	68k	
IC4	74HC04	R16	100k	
IC5	4006	R17	4k7	
IC6	4006	R18	1k	
IC7	74HC4040	R19	39k	
IC8	EPROM 27C256	R20	82k	
IC9	74HC164	R21	100k	
IC10	ZN429	R22	2k2	
IC11	LM324	R23	27k	
IC12	LM393	R24	27k	
IC13	7805	R25	10k SIL	
T1	BC548C	C1	3n3	metallic
		C2	470p	metallic
D1	1N4001	C3	100p	metallic
D2	1N4001	C4	1n	metallic
D3	1N4001	C5	220p	metallic
D4	1N4001	C6	1n	metallic
D5	1N4148	C7	470n	metallic
D6	LED green	C8	1n	metallic
D7	LED red	C9	4u7	Tantalum– 6.3 V
		C10	10u	Tantalum– 6.3 V
R1	270 Ohm	C11	4u7	Tantalum–6.3 V
R2	270 Ohm	C12	470u	Elyt 16V
R3	2M2	C13	100n	Ceramic
R4	100k	C14	100n	Ceramic
R5	8k2	C15	4u7	Tantalum–6.3 V
R6	2k2	C16	10u	Tantalum–6.3 V
R7	10k Trim Vertical	C17	4u7	Tantalum–6.3 V
R8	100 Ohm	C18	4u7	Tantalum–6.3 V
R9	100k			
R10	10k	Bu1	25p–Sub D–Connector	
R11	100k	Bu2	9p–Sub D–Connector	
R12	56k	Bu3	AC–Socket	
		SW1	DIL–Switch 4way	
		OSC1	Crystal Osc. 2.4576 MHz	

Others:

1 IC–socket 28p
3 IC–sockets 24p schmal
1 IC–sockets 16p
6 IC–sockets 14p
1 IC–socket 8p
1 PCB BayCom 8001
1 Alu–Case BayCom 8010

Figure 3.1. Assembly of the PAR96–Modem

4 Installation

The installation of the modem is relatively easy. All that needs to be done is the selection of the proper filter curve with the DIL switch and an adjustment of the outpt amplitude. First of all, however, connections for the PC, the radio and the power supply must be made and installed.

Connecting the PC

The modem can be connected to the PC by any Centronics–type extension cable (25–pin sub–D male plug to 25–pin sub–D female). The cable itself should be as short as possible, under no circumstances should it be longer than 2 metres. If you want to construct your own cable, only very few leads will have to be wired:

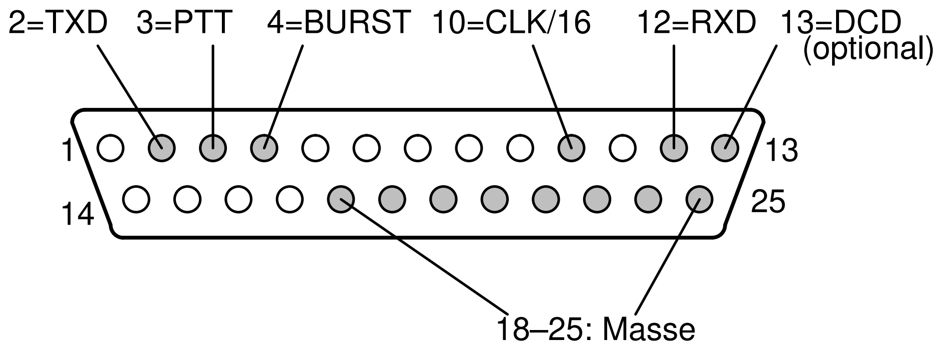


Figure 4.1. Wiring of Centronics Connector

The male sub–D connector of the cable is plugged into a parallel port on the computer, just like a printer. The DCD line only needs to be wired if there is an external DCD signal. If the software DCD is used, the line does not have to be wired.

Connecting the radio

All leads required to connect the radio to the modem are available on a 9–pin sub–D male socket on the modem. The cabling is the same as on the BayCom 1200–Bd micro modem (recent versions with sub–D radio connectors only). Apart from the RX,TX and PTT signals there is a line for external DCD and also for +5V.

The transmitting signal is fed directly into the radio's modulator. The PTT is active low, i.e., it switches to GND during transmission. The received signal is taken directly from the demodulator. At this stage it is appropriate to mention that most radios must be converted for 9600Bd operation. So far (mid–1994), only very few radios are available commercially that allow for the direct connection of 9600 Bd FSK modems such as this one. However, some of the major manufacturers have recently presented radios that feature a 9600Bd packet connector. When choosing a radio, please keep in mind that the switching times for 9600Bd signals on most synthesized radios are very long and will hence affect your throughput as you will require a rather long TXDELAY. Whenever possible, a crystal controlled radio should be used, such as, e.g., the KS–960.

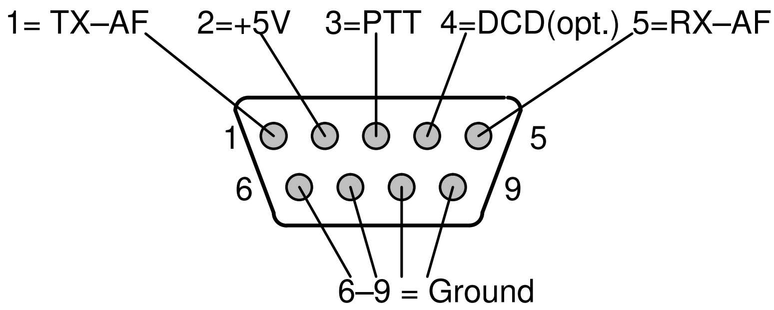


Figure 4.2. Wiring of the radio connector

The DCD line does not need to be connected, however, if your radio has a very fast squelch, it may be advantageous to use it. The DCD must be active–low.

Power supply

Any type of AC or DC power supply that can deliver 8–12 V at about 150 mA may be connected to the modem's AC socket. For example, a plug–in power supply may be used. The polarity does not matter.

It is also possible to operate the modem from a 5V–source, e.g., for portable operation. For this purpose, you need to connect the +5V rail directly to the +5V pin on your radio (if available). Before, you MUST severe the bridge Br1 near IC13. Otherwise IC13 may get damaged. Under no circumstances must the +5V rail be connected to anything while Br1 is closed and an AC power supply connected... .

Connecting the modem

Connect the modem to the PC. The four DIL filter selection switches SW1 should all be in ON position. Now connect the modem and the radio and switch your PC on. You may now connect the power supply to the modem. In rare cases it may happen that the radio will now go into transmit mode. In this case, wait with connecting the radio until the software is installed and running.

Configuring the software

To test the modem, you should install BayCom V1.60 software (or higher) on your PC. To operate the modem, you will need an IBM–AT compatible computer with at least

10 MHz clock frequency. It must have a parallel interface capable of generating an interrupt. It can not be used to drive a printer at the same time. If your PC has more than one parallel port, you can select the one that suits you best. Check your system manual for the base address and interrupt of the interface (if required, check on the interface card what address and interrupt are selected with the jumpers).

Install the software by inserting the BayCom software disk into your disk drive and typing

```
a:\install
```

or

```
b:\install
```

depending on the disk drive that the BayCom disk is in. Choose the express installation option. Everything else should happen automatically. You will be asked for the modem hardware parameters. Simply select 1 or 2 in the field for the 9600Bd modem. If you are not using any other modem, put all other interface selections to zero. If you have an unusual printer port configuration, go ahead anyway and change the parameter(s) manually in the window that will pop up after you have pressed RETURN.

You will then be asked for your personal details (call sign, name and QTH) which are needed for various standard texts, such as the connect text. If you already have BayCom V1.60 installed, you may wish to alter your existing installation by editing SCC.INI or by running the INSTALL program again as described above. Note that you can use the PAR96 modem in parallel with the standard BayCom modems or USCC cards, provided that your machine is fast enough to handle the workload. In this case, your new modem will probably be assigned a channel other than 0, so that you will have to specify the channel number when issuing commands to the software. See the BayCom software manual for details.

First operation

Start the program by entering L2 at your DOS–prompt (make sure that the BayCom directory is your working directory). If all goes well, an all–English blurb will appear and there will be a flashing rectangle in the upper right corner of the screen. In this case, just enter SCC at the prompt and the familiar BayCom screen should appear. If a blurb appears whose last line is in German, it means that the software could not find the FSK modem. Check that the power on the modem is on (green LED) and that you have selected the correct port, interrupt and base address. Other causes for this happening could be a defect in the modem hardware, or a problem with the computer's interface. If you are new to construction, chances are it's your soldering, so go back and check the PCB thoroughly and ask a more experienced friend to help you if required.

Let's assume that all goes well and the familiar three–window BayCom screen appears. Turn on your 9600Bd radio and set it to a 9600Bd packet frequency. If there is traffic on the frequency, you should now be able to monitor it in the bottom window.

Settings and alignment

If you have an oscilloscope at hand, it is easy to do a proper alignment. But even without any technical aid, you will probably find that there is no major difficulty associated with it. Before you start you may have to change a few parameters: if your radio is a high–powered synthesized rig (anything above 2W is high–powered), set your DWAIT on the channel in question to about 20 to allow for long switching times.

Make sure all filter switches are ON. Put :TXDELAY 200 and switch to the monitor port by pressing F10. You can now send out unproto packets by simply pressing ENTER. Have another radio tuned to the transmit frequency and keep it unsquelched. Now adjust the trimpot through the hole in the front panel so that the "noise" level of the test packets is just below the normal channel noise (G3RUH type packets sound different from 1200Bd AFSK packets, much like noise).

Alternatively, check your radio's manual about the signal level required to produce a shift of 3 kHz at the radio's modulator. Now take an oscilloscope or millivolt meter and adjust the trimpot such that the signal level at the modem's tx data output matches this 3 kHz signal level. You should do this while the radio is connected to provide a proper load for the output.

Now you should know what partner station best to connect to. If you can see another station's packets on the monitor, chances are that you will be able to connect to them (unless they are much more high–powered than you are). Let's suppose that this is ZL1AB. Set your TXDELAY back to a lower level (about 20–25 for synthesized rigs – note that this is more than required for 1200Bd AFSK in most cases – and about 10 for crystal controlled radios). While still in the monitor, enter

```
:c zl1ab
```

Now send an unproto test packet by pressing ENTER in an empty line. It will be directed at ZL1AB. If it arrives, ZL1AB will respond by sending 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 a slightly longer TXDELAY or a better antenna location. If there are a few responses, but the majority of packets remain unanswered, try different filter responses. 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 rig, this is also a possible cause for trouble.If all (or an overwhelming majority) of your packets get acknowledged, you're ready to start full operation. All you should try to do now (using the same method as before) is to try and find the lowest possible value for your TXDELAY. Put this value into the initialisation file SCC.INI !

5 Question, Problems and Answers

Can I run the PAR96 and the 1200Bd serial modem at the same time?

Yes, provided that your computer is fast enough. You can also use USCC cards. All that needs to be done is to enter the appropriate interface numbers and parameters during the installation routine. If the installation routine is used to install both the 1200Bd modem and the 9600Bd modem, the 1200Bd channel will be channel 0, and the 9600Bd channel will be channel 1.

Can I run the modem at 19200Bd?

Yes, you can run the modem at 19200 Bd. The following changes have to be made:
– replace OSC1. You will need an oscillator that provides 4.9152 MHz.
– replace C5, C6, C8, C1, C2, C3 and C4 by components of half their value.
– replace the GAL's and the EPROM by faster types, if required.
– you must use a computer with at least a 386 processor.

There is no flashing rectangle after starting the program with L2

This can occur because of various reasons. To reduce the possibilities, check whether there is a square wave signal on pin 10 of your interface with a period length of about 1.6 ms when modem and radio are connected. If so, something's wrong with your installation or computer hardware. If not, the fault is quite likely associated with your modem hardware.

In the first case, check your jumpers on your interface card. Are you sure that the interrupt is not already in use by another device (sound blaster, USCC card etc.)?.

If there is no square wave signal, you will have to check your modem hardware and cabling. It is best to proceed as follows:
– check your Centronics cable. Have you crossed any wires or have you accidentially taken a serial cable? Have you wired the right pin numbers?
– check the supply voltage across the IC's (e.g., between pin 28 and pin 14 on the EPROM). You need almost exactly 5V.
– check the modem PCB optically. Make sure that you don't have dry soldering joints (can be recognised from their pale, frosted colour). Make sure that all IC's are inserted as indicated in the component layout diagram, that all IC pins are properly in their sockets and that all other components are assembled according to the component layout diagram.
– check the clock generation by checking pin 10 of IC7 and pin 1 of IC2.

If you cannot find the fault in the latter case, you may contact your BayCom dealer.

My signals are not received properly by my partner stations

Such problems are frequently due to radios that are not sufficiently suitable for 9600Bd operation. This frequently includes synthesized radios that have been converted for 9600Bd operation. Please check the connection between radio and modem carefully. Other problem sources include a too small TXDELAY (the TXDELAY required may be higher than for 1200Bd operation with the same radio), too much or too little deviation or a wrong choice of filter curve.Also make sure that you have enough DWAIT to allow the partner station to go back to proper receive mode after its transmissions. Under no circumstances should you simply scale the parameters that you have used for 1200Bd.

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

Are you sure it is just carrier? If so, proceed as follows:

– make sure R7 is not turned right down.

– check whether you can get a stair–shaped signal on the oscilloscope from TP1 (pin 4 of IC10). If this is the case, check your setup between TP1 and the radio connector.

– if there is no signal at TP1, the fault is bound to be between the interface and the D/A converter. Due to the complex nature of the interface, fault tracking is diffcult and cannot be described in detail here. However, you may wish to check whether data arrives at the modem (pin 6 of IC2) – maybe it's just the cable that has a fault.

The L2 rectangle flashes, but I cannot receive

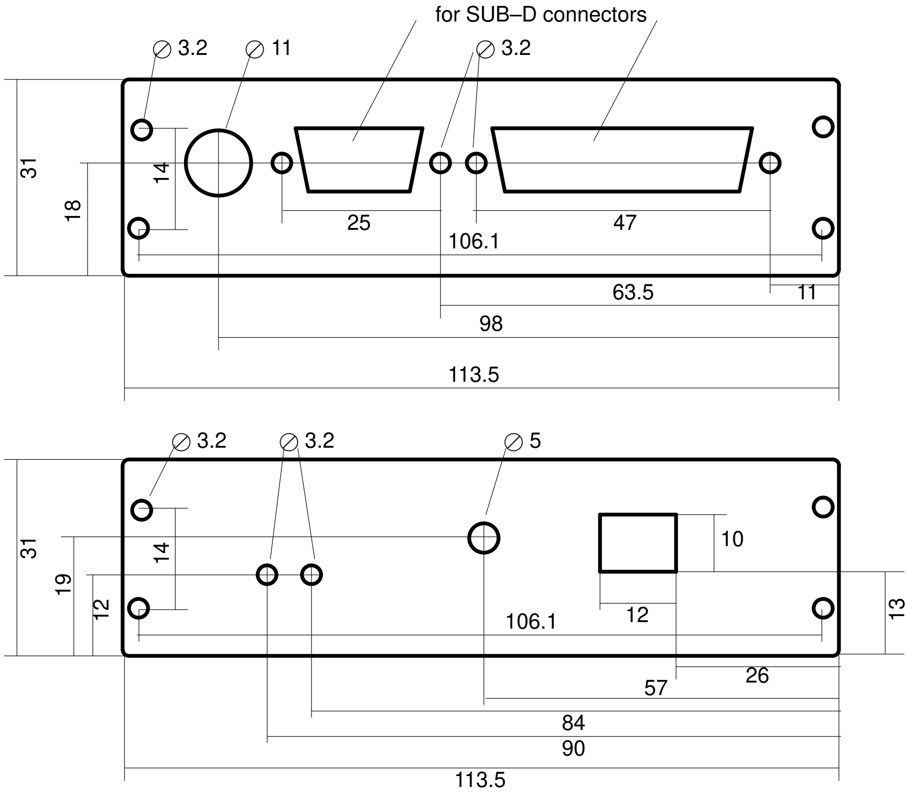
Are you sure that there is traffic on the frequency? If there is, proceed as follows:

– check whether the RX signal is getting through to TP2 (pin 3 of IC12). If this isn't the case, check the setup between the radio's demodulator and TP2.

– if the signal is available at TP2, follow the raw data via pin 1, IC12 and pin 15, IC1 through to the interface. Check your modem cable.

6 Appendix

6.1 Drilling plan for Aluminum Case



6.2 FIR–Parameters in the EPROM

Switch setting				Frequency limit of compensated ext.
SW4	**SW3**	**SW2**	**SW1**	**Low Pass (normalized to 9600Bd)**
ON	ON	ON	ON	∞
ON	ON	ON	OFF	0.8
ON	ON	OFF	ON	0.6
ON	ON	OFF	OFF	0.5
ON	OFF	ON	ON	0.4
ON	OFF	ON	OFF	0.35
ON	OFF	OFF	ON	0.3
ON	OFF	OFF	OFF	0.25

The other switch settings are for planned extensions

6.3 GAL equations

```
GAL BAYCNT (20V8)
BURST-GENERATION, CLOCK AND DATA MULTIPLEXING


Variables:

CLK2-64:  Divided TXCLOCKS
RCO:      Ripple Carry Out
RXD_L:    RXDATA
PTT:      PTT
TXDPC:    TXDATA from Host
RXCLK:    Receive Clock
TXCLK     Transmit Clock
RXTXCLK:  Multiplexed Clocks
SI:       Multiplexed Data


Equations:

SI = PTT & RXD_L + /PTT & TXDPC;

RXTXCLK = PTT & /RXCLK + /PTT & TXCLK;

CLK2 := /CLK2 & /RCO & /CLK64; Rising Edge, if RCO = 0,
                             ; Counter Holds with RCO = 1
CLK4 := /CLK4 & CLK2
      +  CLK4 & /CLK2;         Rising Edge on 01 or 10
CLK8 := /CLK8 &  (CLK4 & CLK2)
      +  CLK8 & /(CLK4 & CLK2);
CLK16 := /CLK16 & (CLK8 & CLK4 & CLK2)
      +  CLK16 & /(CLK8 & CLK4 & CLK2);
CLK32 := /CLK32 & (CLK16 & CLK8 & CLK4 & CLK2)
      +  CLK32 & /(CLK16 & CLK8 & CLK4 & CLK2);

CLK64 := /CLK64 & (CLK32 & CLK16 & CLK8 & CLK4 & CLK2)
       +  CLK64 & /RCO; Rising Edge with 0111x, Reset when RCO = 0.

Pins:

RXCLK = 9, RCO = 5, TXCLK = 6, PTT = 7, RXD_L = 8, TXDPC = 4, SI = 15,
CLK2 = 16, RXTXCLK = 17, CLK4 = 18, CLK8 = 19, CLK16 = 20, CLK32 = 21,
CLK64 = 22;
```

```
GAL BAYSFT (20V8)
INTERRUPT GENERATION and Shift-Signal Generation


Variables:

PTT:      PTT
SHIBURST: Burst from BAYCNT
BURST:    Burst from Host
RXDMODEM: Modem RXDATA
RXTXCLK:  Multiplexed Clocks
CO:       Carry Generation
CLK_2 -
CLK_16:   Divider for Interrupt
RXD_L:    Sampled Raw Data
CLKSR1:   Clock for first Shifter
CLKSR2:   Clock for second Shifter

Equations:

CLK_2 := /CLK_2;
CLK_4 := /CLK_4 &  CLK_2
       +  CLK_4 & /CLK_2;
CLK_8 := /CLK_8 & (CLK_4 & CLK_2)
       +  CLK_8 & /(CLK_4 & CLK_2);
CLK_16:= /CLK_16 & (CLK_8 & CLK_4 & CLK_2)
       +  CLK_16 &/(CLK_8 & CLK_4 & CLK_2);

/CO    =  /RXTXCLK & CLK_2 & CLK_4 & CLK_8 & CLK_16;

RXD_L := RXDMODEM;

CLKSR1   = /CO & /SHIBURST
         +  CO &  PTT & /RXTXCLK
         +  CO & /PTT & /BURST;

CLKSR2   = /CO & /SHIBURST
         +  CO & PTT & /BURST
         +  CO & /PTT & RXTXCLK;

Pins:

RXTXCLK = 6, RXDMODEM = 3, SHIBURST = 8, BURST = 9, PTT = 10, CLKSR2 = 15,
CLKSR1 = 16, RXD_L = 17, CLK_2 = 18, CLK_16 = 19, CO = 20, CLK_8 = 21,
CLK_4 = 22;
```

GAL BAYCLK (20V8)
CLOCK REGENERATION AND CLOCK DIVIDER

Variables:

```
f32:      32 * Transmission Clock
f2:       Double Transmission Clock
PTT:      PTT-Signal
RFSK:     Received FSK Data
X:        Edge Detekt
C1-C5     PLL Counter Bits
RD0:      Delayed FSK Data
FOUT:     Auxiliiary Clock Output
```

Equations:

```
FOUT = PTT & f32 + /PTT & /f2;

RD0  := RFSK & PTT + /RD0 & /PTT;

X    := /RD0 & RFSK +  RD0 & /RFSK;

C1   := /X & /C1 +   X &  C1;

C2   := /X &  C2 & /C1
      + /X & /C2 &  C1
      +  X &  C5 & /C2
      +  X & /C5 &  C2
      +  X & /C5 & /C4 & /C3 & /C2 & /C1;

C3   := /X &  C3 & /C1
      + /X &  C3 & /C2
      + /X & /C3 &  C2 &  C1
      +  X &  C5 &  C3 & /C2
      +  X &  C5 & /C3 &  C2
      +  X & /C5 &  C3;

C4   := /X  &  C4 & /C1
      + /X  &  C4 & /C2
      + /X  &  C4 & /C3
      + /X  & /C4 &  C3 &  C2 &  C1
      +  X &  C5 &  C4  & /C2
      +  X &  C5 &  C4 & /C3
      +  X &  C5 & /C4 &  C3 &  C2
      +  X & /C5 &  C4;

C5   := /X &  C5 & /C4
      + /X &  C5 & /C3
      + /X &  C5 & /C2
      + /X &  C5 & /C1
      + /X & /C5 &  C4 &  C3 &  C2 &  C1
      +  X &  C5 & /C4
      +  X &  C5 & /C3
      +  X &  C5 & /C2;
```

Pins:

```
f32 = 8, f2 = 4, RFSK = 6, PTT = 7, X = 15, C2 = 16, C4 = 17, RD0 = 18, FOUT =
19, C1 = 20, C3 = 21, C5 = 22;
```

BayCom ordering information

Ordering of BayCom Hard– and Software

You can order all BayCom products directly from the BayCom–team, address see below. Please ask for our catalogue and price information.
BayCom products can also be obtained by authorized dealers all over the world.

Technical Support and Service

For all BayCom kits we offer a repairing service. Surely you will understand, that this service cannot be provided for free, but we will try to do it as cheap as possible. We know about the amateurs need having assembled a kit that does not work!
If there is a major damage (more than half of the kit price) we will ask you before we do the repair.
Please send all equipment for repair to the following address:

BayCom
Johannes Kneip (DG3RBU)
Bert–Brecht–Weg 28
30890 Barsinghausen
Tel. 05105/83183 (abends)
FAX. 05105/83449

You also can get technical information from Johannes!

BayCom

R. Dussmann & Partner GBR
Massinger Weg 3 **Tel. 09453/1639**
D–93107 Weillohe **FAX 09453/9829**