PTC

THE PACTOR™ CONTROLLER

The English manual for software version 2.0

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Foreward

The information contained in this handbook has been carefully put together and corrected. It is, however, still possible that errors have crept in. If any errors are found, we ask your forgiveness, and to send us a short note with the correction.

Your SCS–Team

Attention, Important Advice

You should connect the Power Supply plug to the PTC, **only when the power supply is switched off.** First connect the plug to the PTC then connect to the power supply.

The DC plug of the PTC should **never** be pushed into its socket with power connected. This is especially so when the PTC and the Radio Equipment are connected by means of the AF and the PTT cables, and use the same power supply.

The case of the PTC is at Earth potential, and in event of a short circuit, very serious internal damage to the PTC can occur if this advice is not followed.

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1 Introduction

1.1 About this manual

This manual contains information about installation and operation of the SCS PACTOR Controller. The shortform for PACTOR Controller is PTC and is used in this manual alternatively.

The manual may be used as a reference manual for the PTC commands as well as as hardware reference and as an assembling guide.

The second part shows how to quickly start working with the PTC.

Parts 5, 6 and 7 will make you familiar with the command–structure and operating with the PTC. Part 3 and 8 will help you to make your first QSO and tell you something about the behavour on the air.

Part 9 describes the electricle circuits and guides you if you assemble the PTC on your own. If you do so, take care to read chapters 14.3 and 14.4 !

1.2 Why PACTOR?

PACTOR is a new radio teletype mode developed in Germany by DF4KV and DL6MAA to improve on the inefficient modes like AMTOR and PACKET–RADIO in weak shortwave conditions. The AX.25 PACKET has its advantages on VHF/UHF FM channels but gives a lot of problems on shortwave:

- The data rate of 300 baud combined with a large packet lenght used by many radio amateurs is very susceptible on fading or multipath conditions and QRM.
- The large protocol overhead dramatically reduces the amount of information contained in a packet.

AMTOR had been developed specially for transfering text on an HF channel. Even weak signals under distorted conditions where a PACKET connect would never be possible could be copied. But also AMTOR has its disadvantages:

- Using 5–BIT code makes it impossible to transfer the whole ASCII character set or binary data.
- Detecting and correcting errors is insufficient for error free transmission of binary data.
- The effective data rate is only 35 baud.

PACTOR provides a much faster data transmission combined with a highly improved error correction mode. The syncronous dataframe format and short packet lengths are the same as on AMTOR. The result is a highly decreased susceptibility of the protocol against weak signal conditions if compared with PACKET. The PACTOR protocol joined with the SCS PACTOR controller allows data transmission 4 times faster than AMTOR combined with the data transparency known from PACKET–Radio.

1.3 Requirements

To operate PACTOR it is necessary to use a transceiver capable of switching between transmit and receive within 30ms. Any transceiver capable of AMTOR may also be used for PACTOR.

To operate the SCS–PTC you need a computer or a simple terminal that provides an interface compatible with the RS232 (V24) standard. If you use a computer you need a terminal programm to operate the interface with 8 bit, 1 stopbit, no parity and a baudrate of 300, 1200, 4800 or 9600 baud, dependent on jumper setting at the PTC.

1.4 The SCS PACTOR–Controller

The original SCS–PTC comes directly from the creators of PACTOR. This ensures absolute compatibility and optimized support. The concentrated knowledge and experience of the PACTOR team is at your disposal. We highly recommend only to use the SCS–PTC for PACTOR or equipment from manufacturers supported and licenced by SCS. That is the only way to ensure that you are running the optimized protocol with the full performance of PACTOR.

The SCS–PTC also supports AMTOR and RTTY. **It automatically responds in the mode that is requested on the channel.** The mailbox is accessable from PACTOR and AMTOR. This features make the SCS–PTC the optimal equipment for HF–Radio data transmission and teletype.

The PTC also includes a cw keyer function. This unique feature enables the user to control the AMTOR and RTTY part of the PTC completely with cw–paddles. For portable use a keyboard may become redundant.

The command structure of the PTC is similar to that of a TNC with TAPR firmware and therefore wellknown by many operators that come from PACKET–Radio. That makes it very simple switching over to PACTOR.

2 Installation

The PTC is easy to install. Some jumpers have to be placed in their desired position. Some of them select the baudrate of the serial interface. The cable connecting the PTC to the computer or terminal has to be configured.

2.1 Jumper Settings

The following description will help you to easily configure the jumpers for your desired mode of operation. For more details refer to part 11.

2.1.1 Serial Interface

The SCS PACTOR–controller *talks* with your computer using a serial interface in conformance with RS232 or V24 standard. The interface uses 8 bit, 1 stopbit, and no parity. The baudrate is set by the jumpers BR4 and BR5. Table 1 shows the possible configurations.

BR4	BR5	Baudrate
open	open	9600
open	closed	4800
closed	open	1200
closed	closed	300

Table 1: RS–232 Baudrates

2.1.2 PTT

The way the PTT of the transceiver is switched has a lot of different possibilities. They are selected by the jumpers BR3 and BR6. At delivery the PTC is set the way described in point 1.

1. **Transistor switches to GND**
   Jumper BR6 is set towards the edge of the PCB.

2. **Relay switches to GND**
   Jumper BR6 is set towards the center of the board.
   Jumper BR3 is set towards the edge of the board.

3. Two isolated relay contacts switch together
Jumper BR6 is set towards the center of the board.
Jumper BR3 connects the two pins in the middle together.

Using the methods described in 1 and 2 it is possible to supply the PTC with power, using the 5–pole DIN connector by connecting the two pins of BR3 together, that show to the center of the board.

Method 3 does not support this feature as the pin is used for the second relay contact.

2.1.3 AFSK/FSK

The PTC supports both FSK and AFSK. With AFSK operation, the PTC generates a clean audio frequency signal, and passes it to the microphone input of the transceiver. For AFSK the jumper BR8 must be set towards the circuit board edge. AFSK can be used in almost every case, and should work without problem with every modern SSB transceiver. For Lowtone operation, the PTC uses the tones 1200 Hz and 1400 Hz. For Hightone operation, the tones are 2100 Hz and 2300 Hz. In both cases **200 Hz shift** is used.

Using FSK a digital signal is generated and used to switch the transceiver between mark and space. A special FSK input is required at the transceiver. FSK usually produces signals with better purity and is to be prefered therefore. PACTOR uses a shift of 200 Hz, most of the modern transceivers provide a programmable shift. Use 200 Hz shift for PACTOR if your transceiver supports it. To operate FSK set jumper BR8 towards the center of the board.

2.1.4 High Tones

By applying VCC (5V) to pin 13 of the 25–pole RS232 connector (connecting pin 13 and pin 8 together) the Firmware switches over to HIGHTONES (2100/2300 Hz). The switched capacitor lowpass–filter and the AFSK–tones are adapted. **The user has to readjust the discriminator–filters with P1/P2 by using the `ME *` command.** `ME *` will generate the correct calibration–tones.

The Firmware reads the logic level at pin 13 at the STBY prompt to the terminal (on RESET, DISCONNECT, RESTART,...).

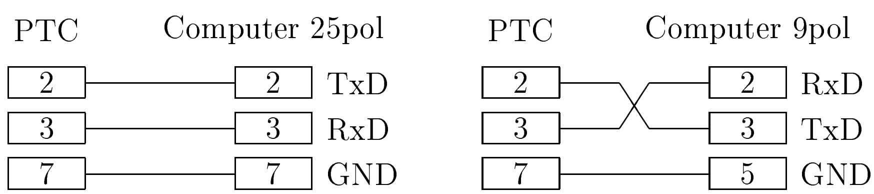
Note: The highpass–filter at the frontend of the converter is not able to be set by firmware, therefore its cut off frequency is much to low for practical use. Working with HIGHTONES only makes sense by using the **narrow IF–filter** of the receiver in FSK mode.

2.1.5 ELBUG

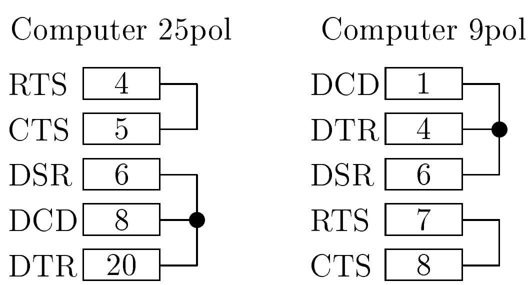
The PTC provides a complete ELBUG CW–keyer function. To activate that unique feature set jumper BR1 towards the center of the board and BR2 towards the edge. For detailed informatiom refer to part /refpbug and 11.5.

2.2 Serial Port Interfacing

The connector for the serial interface is the 25–pole SUB–D connector at the rear panel of the PTC. The following pictures show, how to connect the PTC and the computer together dependent on the connector the computer provides.



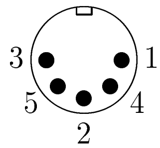
For some computers or terminals it is necessary to make some additional connections to service the handshake lines correctly.



2.3 Transceiver Interfacing

The PTC is connected to the transceiver using the 5–pole DIN connector X3. The pinout is as follows:

- PIN1 — AFSK or FSK output from PTC to the transceiver
- PIN2 — GND (to be connected to the signal–ground of the transceiver)
- PIN3 — PTT output of the PTC
- PIN4 — AF input of the PTC (to be connected to the speaker output of the transceiver).
- PIN5 — Power input of the PTC or second contact of the PTT relay.



Transceiver connector X3. View from the backpanel of the PTC.

3 The First QSO

Before the first QSO takes place, the PTC has to be connected to the computer. This should happen with PTC and computer still switched off. The next step is switching on the computer and loading an adequate terminal program. Take care that the parameters of the serial interfaces of the PTC and the terminal are set correctly, e.g. 9600 baud, no parity, 1 stopbit and halfduplex. If this is ok then switch on the 12 V power supply of the PTC. The following announcement should appear on the screen of your terminal:

```
==  Pactor  V.2.0  ==
(C)   SCS-GmbH   1992

32768 Bytes good RAM /  20750 Bytes free

<System-Level: 1>  ROM-Call: DL0WAA

*** PACTOR ACTIVE >>>

*** STBY >>


cmd:
```

If nothing appears or if it is not readable the serial interface setup might not be correct.

To check wheather the PTC accepts your inputs simply press RETURN. The PTC should respond each RETURN with `cmd:`. If that works some alignments may be checked. Typing `MY` should respond with your own call. `TI` shows the time of the internal clock and `DA` should show the date. Type `HELP` to get the help–page of the PTC.

For a QSO the PTC has to be connected to your transceiver. The lines microphone, speaker, PTT and ground are required. If they are wired correctly the tuning display should show a broad flickering of all leds if the AF input signal is only noise. Choose the upper sideband at your transceiver and an IF bandwith of about 500 Hz but not smaller. PACTOR signals are easily found on 80m or 20m band. Type `L 1` to monitor a QSO on the frequency.

PACTOR Frequencies:	
3.587.0	DK0MHZ from 17 to 8 UT
3.592.5	DF0THW
7.040.0	DK0MHZ from 8 to 17 UT
14.073.0	DK0MHZ
14.078.0	DK0BLN, JA5TX
14.079.0	DL2FAK, WA2MFY, DJ0OW, ...

Only monitoring is a bit tedious therefore you should try to make your first QSO on your own. Mailboxes are proper for the first test. After 17UT you find DK0MHZ on 80m. The list shows a frequency of 3.587 MHz. This is the mark-frequency of the fsk–signal. The PTC generates the tones mark and space as 1200 Hz and 1400 Hz AF–signals. The higher tone is the mark frequency. If the transceiver operates on the upper sideband the display should indicate a frequency 1400 Hz below the desired one. Adjust the transceiver tuning to a displayed frequency of 3585.6 kHz. Now you can begin by typing `C DK0MHZ` on the keyboard. After the RETURN the PTC begins transmitting. The frequency should be varied for about 100 Hz until the connect led lights. The connect message appears on the screen. The operating frequency should be optimized so that only the upper and the lower led of the tuning display are flashing. At this time the welcome text from the mailbox should be on your screen. The box asks for your name and MYBBS. With HELP followed by RETURN you may order a command–list. With Q like QUIT you can terminate the connection.

The next possibility is to try to connect DL2FAK. DL2FAK is stand–by on 14.079.0 kHz. The same procedure as before: Upper sideband means subtracting 1400 Hz and a display indication of 14.077.6 kHz. Type `C DL2FAK` and after a fine adjustment of the frequency you are connected with DL2FAK.

On direct QSO's the change over is initiated with CRTL–Y and not with RETURN as in QSO's with mailboxes.

4 The LED display

The SCS PACTOR Contraller provides 12 LEDs indicating all operating conditions and aditionally 8 LEDs as a tuning display. The following table describes the display.

HISpeed:	Data is transmitted at 200 baud.
Send:	This PTC is currently the sender of packets.
CHO:	A CHANGEOVER is executed. The LED goes off after complete confirmation of the changeover by the other station.
Connected:	A link to a remote station is established. This LED also serves as a connect–indicator. If a remote station contacted this PTC while the operator was not present, this LED blinks until an operator activity is noticed. When a message was deposited in the internal mailbox, the LED blinks in a rhythm twice as slow.
Traffic:	The system transmits data, there are no repeat–requests pending.
Idle:	There is at least one idle–character in the current data packet.
Request:	The other station is requesting a retransmission of the last information packet or control character.
Error:	A received packet or control contains bits with errors and can not be decoded properly.
Traffic + Error:	If Error and Trafic light simultaneously, a packet was reconstructed by memory–ARQ.
Request + Error:	If Request and Error light simultaneously, a control packet was reconstructed by memory–ARQ.
ASCII:	The PCT sends or receives packets with normal ASCII–coding.
Huffman:	The PTC sends or receives packets with Huffman data compression.
TUNE:	Optimized tuning is indicated by only the top and bottom leds of the tuning display are flashing.

Table 2: LED description

5 The Software

5.1 General

The PTC is controlled by command sequences which are sent to the RS232 port. Usually this will be done from a terminal which is connected via a serial cable. Refer to 11.1 (table 7) for details about setting the RS232 baudrate (data format is 8 data, 1 stop, no parity). The PTC sends the command prompt, `cmd:` and waits for command input. All commands and command sequences are terminated by a <CR> (ASCII 13), <LF> (ACII 10) is ignored. Corrections within a command line can be made with the <backspace> character (ASCII 8). During standby, the command mode is permanently active, i.e. the prompt will appear after the completion of a command. During the *connected* state (including the synchronization phase), all input is written to the transmit–buffer (maximum capacity is 5000 characters) and is later transmitted on the rf channel. Commands must be preceded by an `ESCchr` (preset to ASCII 27). The `cmd:` prompt appears and a command line can be entered as described above. After completion of a command, the PTC returns to the text input mode.

When it is in the PACTOR–STBY–mode, the PTC detects automatically whether it is called in AMTOR or PACTOR. After phasing to an AMTOR call, the PTC switches from PACTOR–STBY to AMTOR. It returns to PACTOR–STBY after the AMTOR–QRT. To be stanby im AMTOR only, the PTC has to be set to the AMTOR–mode.

5.2 Personal–Mailbox Commands

A small mailbox is included in the PTC. Messages are stored in the static RAM. The commands below refer to the administration of the mailbox. The maximum permissible file length depends only on the available RAM. The maximum capacity of the mailbox is 20750 byte. The maximum number of files permitted is 31. File names can be 1 – 8 bytes long and have to be alphanumeric. The PTC cuts off file names that are too long at the end. No distinction is made between upper and lower case.

The PTC responds with the error message `*** SYSTEM BUSY` to an unpermitted multiple access to the file system by the sysop and the QSO–partner.

Not allowed:
Simultaneous writing/reading of file; deletion of file during an other file operation.

5.3 Command structure

There are commands with no arguments or one argument, which is separated from the command word by at least 1 space. A command's current argument setting is displayed if the command word is entered without an argument. Nearly all commands can be used in abbreviated form to save keystrokes. The shortest keyword of a command consists of the fewest number of characters that uniquely identify it, e.g. you may type `C` or `Connect` instead of `Call`. Note: all command inputs are internally converted to upper case, so both character shifts may be used. All commands are listed below, significant memonics are printed in capital letters. remote indicates that remote control access is possible (see 5.4.38 REMote).

5.4 Commands

5.4.1 AMtor

This command switches to the AMTOR mode. A detailed description of the AMTOR commands is given in chapter 6.

5.4.2 ARX <0/1>

Default: 1

Parameter:	0	AMTOR phasing off.
	1	AMTOR phasing on.

This command is used to prevent an AMTOR connect while STBY in PACTOR mode.

5.4.3 AUto <0/1/2> remote

Default: 2

Parameter:	0	100 baud mode.
	1	200 baud mode.
	2	auto–speed mode.

This command is intended for test purposes or special operating conditions. It permits adjustment of the baud–rate while in the receive mode.

Normally the PTC operates in the auto–speed mode i.e. the baud–rate is automatically adjusted to the receiving conditions by evaluating the packets received.

When in the 200 baud mode the PTC never sends a request for a speed–change to the TX, even when the link conditions are poor. If the command `AUto 1` is entered during a 100 baud contact, the speed–change is executed after the first *correctly* received block.

When in the 100 baud mode the PTC never sends a request for a speed–change to the TX, even when the link conditions are good. If the command `AUto 0` is entered during a 200 baud contact, the speed–change is executed after the first *incorrectly* received block.

5.4.4 BKchr <X>

Default: 25 (CTRL–Y)

Parameter: X 0...127, decimal ASCII–code of breakin character.

Defines the BREAKIN–character which is a special command for a forced direction change from RX to TX (break–in). Since this is a frequently used command, the PTC accepts the BK–character only when in text–mode, and not after the `cmd:` prompt.

The BK–character may be changed to any other convenient character. For example: to define CTRL–B as the BREAKIN–character enter: `BK 2`.

The following characters are not permitted: CR (ASCII 13), SPACE (ASCII 32), IDLE, XON, XOFF, and other reserved special characters.

5.4.5 Call <ADDR>

Default: DL6MAA or previous address

Parameter:	ADDR	i.e. callsign, 2 to 8 characters.
	!ADDR	Starts a long path call.

When entered from stby, the `Call` command starts an ARQ PACTOR contact. If the address is omitted, the last one is taken from the system memory. The command may be repeated with different addresses until synchronization is complete after reception of a control signal. If no response is received after a number of tries (set by the `MAXErr` command), or if a `Disconnect` is entered, the system returns to stby. In the connected state the actual destination address is displayed.

With an exclamation mark (`!`) directly before the callsign (example: `C !DL0WAA`) it is possible to call a PACTOR–Station with syncpackets adapted for ARQ–traffic over the long path. The cycletime becomes increased to 1.4 seconds and the pause for the controls become long enough for ARQ contacts to over 40.000km (TRX–Delay 25ms).

Systems with firmware–versions less than 1.3 will not recognize syncpackets with LONGPATH–OPTION and will not react. Connections in LONGPATH will have a decreased traffic throughput (abt. 90%).

5.4.6 CHOBell <0/1>

Default: 1

Parameter:	0	Changeover bell off.
	1	Changeover bell on.

As a default a changeover (change of data transmisssion direction) is indicated by a beep of the internal beeper. In addition, the PTC can send a BEL-character (ASCII 7) to the terminal and let it beep. `CHOB 0` inhibits the sending of the BEL–character to the terminal.

5.4.7 CHOchr <X>

Default: 25 (CTRL–Y)

Parameter: X 0. . . 127, decimal ASCII–code of changeover character.

CHO defines the changeover character which is a special command for the a change from TX to RX. Since this is a frequently used command, the PTC accepts the CHO–character only when in text–mode, and not after the `cmd:` prompt. The CHO–character is not part of the transmitted data and is not transmitted.

A changeover initiated by the TX–operator is not executed until all text in the transmit buffer is transmitted.

The CHO–character may be changed to any other convenient character. For US–style keyboards we recommend the use of CTRL–Z (enter: `CHO 26`).

The following characters are not permitted: CR (ASCII 13), SPACE (ASCII 32), IDLE, XON, XOFF, and other reserved special characters.

5.4.8 CLR remote

Clears the transmit buffer.

5.4.9 CMsg <0/1>

Default: 0

Parameter: 0 Connect–Text off.
1 Connect–Text on.

This command turns the connect–text on or off. There is only one common c–text for AMTOR and PACTOR. Therefor `CMsg 1` enables the c–text in PACTOR as well as in AMTOR.

5.4.10 CSDelay <X>

Default: 6

Parameter: X 2. . . 10, delay in X · 5 msec.

Selection of time delay between the end of the RX–packet and start of the first CS–data bit. The time equals the value X multiplied by 5 milli–seconds. The parameter influences the response time (controls) of the RX at RX–start. With a large value of `CSDelay` even transceivers that have slow transmit–receive switching can be used for PACTOR. However, the maximum distance that can be covered is reduced due to the time delay caused by the final speed of radio waves (more than 0.07 seconds for a wave to reach the other side of the globe). DX is only possible with fast transmit–receive switching. The default value will work fine with most modern transceivers.

5.4.11 CTExt <string>

Default: PTC Maildrop QRV...

Parameter: String of 249 characters maximum.

There is only one connect–text for PACTOR and AMTOR. The C–Text is transmitted when CMsg is set to "1" and the PTC receives a connect.

The C–Text input uses the normal command interpreter. Therefore some conventions have to be adhered to when entering capital letters and CR/LF. A CR/LF is represented by a # and a capital letter has to be preceeded by a $.

For example:
```
This is DL6MAA in Mindelheim
Terminal not active now!

73 de Peter.
```

has to be entered as:
```
CTE $this is $d$l6$m$a$a in $mindelheim#$terminal not active
now!##73 de $peter.
```

The command and the connect text together may not exceed the length of 255 caracters.

5.4.12 CTrlchr <X>

Default: 22 (CTRL V)

Parameter: X 0. . . 127, decimal ASCII–code of a character.

Defines the CTRL–character. If the CTRL–character is immediately followed by a–z or A–Z, the PTC will tranmit a control–code (ASCII 1–26) on the HF–channel. With this simple convention controls that are used by your own terminal can also be send to the other station. It is recommended to put all definable control–characters in the control block. XON and XOFF can not be transmitted.

5.4.13 CWid <0/1>

Default: 1

Parameter:	0	automatic CW identification off.
	1	automatic CW identification on.

Automatic CW identification after every 7 minutes of transmitting and after terminating the transmission (speed: 40 WPM). The ID is keyed on the PTT line. During the ID, FSK or AFSK remain on the mark–tone.

5.4.14 DAte <DATE> remote

Default: none

Parameter:	DD.MM.YY	Desired date.

Arguments are ignored during remote control.

`DAte` is used to set or read the PTC calendar. If `DAte` is enterd without a parameter, the current date is displayed. When the date is set, leading zeroes must not be omitted. The periods may be omitted.

The day of the week is set by `DAte *X`, where `X` is 1...7 (Monday=1 and Sunday=7).

Example: To set Sunday March 24th, 1991 enter: `DA 24.03.91` and `DA *7` –or– `DA 240391` and `DA *7`.

5.4.15 DD

Unconditional stby (*emergency exit*). Should not be used to terminate an ARQ contact.

5.4.16 DELete <FILE> remote

Delete files in the personal mailbox. During remote control only files that were input under the remote station's call–sign or are addressed to the remote station's call can be deleted. This includes a suffix to the call, i.e. the N5MQD-p can be deleted by N5MQD.

5.4.17 DIR remote

Reading of the personal mailbox directory and the amount of RAM (Bytes) that is free for new messages in the mailbox.

5.4.18 Disconnect

Regular termination of a PACTOR contact (only valid in TX mode). In the connected state the shutdown procedure is performed.

5.4.19 ESCchr <X>

Default: 27 (ESCAPE)

Parameter: X 0...127, decimal ASCII–code of a character.

Defines the ESCAPE–character. CAUTION: We recommend not to experiment with this character, since it is crucial to the control of the PTC.

5.4.20 HElp remote

Gives a short list of all available commands.

5.4.21 LCall <0/1>

Default: 1

Parameter: 0 supervisor sequences are not displayed.
1 supervisor sequences are displayed in L–mode.

Supervisor sequences are displayed in L–mode. Example: `<<ID: DL0WAA>>`.

5.4.22 LFignore <X>

Default: 1

Parameter: 0 no insertion of LF.
1 insertion of LF after each CR.

`LFignore` determins whether a LF is automatically appended to each CR that is sent to the terminal. For `LFignore 0` the characters are passed exactly as the PTC receives them. For `LFignore 1` all LF sent to the PTC are ignored. However, for every CR sent to the terminal a LF is appended.

A LF is always appended to a CR sent to the PTC (auto–LF).

5.4.23 Listen <0/1>

Default: 0

Parameter: 0 Listen mode disabled.
1 Listen mode enabled.

This command can be entered only in stby mode. Both Unproto and ARQ PACTOR traffic in the receive channel can be monitored. The PTC can still be connected, but synchronization needs an extra cycle. Listen mode is disabled by a `DD`, `Listen 0`, or `Call` command or after a connect. When the Listen–mode is active, connect–packets are also displayed: `[CONNECT-FRAME: CALL]`. If reception is marginal, only parts of the CALL may be displayed i.e. the first properly decoded characters.
CAUTION: No AMTOR–phasing is possible when the LISTEN–mode is active.

5.4.24 LOCk <0/1>

Default: 0

Parameter: 0 Lock off.
1 Lock on.

By this command it is possible to save PTC–parameters against accidental change. `LOCk 1` switches the function on, `LOCk 0` switches the function off.

The following commands are not affected by `LOCk`:
`CLR, Connect, D, DD, DIR, HElp, LOCk, LOG, RESEt, SHow, Unproto, Read, Write, Del`.

5.4.25 LOg remote

Displays the PTC's logbook page, i.e. the last 16 PACTOR contacts. UNPROTO contacts are not logged. The log can only be deleted by a `RESTart`. Slave–contacts are marked by a * behind the call–sign.

AMTOR connects are indicated with a # after a valid LOGIN (see 6.4).

5.4.26 MAXDown <X> remote

Default: 6

Parameter: X 2...30, number of error–packets before down–speed.

Selection of down–speed parameter for automatic speed changing. `MAXDown` determines how soon the system steps down from 200 baud to 100 baud during poor channel conditions (2=fast / 30=slow). Example: `MAXDown = 6` i.e. the PTC switches down to 100 baud after receiving 6 error–packets in a row.

5.4.27 MAXErr <X>

Default: 80

Paramameter: X 30...255, maximum number of retries or errors.

`MAXErr` defines the time–out value. When initially calling a station, this value sets the maximum number of sync–packets that the PTC sends without a response from the other station. See 5.4.5 (Call).

When connected, `MAXErr` determines how many faulty blocks or controls are permitted before the connection is aborted (`***TIMEOUT: DISCONNECTED`). Request blocks or request controls are not interpreted as errors and reset the error–counter to zero.

5.4.28 MAXSum <X> remote

Default: 30

Parameter: X 5...60, maximum count for memory–ARQ.

`MAXSum` is the time–out value for the memory–ARQ counter. It determines the maximum number of faulty packets that are summed up. If `MAXSum` is exceeded, the sums are deleted, since it can be assumed that crude errors have entered the sum and that further summation of the packet will not restore it. The optimum value of `MAXSum` depends on the quality of the HF–channel. The worse the channel, the higher should MAXSum be set in order to be able to pass any information at all.

5.4.29 MAXTry <X> remote

Default: 2

Parameter: X 0...9, maximum number of up–speed attempts.

`MAXTry` determines how often the PTC repeats 200 baud packets during an attempt for up–speed.

5.4.30 MAXUp <X> remote

Default: 3

Parameter: X 2...30, number of error–free–packets before up–speed.

Selection of up–speed parameter for automatic speed changing. `MAXUp` determines how soon the system steps up from 100 baud to 200 baud during good channel conditions (2=fast / 30=slow). Example: `MAXUp = 3` i.e. the PTC switches to 200 baud after receiving 3 *correct* packets in a row.

5.4.31 MEasure

Facilitates a check of the analog/digital converter (ADC) and tuning of the converter. `MEasure` can only be entered during STBY–mode. The PTC reads a value from the ADC every 0.3 seconds and outputs this value as ASCII to the terminal. The value corresponds to the signal present at the input of the PTC i.e. noise or audio from the radio. In addition, the beep is activated for test purposes. The PTC ignores calls on the HF–channel when MEasure is active. ESCAPE terminates the measuring process. `MEasure *` starts the converter tuning procedure. **No external AF** should be present at the converter input during tuning (audio input disconnected). The tuning procedure is described in 13.2.

5.4.32 MOde <0/1> remote

Default: 1

Parameter: 0 TX mode ASCII–8–bit character set.
1 TX mode ASCII–7–bit with Huffman data compression.

Selects the TX data format. In most cases (plain text transmissions), the best results are obtained with Huffman data compression, which can improve speed up to 80% (effective character length 4.5 to 5 bit). 8–Bit–mode will be useful only if the text contains non–ASCII characters or many uppercase letters. In both modes, ASCII control codes (decimal 1. . . 26) can be transmitted by prefixing them with the `CTrlchr` (see 5.4.12).

In the Huffman–mode only the ASCII–characters 0 – 127 (7 bit) can be transmitted. To transfer certain IBM/ATARI special characters (Umlaut), the PTC converts these characters according to the following table:

Umlaut	ASCII	Transmitted ASCII–Character
ä	132	14
ö	148	15
ü	129	16
Ä	142	20
Ö	153	21
Ü	154	22
ß	225	23

Table 3: Conversion of German special characters

Due to the slightly different coding of the ATARI–characterset, ASCII 158 is also permitted for the character ß.

The PTC firmware looks at each packet determinig wheather HUFFMAN or ASCII coding will be more efficient for transmission and selects the better one. This feature is only active in MODE 1 (HUFFMAN). Manually selecting MODE 0 (ASCII) makes the controller transmit ASCII anyway. Doing this should only be necessary in very special cases.

The automatic also works on characters exceeding 127 decimal. Therefore 7PLUS files may be transfered without any user access.

5.4.33 MYcall <ADDR>

Default: ROM–callsign

Parameter: ADDR Home address (callsign), 2 to 8 characters.

The own address (callsign) can only be set during stby. Without a parameter, the actual home address is displayed. Whenever the home address is received during stby, the PTC performs slave synchronization and responds with a control signal.

5.4.34 Offset <0/1>

Default: 0

Parameter: 0 automatic selection of converter zero threshold.
1 converter zero threshold set to $\frac{V_{cc}}{2}$.

Selection of converter zero threshold (trigger–level for the software).

During the automatic selection of the converter threshold the PTC uses the filter–IC XR–1015 (U15) to switch off the AF to the discriminator filters and measures the zero value of the converter output. ATTENTION: This mode should only be used when using the original PTC–converter (XR–1015).

If an external converter is connected to the PTC A/D–converter, the converter zero level has to be set to $\frac{V_{cc}}{2}$. Then the software assumes a fixed threshold value of $\frac{V_{cc}}{2}$ (about 2.5 Volts). The output of the external converter has to be set to this value. The voltage swing of the external converter should be about ±0.7 Volts.

5.4.35 Phase <X> remote

Default: 0

Parameter: X –70. . . +70, phase correction in ppm.

Note: The parameter setting is ignored during remote operation.

This command allows fine adjustment of the system clock and displays the accumulated phase correction during a PACTOR contact. All PTC timing is derived from an internal crystal oscillator. Normally it is sufficient to adjust the crystal frequency to 6.144000 MHz once during the initial alignment. However, a frequency drift due to temperature and other effects may occur. These offsets can be corrected by use of the `Phase` command. For example, a system clock running 10 ppm too fast can be compensated by typing `P -10`. The entered correction parameter becomes valid when the next PACTOR contact is started. During slave mode, the PTC software automatically issues the appropriate phase correction setting, so that exact synchronization between the master and slave station will be established within a few minutes after start of the contact, provided the initial clock difference did not exceed 30 ppm. When called without an argument, the actual total phase correction, manually and system–generated initial values are displayed. This is a powerful feature that you can use for aligning your PTC crystal oscillator without any measuring instruments, following these steps:

1. Perform a master call to a station with a known highly–accurate PTC–clock frequency.
2. After at least five minutes of contact, you can read out the phase correction data from the reference station by sending a remote control `//P` command. Enter the phase correction data from the reference station with inverted sign as a new initial value for the `Phase` command.

(If a timeout occurs before 5 minutes, your system clock offset is probably too great to be compensated by the automatic phasing. In this case, the data readout will only show a tendency.)

When using an external reference clock (see 'Xtal'), the `Phase` parameter setting is ignored.

5.4.36 QRTchr <X>

Default: 4 (CTRL–D)

Parameter: X 0. . . 127, ASCII–CODE (decimal).

It is possible to define a QRT–character that initiates a QRT whereever it appears. It may be inserted in a text–string or given in RX–mode. It becomes effective during the next TX–phase.
The use is alternately to the command DISCONNECT.

5.4.37 Read <FILE> `remote`

Remote reading of files from the mailbox. The remote reading process can be stopped by sending a changeover. If the sysop enters `Read` during a contact, the file is **not** transmitted.

5.4.38 REMote <0/1>

Default: 1

Parameter: 0 disabled remote control.
1 enabled remote control.

`REMote` controls the access to the remotely controllable commands. When `REMote 1` is set, the other station can use all the commands that are marked remote. The commands have to be preceded by the sequence `//`.

Example: `//Write testmsg` –or– `//DIR`.

Several remote commands in a row are not permitted unless they are seperated by a CR. A singe command does not have to be terminated by a CR when it is immediately followed by a change–over. Remote commands cause an automatic change-over when the first idle–character appears. System messages of the remotely controlled PTC are transmitted in lower case. This results in better Huffman coding and a clearer display.

`REMote 0` disables remote access.

5.4.39 RESEt remote

Soft reset of the System. ATTENTION: This command may be used at any time and causes an uncontrolled disconnect while connected! The parameters entered and the personal mailbox and the log are **not** deleted.

5.4.40 RESTart

Causes a complete re–initialization of the PTC! ATTENTION: This command may be used at any time and causes an uncontrolled disconnect while connected! Customized parameters are replaced by the defaults from the ROM and the mailbox messages and the log are erased.

5.4.41 Send <FILE> remote

Same as `Read`, but the file is transmitted, if `Send` is enterd by the sysop during a contact. The command `CLR` stops the file transmission. During remote control `Read` and `Send` are identical.

5.4.42 SHow <X> remote

Default: none

Parameter:	A	(ALL) complete list of parameters.
	C	(CHARACTERS) list of the set control-characters.
	P	(PARAMETERS) list of system–parameters.
	B	(BUFFER) output of the last 1600 characters.

Displayes system–parameters, the link state, and defined special characters. `SHow` without a parameter lists the current link–parameters. This list is not lost after QRT.

Attention: `SHow B` is not remotely accessible.

5.4.43 STatus <0/1>

Default: 1

Parameter:	0	status polling off.
	1	status polling enabled.

This command facilitates polling of all operational states of the PTC via the serial interface. This is useful for mailbox systems or more luxurious terminal programs.

The status byte is called by the RS character (ASCII decimal 30). This definition of the status request byte does not impose any restrictions on data transparency. PACTOR uses ASCII 30 (decimal) as the *idle byte* which can only be transmitted via a supervisor sequence.

The PTC's status reply always begins with an echo of the RS character (ASCII decimal 30) to facilitate unique identification of the status information following. The actual status byte follows this *header*.

This modular status–level concepts facilitates an expansion of the status information in the future i.e. in a higher status–level even several bytes containing status information can be implemented. The status bytes (incl. header) are sent in direct sequence.

During the transmission of status information new status requests are ignored.

The status information is processed totally independent from the current XON/XOFF state of the serial interface.

Hints for programmers: Through the PACTOR software the status reply may be deleayed by 150ms.
After a system boot (power on, `RESTART`, or `RESET`) the status polling is ready after the first `cmd:` prompt.

Construction of the status byte (status–level 1):

Bit	7	6	5	4	3	2	1	0
Meaning	1	MODE			D	STATUS		

Bit 7 always 1 to avoid control-codes (XON/XOFF, etc.)
Bit 3 (DIRECTION–Bit) reflects the state of the SEND–LED. This bit is 1 when the PTC is the packet sender.

The fields mode and status have the following meaning:

Bit 2	Bit 1	Bit 0	STATUS–Bits	Remark
0	0	0	ERROR	
0	0	1	REQUEST	
0	1	0	TRAFFIC	
0	1	1	IDLE	Idlebyte in packet, does not exclude traffic bytes in the packet!
1	0	0	OVER	The system is busy with a changeover. ERROR, REQUEST, TRAFFIC, and IDLE are ignored.
1	0	1	PHASE	AMTOR only.
1	1	0	SYNCH	Active immedeately after firsthalf of a selcall or the first 4 decoded PACTOR address bytes.
1	1	1	IGNORE	Status currently not defined (e.g. STBY.

Bit 6	Bit 5	Bit 4	MODE–Bits	Remark
0	0	0	STANDBY	
0	0	1	AMTOR–ARQ	
0	1	0	PACTOR–ARQ	Activ no more than 20 ms after the end of the SYNC–sequence in the received SYNC–packet, or for a MASTER–start no later than the begin of the data packet.
0	1	1	AMTOR–FEC	
1	0	0	PACTOR–FEC	
1	0	1	RTTY	
1	1	0	LISTEN	AMTOR or PACTOR.
1	1	1	Ch–Busy	RF channel busy.

Table 4: PTC Status Information

In PACTOR STBY mode the PTC has the capability to detect a CHANNEL BUSY condition when the HF–Channel is occupied. The channel busy condition is accessable from the status word information as decimal 247. The feature will be of interest for automatic forwarding. When CHANNEL BUSY occurs the TRAFFIC LED is switched on.

CHANNEL BUSY condition is detected on signals that differ from normal noise. RTTY signals not exceeding 250 baud will be detected well while 300 baud packet radio signals and strong carriers in the channel will be virtually ignored.

5.4.44 Term <0/1/2/3>

Default: 0

Parameter:	0	Simple terminal mode.
	1	Terminal mode with delayed echo.
	2	Same as (1) but with splitscreen support.
	3	Same as (2) but with extended splitscreen support.

With this command it is possible to make the PTC support a splitscreen terminal.

- In simple terminal mode text is not sent to the terminal when the PTC receives commands from the user. The textstream is interrupted by the first command-sign given to the PTC. At maximum 2000 characters are stored. The terminal must have local echo (halfduplex).
- Terminal mode 1 is for use with simple splitscreen terminals. The incoming text and the text to be sent out should be displayed in seperate windows on the screen. All transmitted characters are echoed by the PTC as soon as they are correctly received by the station the PTC is connected to (delayed echo).
- Terminal mode 2 the PTC completely controls the switchover between the two windows on the screen. In one window the system announcements of the PTC and the text to be transmitted appears. The other window shows the received text and the delayed echo–text.
  The PTC sends CRTL–A as a changeover character to the TX/announcment–window and CRTL–B as a changeover character for RX/delayed echo–window. The windows should be scrollable independently.
- Mode 3 arranges the delayed echo to be signalled by a CRTL–C, not a CRTL–B as it is in mode 2. The normal RX–text is still signalled by a CRTL–B. This convention makes it possible to divide the screen into three parts. One part for system announcements and TX–text, the second part for RX–text and the third part for delayed echo–text.

The TERM command is valid for PACTOR and AMTOR simultanously.

5.4.45 TIme <TIME> remote

Default: none

Parameter: HH:MM:SS Desired time.

Arguments are ignored during remote control.

`TIme` is used to set or read the internal clock. If `TIme` is entered without a parameter, the current time is displayed. When the clock is set, leading zeroes must not be omitted. The colons can be ommitted.

Example: `TI 09:56:05` or `TI 095605`.

5.4.46 Unproto <X>

Default: 1 *2

Parameter:	1	unproto transmission at 100 baud.
	2	unproto transmission at 200 baud.
	*n	number of packet repetitions (2 to 5).

This command allows broadcast transmissions (cq–calls, etc.) without an acknowledgement from the receiving stations. The baud rate and repetition number can be set according to actual conditions. Example: `U *3` ; every packet is repeated 3 times `U 2` ; start of transmission at 200 baud

`Disconnect` or `DD` terminates this mode.

Repeated packets do not appear on the screen of the receiving station. In this case the PTC increases the redundance of the transmission by increased repeat parameter. The transmission time becomes longer and the probability of correct receiveing data increases therefore.

5.4.47 Write <FILE> remote

Remote input of files to the mailbox. During direct terminal input the end of the file is indicated by pressing the ESCAPE–key. During remote control the file is terminated by a changeover. An ESCAPE from the sysop will interrupt remote file writing. The PTC will put out an error message, if a filename does already exist. The remote control sequence `//` may be contained in a file, since it is ineffective during a file transfer.

5.4.48 Xtal <0/1/2>

Default: 1

Parameter:	0	external clock reference, RX phasing only.
	1	internal crystal clock, master/slave phasing.
	2	external clock reference, master/slave phasing.

Selects the clock reference. Normally, the PTC operates with the internal crystal reference clock, which provides sufficient stability in most cases. Master/slave phasing is applied, i.e. the called station (*slave*) performs phase and speed correction of the transmission frame, whereas the calling station (*master*) only corrects its receive scan point. For special tests, an external reference (50 Hz) can be connected to X1/pin 13. Two different modes are supported by the software:

2 master/slave phasing for use with non phase–locked oscillators of high accuracy (e.g., TCXO).

0 RX phasing only (receive scan) for use with phase–locked oscillators (e.g., both stations receiving a time standard broadcast). This mode will provide the best possible results.

6 AMTOR

6.1 General Information

Simultaneous standby in AMTOR and PACTOR:
When in PACTOR STBY–mode, the PTC can also be connected to in AMTOR! The system will immediately reply in AMTOR. After the AMTOR–QRT the PTC will return to PACTOR–STBY.

Please refer to articles in QST and other magazines for basic information about AMTOR.

To switch to AMTOR enter `AMtor` when in the PACTOR mode. The system responds with a message that starts with `>>>` and displayes the parameters SELCALL and total delay. All commands have to be preceded by the ESCAPE–key. The system responds with the command prompt `**-mode-**(<SELCALL>):>`. `Mode` corresponds to the currently active operating mode i.e. `A` for AMTOR and `R` for RTTY. `SELCALL` indicates the current SELCALL of the PTC. There is an important difference to the PACTOR system: the command mode (invoked by ESCAPE) stays active for one command line only! All subsequent inputs are stored in the transmit buffer. The transmit buffer may be erased by `CLR`.

The timeout for mode–A–master is fixed to 2 minutes. The default for the slave response time is 35 msec and for the TX PTT–delay it is 15 msec. Higher values are recommended for transceivers that have a slow PTT response (see the TXD and CSD command).

The LED assignment is identical to PACTOR with the following exceptions:

Meaning	LED
PHASING–state	HISpeed
ARQ (Mode–A)	ASCII
FEC (Mode–B)	Huffman
LISTEN (Mode–L)	ASCII+Huffman

Table 5: Meaning of LED's in AMTOR mode

6.2 Special Key Assignments

<ESCAPE>	:	Switch to command mode.
Ctrl–B	:	Switch to character level during receive.
Ctrl–Y	:	Switch to FEC (mode B) transmit while in STBY. Break–in during ARQ (mode A) receive. Resynchronize during LISTEN (mode L). Switch to transmit during RTTY receive.

Table 6: Special Key Assignment in AMTOR

6.3 The AMTOR commands

6.3.1 BAU <X>

Default: 45

Parameter: X 30 to 255 Baud.

Switch to RTTY with the desired baudrate. BAU 100 switches to RTTY with 100 baud. Values between 30 and 255 are accepted.

6.3.2 BC <0/1>

Default: 1

Parameter:	0	FEC reception off.
	1	FEC reception on.

Enable or disable FEC reception.

6.3.3 C <XXXX>

Default: previous selcall

Parameter: XXXX selcall.

Starts an ARQ (mode A) call for the selcall XXXX. C WVFN starts a call to WVFN (corresponding to the call–sign W5VFN for example). When repeating the call to this station the call–sign may be omitted.

6.3.4 CLR

Erases the transmit text buffer. The sign ˜ appears as a confirmation.

6.3.5 CSD <X>

Default: 5 msec

Parameter: X Slave response time in msec.

Sets the slave response time to <X> in msec.

6.3.6 DD

Immediate change to the STBY mode without a proper disconnect.

6.3.7 FEC

Starts an FEC transmission (mode–B) while in STBY. Same as CTRL–Y.

6.3.8 HE

Output of a short command list.

6.3.9 LFI <0/1>

Default: 1

Parameter:	0	Linefeed insertion off.
	1	Linefeed insertion on.

Automatic insertion of linefeed after each carriage–return. `LFI` is only valid for the data direction from the PTC to the terminal.

6.3.10 LIN <X>

Default: 64

Parameter:	X	Number of characters for auto linefeed.

Automatic linefeed after n transmitted characters (word–wrap). Disable this function with arguments greater 127.

6.3.11 MON

Switch to listen–mode (mode–L).

6.3.12 MY <XXXX>

Default: Own selcall in ROM

Parameter:	XXXX	Own selcall (4 characters).

Set the PTC selcall to <XXXX>.

6.3.13 NUL <0/1>

Default: 1

Parameter:	0	NUL–character as backspace.
	1	NUL–character as upper/lower case shift.

The PTC supports the PLX–APLINK convention on handling upper and lower case letters. This enables the user to transfer files in AMTOR with capital and small letters included through the worldwide APLINK net. Users with compatible equipment like PTC, BMKMULTI or QBF will be able to receive the files the way they were transmitted.

6.3.14 PT

Return to the PACTOR mode.

6.3.15 QRTCH <X>

Default: 4 (CTRL–D)

Parameter: X 0...127, ASCII–CODE (decimal).

Define the QRT–character that initiates a QRT wherever it appears. It may be inserted in a text–string or given in RX–mode. It becomes effective during the next TX–phase.

6.3.16 SHOW

Lists the actual parameters.

6.3.17 TR <0/1/2/3>

Default: 0

Parameter:	0	TX and RX audio shift normal for USB–operation.
	1	Set only RX shift to reverse.
	2	Set only TX shift to reverse.
	3	Set TX and RX shift to reverse.

Invert the TX und RX audio (mark and space tones).

6.3.18 TXD <X>

Default: 25 msec

Parameter: X PTT delay in msec.

Sets the PTT delay to <num> in msec.

6.4 Personal–Mailbox

It is possible to have access to the PTC–Personal–Mailbox from AMTOR. The `REMote` command has to be switched to 1. All commands have to begin with //, the same as it is in PACTOR. Only the first character after the // is valid for the command interpreter. The following characters until the first SPACE or CR or + are ignored.

The following commands are available (**only from RF channel!**):

H(ELP)	: Provides a short help–info.
D(IR)	: Lists the files in the mailbox.
C(LEAR)	: Clears the TX–Buffer of the remoted PTC, e.g. to interrupt long Mailbox outputs.
U(SER)	: Displays the PTC's logbook page, i.e. the last 16 PACTOR or logged AMTOR contacts.

L(OGIN)	URCALL	: User logs his call into the mailbox. Mailbox WRITE access from AMTOR is only possible after a LOGIN procedure has been passed. Valid logins are inserted into the internal logbook of the PTC. AMTOR logins are signed with # in the log.
W(RITE)	FILENAME	: Input of Files into the Mailbox. Only possible after login.
R(EAD)	FILENAME	: Reading of files from the mailbox.
E(RASE)	FILENAME	: Erase files in the mailbox similar to DEL command in PACTOR. Only possible after login.

All convention of the PACTOR–Mailbox are the same if accessed from AMTOR, e.g. maximum numbers of files or the filename convention for deleting files.

All commands must be finished with **+?** . CR will be accepted as optional. LF will be ignored.

7 The PTC–ELBUG

7.1 Special Features

This is an expanded and improved version of a program for an electronic keyer that was developed in 1983. It has a number of features beyond the basic keyer functions made possible by the micro–processor:

- exact generation of code without shortening of the first element
- crystal–stable selection of speed (PARIS–norm)
- speed independant adjustment of weight facilitates compensation of transmitter keying distortion
- single–lever or squeeze operation with a dynamic dot/dash memory
- decoding and display of keyed text
- complete integration into the AMTOR/RTTY environment facilitates control of all functions (an alternativ to the keyboard)
- compatible to Curtis 8044A

7.2 Wiring

As described in section 11.5 two pins of the terminal interface X1 are already reserved for the ELBUG. The corresponding jumpers have to be inserted and one additional 10 kΩ resistor has to be wired to pin 8 (+5V) to both pin 12 (dot–lever) and pin 25 (dash–lever). The keyer ground has to be connected to the PTC case ground (pin 7 of socket X1). In STBY–mode the PTT–output of the PTC is keyed by the CW code generated. For most (modern) transceivers with positive keying this PTT–output may be connected directly to the transceivers CW keyer–input. An additional relay should be inserted for older (tube) equipment. When in the connect state, the control over the PTT–output is automatically given to the AMTOR/RTTY function. Then the ELBUG functions only as an input to the transmit buffer. A 500 Hz side–tone is given through the internal beeper.

The ELBUG can only be activated by the comand `BUG <speed>`, where `<speed>` has to be greater than 0 !

7.3 Operation

The keyed text is decoded by the program and sent to the terminal. All regular morse characters are converted to the corresponding ASCII–characters. Incorrect characters are output as ˆ which is a neutral character in AMTOR and RTTY (character shift).

7.4 Commands

7.4.1 BUG <X>

Default: 0

Parameter: X CW speed in character/minute.

CW speed in characters per minute obeying the PARIS–norm. Minimum value is 75 cpm. A value of 0 will turn off the ELBUG!

7.4.2 KSP <0/1>

Default: 1

Parameter:	0	Spacing correction off.
	1	Spacing correction on.

If this fuction is activated (1), character spacings that are slightly too short are automatically extended to the norm–value (length of 3 dots). For additional control the HISpeed–LED lights when the character spacing is too short. The function of the LED does not depend on the parameter setting.

7.4.3 WGT <X>

Default: 0

Parameter: X $0.5 \times$ weight in msec.

The extension is applied symetrically to the dots/dashes and pauses to facilitate a speed independant correction. The (seldom required) shortening of pauses is also possible by subtracting the value from 256.

7.5 ELBUG Remote Control (ERC)

Since the ELBUG–output works parallel to the normal terminal–keyboard, the complete control of AMTOR/RTTY functions via the keyer was implemented.
The following control strings were defined:

ESC = -.-.--	('kw')	BACKSPACE = ...-.	('ve')	CR = -.-.-	('ka')
\ = --..-.	('gr')	CONTROL–Y = -.-..	('ce')	+? = ...-.-	('sk')

The ERC–function requires some practice and is therefore more apt for the experienced CW–operator.

8 PACTOR–Operation

This is a brief introduction to PACTOR operating procedures by Armin Bingemer (DK5FH). We assume that the reader is already familiar with the PACTOR protocol and that he knows how to operate the PTC. Please refer to the October 91 issue of QEX for details on PACTOR.

PACTOR is one of the most fascinating modes available for amateurs. It is possible to run contacts with very little power or poor antennas. Similar to CW, signals that are down in the noise (QRM, QRN) can be decoded. The PTC does all the work and the operator does not have to strain his ear as with CW. PACTOR is much superior to AMTOR, since the transmission speed adapts to the quality of the link.

In addition, the memory–ARQ brings advantages over the normal ARQ as used for AMTOR. Compared to AMTOR the through–put is increased four–fold in addition to a much improved error correction.

Direct QSO's should be the dominating type of contact. Contacts with mailboxes can not replace a live QSO, but may be helpful in checking propagation conditions to a certain region. Hopefully there will soon be as many PACTOR mailboxes as there are AMTOR boxes. Then it will be possible to attempt such personal records with PACTOR as contacting five continents in 5 minutes, which can be done in AMTOR today! Mailboxes are also useful for sending messages to hams that are not on the air at that time or can not be reached directly due to poor propagation. They present a neat way of setting up skeds for later direct QSO's.

As with other modes there are two ways to establish contact: calling CQ or replying to a CQ. Check whether the frequency is clear before calling CQ.

Which frequencies? Try one of the classic AMTOR calling–frequencies such as **14.075 MHz** for AMTOR calls. PACTOR activity is centered around **14.079 MHz** and **21.079 MHz** ±QRM. In Germany the frequency for direct QSO's is **3583.8 KHz** ±QRM. The PACTOR mailbox DF0THW is activ on **3592.6 KHz** and might present a challange to overseas low–band DXers.

Your call in UNPROTO–mode (FEC) could look like this:
`CQ CQ CQ de N5MQD`.
You may want to repeat this 3 to 8 times. End with `PSE K` and switch to standby. Then turn on the listen–mode to copy possible UNPROTO–replies. While in listen–mode the PTC will also respond to PACTOR–ARQ calls to your station. Most contacts will be run in the ARQ–mode to take advantage of the error correction and memory–ARQ.

Sending RYRYRY... in FEC or ARQ makes no sense, since the RY's do not synchronize the stations as they do for RTTY.

The station replying to a CQ starts a PACTOR ARQ–call to the call–sign listed in the CQ–call. Then both stations synchronize. CONTROL–Y is the customary change–over sequence for PACTOR.

If the contact was begun on an established calling frequency, both stations should change to another clear frequency as soon as possible. During the frequency change the transmitters should be turned off to avoid interference to other stations.

The QSO is run in the same way as an RTTY contact. However, it is possible to interrupt the other stations transmission by entering CONTROL–Y. During normal QSO's this possibility is seldom used.

To end the contact, the station in tx–mode enters `<ESCAPE> D` and the PTC's will terminate the link. The station that started calling CQ may start a new UNPROTO call on this or the calling frequency.

If a station to station contact is not desired i.e. a roundtable is established or a bulletin is transmitted, the mode of operation is UNPROTO (FEC).

9 Circuit Description

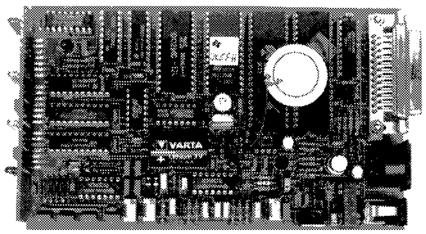


Figure 1: The PTC main–pcb

9.1 The Power Supply Section

The PTC requires a filtered DC source of 9…14 volts, capable of delivering 400 mA. Where possible, CMOS components have been used in the PTC design, the typical supply current being 210 mA or less. There are several ways of connecting the power supply to the PTC. In most cases, it will be convenient to use the special DC–connector X2. The positive (+) line is fed to the center pin and the negative (–) line is connected to the outer pole of the DC plug. Diode V1 serves as a protection against reverse polarity and decouples this DC input from the others. Alternatively, DC–power can be supplied via the RS232 connector X1, plus(+) at pin 9, negative(–) at pin 1 or pin 7. Finally, the transceiver–interface connector, X3, pin 5(+) and pin 2(–) can be used as DC supply input, if jumper BR3 is set properly (for more details, see 11.2). Both alternate DC inputs are protected and decoupled with diodes V2 and V4, respectively.

The DC supply current passes through one of the protection diodes to the voltage regulator U16, which delivers a stable output voltage of 5 volts. Depending on the input voltage, U16 generates 1…2 watts of heat dissipation power, so this device is mounted to the PTC case. The whole PTC circuit is supplied from the regulated 5–volt output of U16, any ripple on the PSU voltage will have negligible effect on PTC performance. Some of the ICs require an additional –5V supply voltage, which is available at pin 5 of the DC–DC–converter, U14.

9.2 The CPU section

The processor is a CMOS–Z80 CPU running at a clock frequency of 6.144000 Mhz. Besides the CPU (U1), there are a multi–function–interface Z80–STI (U4), (E)PROM (U2) and RAM (U3).

Inverter U11A, together with the crystal Q1 and the components C1, TC1, R5 is the clock frequency generator. Trimmer capacitor TC1 allows exact frequency adjustment. Output from a buffer (U11B) is led to the processor clock input.

A special controller IC, MAX691 (U10) provides a well–defined power–on reset and a stable back–up–powering from the lithium–battery (BAT1). During input–voltage failure U10 maintains backup power for the RAM (U3) and real–time–clock (U8). An additional feature of the MAX691 is its *watchdog*–function, which is a rather effective protection against software–*crashes*. The WDI–input (pin 11) of U10 senses pulses delivered from the PTC program. If, for some reason, e.g. due to supply spikes or RFI, some memory or register contents become corrupted (which in many cases results in an endless program loop), the pulse generation stops and U10 will perform a complete hard- and software reset. Safety against undefined states and uncontrolled transmissions etc. is regarded indispensible for a modern stand–alone system. After reset, the PTC will perform a memory check and go into STBY. If invalid system parameters or mailbox contents are detected, a `RESTart` will be performed.

The STI (U4) serves as an parallel interface for CPU in-/outputs and contains four programmable timers/dividers, output from which is delivered to the AFSK, and to the clock input of the programmable low–pass–filter, U15. Serial I/O–signals are led to the RS232 interface, U5 (MAX233), converting V24 to TTL–level.

The LED–Driver–Unit consists of latches U6, U7 and the demultiplexer U13, which decodes the tuning display from 3 lines.

U12, a 8–Bit A/D converter, is the interface between the audio and digital section, transforming continuous voltage levels from the receiver– demodulator–chain into discrete values which can later be processed by the microcomputer. Conversion speed is determined by R18 and C21, transistor T3 provides a startup RESET signal.

The real time clock, U8, is buffered from the lithium battery, BAT1. If this battery is intact and built in properly, the power supply may be disconnected without risking loss of time information and memory contents. Therefore, time and date normally have to be set only once (after initial power up).

A special CMOS custom decoder (GAL), U9, incorporates the functions of several ordinary TTL chips and delivers address signals for the various peripheral components. This device has been specially programmed for the PTC and can therefore not be replaced by another chip.

9.3 (A)FSK

One of the four STI timer channels is used for generating the AFSK audio signals of 1200/1400 Hz for PACTOR and 1230/1400 Hz for AMTOR mode, respectively. A second–order active low pass filter (U18D) provides an output signal of low harmonic distortion at Pin 1 of X3. P3 allows adjusting the signal level according to the SSB transmitter microphone input sensitivity. Transmitters with special FSK inputs or an external AFSK generator can be used if jumper BR8 is set as described in 11.3. In that case, the PTC's AFSK filter is disabled and a TTL compatible keying signal from T2 can be taken from pin 1/X2.

9.4 The Demodulator Section

In this stage the information–carrying portion is filtered from the receiver audio passband and then converted into a frequency–dependent DC voltage, which is later processed by the computer's Analog–to–Digital converter. In order to achieve a good shortwave performance even with an SSB receiver bandwidth, a high selectivity bandpass was added in front of the detector. U18b and U18c form an active fourth–order high–pass– filter with 1150 Hz cutoff frequency. A special switched–capacitor 7th–order low–pass (U15) provides excellent skirt selectivity without any external components. Its cutoff frequency depends on the frequency of the clock input signal at pin 3, which is connected to one of the STI divider outputs. It is therefore possible to select different filter parameters by software, depending on baud rate, mode, and conditions, etc. Output from U15 is amplified and limited by U18a and converted into a DC voltage by the envelope detector U17a/b. U17c/d act as adder and 4th–order low–pass / ADC level–conversion stage. The low–pass parameters have been optimized for the PACTOR–200–Baud–mode; additional low–pass action is done by software processing of the ADC input samples. The discriminator filter frequencies are adjusted with P2 and P3. This alignment can be made without measurement equipment (see 13.2).

10 Construction

10.1 General

The whole circuit is built on two double–sided plated–through printed circuit boards of very high quality. A component map on the top side greatly reduces the chance of wrong component placement. Even though the assembly is quite simple, all soldering operations should be made with great care. It is highly recommended to use IC sockets, since it will be difficult to remove damaged or misplaced components from a double–sided pcb. Also, a proper operation, especially of the demodulator section, can only be ensured by using those components that are specified in the PTC parts list. Components with defined polarity are unambigously marked with special symbols: + stands for the positive lead of an electrolytic capacitor, a bar for the kathode of a diode, a flag for the emitter of a transistor.

All external connectors will usually show sufficient mechanical stability after they have been soldered on the pcb. The RS232 connector (X1) may additionally be mounted to the rear panel with two screws.

Multi–post pin–connectors are built in for the BR... jumpers, which are later provided with an individual set of contact bridges.

Most of the ICs used can be damaged by electrostatic charges, so it is advisable to take appropriate precautions during assembly.

10.2 Special components

10.2.1 Trimmer Potentiometers

The precision trimmer potentiometers should be mounted with the alignment screws facing towards the center of the pcb. Adjustments can then be made later without removing the side covers.

10.2.2 Resistor Arrays

The two resistor arrays on the display circuit board (RP2,RP3) are built in with pin 1 (marked with a dot or a bar) inserted into the quadratic soldering hole. Before soldering, the leads are tilted in a right angle so that the resistor array is directly mounted on the board's surface.

10.2.3 The LEDs

The display–panel LEDs anode is marked with an **A** on the circuit board, correspondig to the longer of the two leads. The diode case should be mounted as close as possible

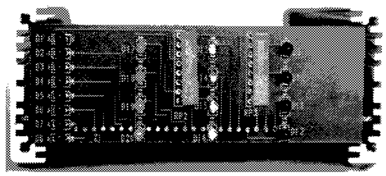


Figure 2: The front pcb

to the board's surface, aligned and soldered. Because all 20 Leds must fit into the holes of the aluminum front panel, it is best to use that as an alignment gauge. This *sandwich* is then turned upside–down. The best method is to solder only one of each LED's lead at a time. This avoids excessive heating and allows final adjustments before the second wire is soldered.

Recommended LED colours: D1…D12 – red, D13…D16 – green, D17…D20 – yellow.

10.2.4 Voltage Regulator IC

The voltage regulator, U16, is mounted vertically and its heat sink is screwed to the PTC side cover. Soldering U16 to the pcb should be one of the last steps before final assembly of the PTC case and after the two circuit boards have been joined together (see 10.3).

10.2.5 Lithium battery

The Lithium battery is the last component to be installed. This should be done with very great care as short circuits will lead to severe damage of the battery and of the circuit.

10.2.6 Piezo–Beeper

A small passive piezo–speaker can be plugged onto the two pin–connector BUZ (close to the lithium battery). It may be fixed to the case or to one of the larger ICs with double–adhesive tape, making sure that the terminals do not come in electrical contact with other parts.

10.3 Display board

After complete assembly of the pcb's, the side covers are screwed to the rear panel. Then the main pcb is pushed in so that connector X1 fits through the opening. Then X1 is screwed to the rear panel and the display pcb is put into position in front of the main board, corresponding conducting paths meeting at a right angle (see fig. 3) Now the soldering is done, beginning at the bottom side of the main pcb. A rubber band put around the case frame helps to hold things in place during this process. Finally, the voltage regulator and the lithium battery are built in (10.2.4, 10.2.5).

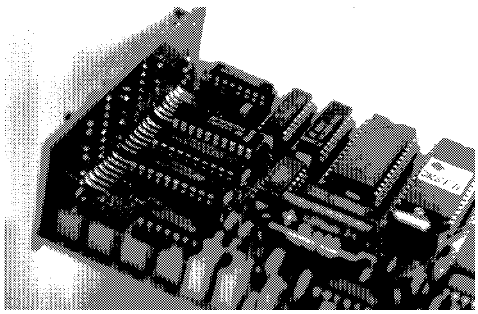


Figure 3: Soldered display pcb

11 Jumper Settings

11.1 The Serial Interface (RS232)

The serial I/O operates with 8 data bits, 1 stop, no parity. The baudrate can be selected by using jumpers BR4 and BR5. Figure 4 shows the location of the jumpers, the baud rate settings are listed in table 7. You have to `RESTart` after changing the setting.

BR4	BR5	Speed
open	open	9600 Baud
open	closed	4800 Baud
closed	open	1200 Baud
closed	closed	300 Baud

Table 7: Baud–rate setting

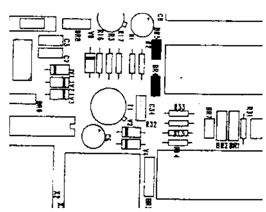


Figure 4: Location of jumpers BR4 and BR5

11.2 PTT setup

There are several possibilities of wiring the PTT–control. This is done by configuring jumpers 3 and 6:

1. X3 pin 3 switched to ground by transistor. This mode should be selected when the PTC is supplied with power through X3 pin 5. Figure 5 shows the jumper setting. If the power is not supplied through X3, no jumpers are set at BR3.

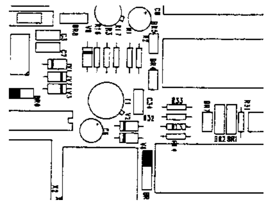


Figure 5: PTT–transistor switches to ground

2. X3 pin 3 switched to ground by relay. In this case the PTC may also be supplied with power through X3 pin 5. Figure 6 shows the setting of the jumpers.

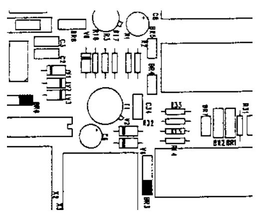


Figure 6: The PTT–relay switches to ground

3. X3 pin 3 and pin 5 as a floating relay contact. Figure 7 shows the jumper settings.

The relay K1 may be omitted, if it is not used (configuration 1). The PTC's are shipped without a relay.

11.3 AFSK / FSK

The PTC allows operation in both AFSK and FSK. With AFSK, an audio signal from the PTC is fed from X3 pin 1 to the transmitter microphone input. Jumper BR8

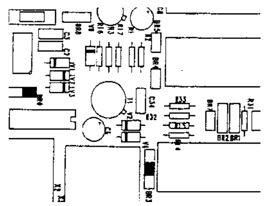


Figure 7: Floating relay contacts

is set pointing to the edge of the main pcb. This mode should work with almost every modern SSB transmitter. FSK mode should be preferred because a greater spectral purity of output signals can be obtained. In that case, X3 pin 1 is connected to the transmitter's FSK input. Jumper BR8 is set towards the center of the main pcb.

11.4 DC power supply using X1

The PTC may be supplied with DC from connector X1. The (+) line must be connected to Pin 9, the (–) line to Pin 1. A jumper must be plugged onto BR7.

11.5 ELBUG and Hardware Handshake

Newer software versions (1.1 or higher) provide a CW–input to control the AMTOR part of the PTC. Pins 12 and 25 of the the terminal interface X1 are used to hook up the ELBUG (see 7.2). The jumper setting of BR1 and BR2 is shown in figure 8. When the jumpers are set, the harware handshake lines of the terminal interface are connected. The hardware handshake is not implemented in the software version 2.0. Version 2.0 fully supports XON/XOFF (CTRL–Q / CTRL–S).

11.6 High Tones

By applying VCC (5V) to pin 13 of the 25–pole RS232 connector (connecting pin 13 and pin 8 together) the Firmware switches over to HIGHTONES (2100/2300 Hz). The switched capacitor lowpass–filter and the AFSK–tones are adapted. **The user has to readjust the discriminator–filters with P1/P2 by using the `ME *` command (refer to the manual).** `ME *` will generate the correct calibration–tones.

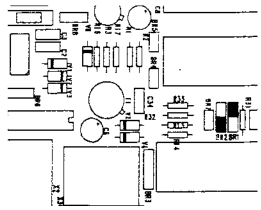


Figure 8: Jumper setting for CW–input

The Firmware reads the logic level at pin 13 at the STBY prompt to the terminal (on RESET, DISCONNECT, RESTART,...).

Note: The highpass–filter at the frontend of the converter is not able to be set by firmware, therefore its cut off frequency is much to low for practical use. Working with HIGHTONES only makes sense by using the **narrow IF–filter** of the receiver in FSK mode.

12 Initial Operation

12.1 Even if all looks well...

Before applying power to the PTC, make sure that

- the right ICs are placed correctly at the correct loction.
- the right DC supply input is chosen and the DC cable shows the right polarity.
- all jumpers are set according to Your individual requirements.
- the RS232 terminal parameter setting is correct (baud rate, 8 bit, 1 stop–bit, no parity)
- the terminal connection cable is wired properly. We recommend using only lines 2, 3, and 7.

12.2 RS232 cable

There are a great number of ready–made RS232 cables, designed for connecting telephone modems and other peripheral devices to a computer. This may cause some problems, however, because several pins of the connector X1 are used for special purposes. Serial data transfer to and from the terminal only needs three lines: Ground (X3/pin 7), RXD (pin2), TXD (pin3). Some older terminals require additional bypassing of the handshake lines by connecting RTS (4) to CTS (5) and DSR (6) to DCD (8) and DTR (20) at the terminal end of the cable. This is often required by dumb terminals.

Caution: when using a commercial cable make sure, that lines 11, 24, 12, 25 and 13 of X1 are not used by the cable. This may damage the PTC.

12.3 Applying Power to the PTC

After the whole setup has been checked again very carefully, the DC voltage can be connected to the PTC. You should verify that all LEDs light for a short moment after startup. If that is not the case, there probably has been some damage caused when soldering. A system initialization message, including the owner's call sign, will appear on the terminal screen. Some ICs, especially the STI (U4) will become warm (about 100° F) during normal operation. If you notice a considerably higher temperature, you should disconnect the DC supply and check again for possible faults.

13 Alignment

13.1 CPU clock frequency

Since PACTOR and AMTOR are synchronous modes, inaccurate clock frequency settings may lead to a performance degradation. Within certain limits, the software will automatically compensate these effects, nevertheless precise adjustment of the crystal oscillator is recommended. Connect a frequency counter to pin 6 of U11 and, using a non–conductive alignment tool, adjust trimmer capacitor TC1 for a 6144.000 kHz reading. In a very few cases, the crystal frequency offset is too great to be tuned by TC1. Changing the value of C1 should help, otherwise the crystal has to be replaced.

13.2 Demodulator

Alignment of the demodulator filters is supported by software and requires no instruments. When in command mode, type in the sequence `MEasure *`, followed by <CR> (Important: do not leave out the space before the asterisk). A continuous sequence of numbers should appear on the screen. Adjust P1 until the numbers reach a maximum value, then type <CR>. Repeat this procedure with P2, ending with <CR>. All readings should be in the range of +20…+25. If P1 or P2 are set to very low resistance, oscillation of the filters may occur, indicated by readings much higher than 30 or 40. In that case you should repeat the whole alignment until the proper results are achieved.

You may also use an oscilloscope for tuning. Start the tuning procedure by entering `MEasure *` and connect the scope to pin 7 of U17 (ABST2). Adjust P1 for maximum amplitude. To adjust P2 for maximum amplitude, connect the scope to pin 1 of U17 (ABST1). While adjusting P1 or P2, the measured frequency must not change. For P1 the frequency is 1400 Hz, for P2 it is 1200 Hz.

13.3 AFSK Output level

In order to prevent overdriving of the transmitter microphone input, an AFSK output level of a few millivolts will be sufficient. Set the transmitter MIC GAIN control to the same level as during normal SSB operation. Then adjust P3 for an output of roughly half the maximum power.

After that, the PTC is ready for use.

14 Troubleshooting

Though easy assembly and alignment of the PTC has been one major design objective, there still remains the risk of unexpected malfunction. This section should give a few hints for troubleshooting. We have made a list of frequent error causes. Even if you cannot solve the problem, it will be helpful for us to know as many symptoms as possible.

14.1 If the CPU does not work

- Check if all IC's are inserted properly, verifying that all pins are in the socket holes.
- Check the supply current (approximately 210 mA).
- Check the regulator output voltage (+5 Volts).
- Check the supply voltage of all ICs (refer to table 1 of circuit diagram).
- Check the crystal oscillator (6.144000 MHz at pin 6 of U11).
- Check if there is a regular train of pulses at pin 11 of U10.
- Check the DC/DC–converter output (-4. . . -5 Volts at pin 5 of U14).
- Check if all jumpers are set properly.

U9 must be the originally programmed GAL16V8. Other ICs (e.g. a new 16V8 from your electronic shop) will not work!

14.2 If the serial I/O port does not work

First you should make sure that the communication parameters of both your terminal and PTC are identical (baud rate, number of data and stop bits, parity). The RXD and TXD lines of your RS232 cable may be reversed. Some terminals and terminal programs require a wire connection between RTS and CTS at the terminal. Finally, U5 may be damaged or installed incorrectly.

14.3 Failure of the LED-Display

Some units showed the following effect: At the begin of a contact only half the display is active after the first change–over. This problem is solved by insertion of a ceramic 100 nF capacitor between pin 4 and pin 11 of U17.

14.4 Damage of the lithium–battery

Important: Some unlucky interactions between MAX691 and the CMOS–RAM of several manufacturers may have the result that the lithium–battery in the PTC becomes charged and therefore demaged.

To prevent this, insert a 100 nF capacitor into the two through-plated holes at the right of C24 (below the GAL U9). The effect will be a capacitiv grounding of the MAX691 pin 2.

A Pin Assignment of Sockets

Socket X3: the connection to the transceiver has the following pins:

Pin 1 :	AFSK or FSK output
Pin 2 :	Ground
Pin 3 :	Transmit/receive line of the transceiver (PTT)
Pin 4 :	RX audio input
Pin 5 :	Power input or PTT–switch

Table 8: The 5–pin DIN–socket

Jumper BR8 toggles AFSK and FSK operation, see 11.3. The different ways of realizing the PTT are described in 11.2.

Socket X1, the terminal interface:

Pin	1 :	Ground
Pin	2 :	RxD (input)
Pin	3 :	TxD (output)
Pin	4 :	CTS (input)
Pin	5 :	RTS (output)
Pin	6 :	DSR (= +5 V)
Pin	7 :	Ground
Pin	8 :	DCD (= +5 V)
Pin	9 :	Power (9...14 Volt)
Pin	10 :	Output for external tuning display
Pin	11 :	CW input (dot lever)
Pin	12 :	External sync input
Pin	24 :	Output for external tuning display
Pin	25 :	CW input (dash lever)

Table 9: Pin assignment of sub–D 25 socket

Attention:
The assignment of pins 9,11,12,13,24, and 25 differs from the RS–232 norm!

B Important System and Error Messages

*** PARAMETERS RELOADED

A `RESTart` was executed, the default values in the ROM were loaded. The mailbox and log were erased.

*** NO RESPONSE FROM <call>

A calling attempt was terminated after not receiving a reply within the timeout period.

*** ONLY FOR RX–MODE

The command entered can only be executed while the PTC is receiving packets. For example: `AUto`.

*** CHANGE OVER FIRST

The command can only be executed after a changeover. For example: a disconnect is not possible when in RX–mode.

*** SWITCH TO STBY FIRST

The command can only be executed when in STBY–mode. For example: `MYcall`.

*** RT–CLOCK NOT FOUND

The clock chip could not be found when booting (missing or defect).

*** ERROR: MISSING DATA

The packet counter detects a missing packet. This is a very rare event.

*** FILE TABLE FULL

Already 16 entries in the directory. Further entries not possible.

***** REMOTE REJECTED**

The command entered can not be executed remotely.

***** RTC REQUIRED**

Command execution only possible with clock chip functioning. Example: Logbook.

<File> TOO LONG! MAILBOX–MEMORY FULL!

Not enough memory was available for the file. Therefore parts of the file were not stored.

***** SYSTEM BUSY**

Multiple access to the mailbox by sysop and remote user not permitted.

***** ACCESS REJECTED**

Access denied. For example: deletion of files for other calls.

C Parts List

Part	QTY	Reference	Description
1	1	U1	Z80–B–CPU CMOS ZILOG!
2	1	U2	27C256–PTC
3	1	U3	62256 150ns
4	1	U4	Z80–B–STI (MK3801)
5	1	U5	MAX233, SP233
6	2	U6,U7	74HC377
7	1	U8	RTC72421
8	1	U9	16V8–PTC
9	1	U10	MAX691, LTC691
10	1	U11	74HC00
11	1	U12	ADC0804 NATIONAL
12	1	U13	74HC138
13	1	U14	ICL7660, LTC1044
14	1	U15	XR1015
15	1	U16	7805
16	2	U17,U18	TLC274
17	1	T1	BC140, 2N2219
18	2	T2,T3	BC337
19	4	V1,V2,V4,V7	1N4007
20	2	V3,V8	ZPD18 18 V zener–diode
21	2	V5,V6	AA116 or BAT142
22	12	D1,D2,D3,D4,D5,D6,D7,D8, D9,D10,D11,D12	Low–Power LED 3 mm red
23	4	D13,D14,D15,D16	Low–Power LED 3 mm green
24	4	D17,D18,D19,D20	Low–Power LED 3 mm yell.
25	1	R20	270 Ω
26	4	R14,R15,R23,R36	3,3 kΩ
27	2	R10,R31	6,8 kΩ
28	11	R1,R2,R3,R4,R6,R16, R17,R18,R32,R33,R35	10 kΩ
29	4	R8,R19,R21,R22	15 kΩ
30	2	R28,R29	27 kΩ
31	2	R24,R25	39 kΩ
32	1	R7	47 kΩ
33	4	R12,R13,R26,R27	56 kΩ
34	1	R34	100 kΩ
35	1	R30	150 kΩ
36	1	R9	180 kΩ
37	2	R5,R11	2,2 MΩ
38	1	RP1	R–Network 5*10 kΩ
39	2	RP2,RP3	R–Network 7*1 kΩ
40	2	P1,P2	200 Ω Trim–Pot

Part	QTY	Reference	Description
41	1	P3	1 kΩ Trim–Pot
42	1	C1	22 pF ceramic
43	1	C21	150 pF
44	1	C14	2,2 nF Foil
45	1	C19	3,3 nF Foil
46	6	C9,C10,C11,C12,C13,C15	10 nF Foil
47	3	C20,C36,C37	33 nF Foil
48	5	C4,C5,C17,C18,C38	47 nF Foil
49	16	C2,C3,C22,C23,C24,C25, C26,C27,C28,C29,C30,C31, C32,C33,C34,C35,C40,C41	100 nF
50	1	C39	220 nF
51	1	C16	2,2 μF Tantal
52	1	C7	10 μF Tantal
53	2	C6,C8	100 μF Electrolyte 16V
54	1	TC1	2…45 pF Trim–C
55	1	Q1	Quartz 6,144000 MHz HC18U
56	1	BAT1	3V Lithium Battery
57	1	K1	DIL–Relay optional
58	3	BR4,BR5,BR7,BUZ	2pin jumper socket
59	4	BR1,BR2,BR6,BR8	3pin jumper socket
60	1	BR3	4pin jumper socket
61	1	X1	25pin SUB–D–female
62	1	X2	2pin DC–socket
63	1	X3	5pin DIN–female
64	6		Jumper
65	1		Piezo–buzzer
66	2		IC–Socket DIL40
67	2		IC–Socket DIL28
68	5		IC–Socket DIL20
69	1		IC–Socket DIL18
70	2		IC–Socket DIL16
71	3		IC–Socket DIL14
72	2		IC–Socket DIL8
73	1		Main–board PTC
74	1		Front–board PTC
75	1		Case
76	1		Manual

D Layout of Parts

Figure 9: Parts layout of front board.

Figure 10: Parts layout main board.

E Problems ?!

If you have questions, problems, proposals or comments relating to the PTC or PACTOR, please contact the following address.

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F History

Two German hams (Ulrich DF4KV and Hans–Peter DL6MAA) initiated the PACTOR project. As early as 1986 experiments with modified AMTOR protocols began. In tedious tests the noise conditions on the HF–bands were investigated and the best transmission parameters were determined. The PACTOR protocol was deduced from the results.

The first PTC's were wire–wrapped on bread–boards. DL6MAA built his PTC based on a SMD Z80 single–chip processor. DF4KV wire–wrapped his PTC in conventional Z80 technologie.

The third station that got on the air in PACTOR was Tom (DL2FAK). His PTC was based on DL6MAA's SMD Z80 version. DL2FAK and DL6MAA ran a lot of tests that resulted in considerable improvements to PACTOR. In the fall of 1989 Tom developed a *PT–link* system that facilitated access to packet radio nets from PACTOR. Tom also took on the difficult task of a project manager to coordinate the various proposals, comments, and critiques that came pouring in from the ham community.

The 4th station that got on the air was DK5FH with a DL6MAA–PTC. He discovered several weaknesses in the software and proposed many improvements. Within the PACTOR–project he is now reponsible for logistics, purchasing, and public relations.

Since the SMD–based PTC of DL6MAA was too difficult for home construction, and DF4KV's version contained too many parts, it was decided to develop a completely new hardware. The current version of the PTC was developed by Peter DL3FCJ. DL6MAA added the modem part and adapted the software. The AMTOR and RTTY software was added by DF4KV.

DL1ZAM did the schematics and the board layout. Currently he takes care of getting the kits ready for shipment.

DF4WC wrote the mailbox software for the first official PACTOR mailbox. The box is operating under the call DF0THW on 3.5926 MHz (Mark) ±QRM. Contacting this box could be a definite challenge for low–band DXers from outside Germany. A link to the packet radio store & forward net is planned for the near future to facilitate message exchange between PACTOR and packet radio.

This manual was put together, edited, and improved by Peter DL3FCJ from articles by DL1ZAM, DL6MAA, DF4KV and DK5FH. It was written on the text system LaTeX and printed on an HP LaserJet III.

The translation from German to English was done by Ulrich DF4KV and Guido DF9PW/N5MQD.

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