

Manual for Professional Firmware (Version 3.2)

The so-called Professional firmware for the PTC-II/pro/e is a professional variant, especially adapted for mobile (maritime) use. Amongst other things, it offers the new high speed protocol PACTOR-III and improved access to professional HF services (e.g. E-mail servers). All functions of the freely available firmware (“Amateur Radio firmware”) are also contained in the Professional firmware.

A SHAREWARE version is available for the standard PTC-II (PROFI32.PT2), the PTC-IIpro (PROFI31.PRO) as well as for the PTC-IIe (PROFI32.PTE). It allows up to 20 PACTOR links to be made to evaluate the additional functions. Thereafter, registration through SCS is necessary for further use: You need an access-code from SCS. (See the LICENSE-command in section 2 of this documentation).

Licenses for the Professional firmware 3.1 remain valid for Professional firmware 3.2.

Contrary to Professional firmware 3.1, version 3.2 does not work in Hayes mode per default but in normal command mode like the “Amateur firmware”. This improves compatibility to many PC programs frequently used in conjunction with the PTC-II. Besides that, version 3.2 again provides autobaud detection on the serial PC interface.

SCS also offers a Professional firmware using the old (3.1) presettings, i.e. Hayes mode and a fixed baudrate of 38400 Bd. The filename of this type of firmware is XPROFI32 (.PT2, .PTE, .PRO) and it can be downloaded from the SCS web site as well. Please consider the following note if you want to utilize XPROFI32: Programs that are written for the “normal” command mode of the PTC-II might not work properly. Please see section 1.2.2! Per default, the baudrate is set to 38400 Bd. If required, it can be changed by using the SERBaud command. The baudrate setting is stored in the Flash-ROM and thus cannot be reset to its default by a REStart command but only by reinvoking the SERBaud command!

IMPORTANT NOTE: If you want to activate/use PACTOR-III, the TOnes parameter (see section 1.1.3.1) must be set to a value greater than 2! We generally recommend to use TOnes 4. Please be aware of the fact that altering the connect tones leads to a shift of the resulting physical HF frequency and must be compensated by adapting the dial frequency on your transceiver. Otherwise your system cannot be connected on the usual frequency (not by PACTOR-I/II systems, either) after the change.

There is the strict requirement that both systems participating in a PACTOR-III connection must use identical connect tones, i.e. the same TOnes parameter! Otherwise the connection fails or the throughput rate is extremely slowed down. Hence ALL members of an HF network who have PACTOR-III capability MUST use the same TOnes parameter!

1. Additional Functions

- PACTOR-III, High Speed HF Protocol.
- Hayes-compatible command interpreter, Hayes mode (compatibility to telephone modem domain).
- PACTOR-IP-Bridge, direct “TCP/IP over PPP” through HF-radio.
- PACTOR Free Signal Protocol for minimizing packet collisions during automatic access of HF data services.
- A more robust protocol for the PACTOR link initiation ("Robust Connect").
- CCIR 491 Numerical Selcals (4 and 5 figure), as well as WRU recognition and answerback for comfortable access to SITOR coastal radio stations.

1.1 PACTOR-III, High Speed HF Protocol

1.1.1 General

PACTOR-III is a third generation HF protocol building on latest developments in 2-dimensional orthogonal pulse shaping, advanced error control coding, and efficient source coding. Due to the advanced signal processing methods applied, PACTOR-III provides outstanding performance under poor and moderate signal conditions. As PACTOR-III also achieves very high throughput rates under good signal conditions, it is well-suited to HF channels with good SNR and low signal distortion as well. During the development of PACTOR-III, high importance was attached to compatibility with ordinary SSB transceivers (using standard 2.2-2.4 kHz wide IF filters). Therefore, PACTOR-III can achieve its maximum speed with using unmodified, common and cheap SSB transceivers. The occupied bandwidth is around 2200 Hz at a maximum.

Thus PACTOR-III is the ideal means of fast and reliable data communication over (the sometimes difficult medium) HF radio. The new protocol is fully backwards compatible to existing PACTOR-I/II networks.

1.1.2 Key features of the protocol

- Under virtually all possible signal conditions faster than PACTOR-II. Under average signal conditions a speed gain factor of 3-4 is achieved, under very favorable conditions the speed improvement can exceed factor 5.
- Maximum data throughput (without compression) higher than 2700 Bit/sec, around 5200 Bit/sec if PMC (online text compression) is applied.
- At least as robust as PACTOR-II under extremely poor signal conditions.
- Maximum bandwidth only about 2200 Hz.
- Low crestfactor (high mean output power).
- High spectral efficiency – PACTOR-III makes very good use of the bandwidth.
- Fully backwards compatible to existing PACTOR-I/II networks.

1.1.2.1 The sub-protocol levels (“speedlevels”)

In order to achieve a high degree of adaptivity, PACTOR-III utilizes 6 different speedlevels. Switching between these sub-protocol levels is fully automatic and is based on sophisticated estimation algorithms.

The following table shows the different PACTOR-III sub-protocol levels:

SL	NTO	PDR	NDR	CFR
1	2	200	76.8	1.9
2	6	600	247.5	2.6
3	14	1400	588.8	3.1
4	14	2800	1186.1	3.8
5	16	3200	2039.5	5.2
6	18	3600	2722.1	5.7

SL = “Speedlevel”, sub-protocol level, adaptation fully automatic.

NTO = Number of tones (sub carriers) used on actual speedlevel.

NDR = Net user data rate (without data compression), i.e. effective throughput the user experiences after all “overhead” has been subtracted. If PMC (automatic online data compression) is activated, multiply with factor 1.9 in case of text files.

CFR = Crestfactor. Envelope power ratio, peak / average power (dB). If CFR is 3 dB, a 100 W SSB transmitter generates 50 W mean output power without clipping. The smaller CFR, the more mean output power can be used. High possible mean output power is desirable. PACTOR-III uses a novel crestfactor reduction algorithm and thus has very low crestfactors compared to other multi-carrier systems.

1.1.3 Extended and new commands for PACTOR-III

1.1.3.1 TOnes (0-5, Default: 0)

Defines the connect tones (used during link establishment).

The Professional firmware has an extended parameter range of 0-5. Parameter values 0-2 have identical function compared to the standard firmware (“Amateur firmware”). The relation between parameter value and connect tones is as following:

- 0: Fixed “low tones”, 1200/1400 Hz.
- 1: Fixed “high tones”, 2100/2300 Hz.
- 2: Tone pair definable by MARK and SPace commands.

- 3: Fixed tone pair 1200/1400 Hz.
- 4: Fixed tone pair 1400/1600 Hz.
- 5: Fixed tone pair 1600/1800 Hz.

IMPORTANT NOTE: A PACTOR connection will only switch to PACTOR-III during link establishment if the TOnes parameter is greater than 2!

We generally recommend to use TOnes 4 - also for PACTOR-I/II connections. Furthermore we recommend to work PACTOR-III only on the upper sideband (USB).

Please also note that the audio passband, i.e. the occupied audio spectrum, of the PACTOR-III signal always is fixed at 400-2600 Hz and INDEPENDENT of the TOnes setting. Regarding

PACTOR-III, TOnes does ONLY define the (connect) tones used during link establishment, it does NOT define the relative location of the audio passband. If you want to adjust the audio passband, you can only do that by using the “passband tuning / IF shift” (or similar) at the radio!

That’s why both systems participating in a PACTOR-III connection MUST definitely use the same TOnes parameter - otherwise a link will not work properly!

1.1.3.2 MYLevel (1-3, Default: 3)

Identical to the MYLevel command of the standard firmware but as an extension, parameter value 3 is also valid. If MYLevel is set to a value lower than 3, the PTC-II behaves like a Level-I or Level-II controller, respectively. Switching to PACTOR-III during link establishment, i.e. a PACTOR-III connection, is only possible if MYLevel is set to 3.

1.1.3.3 Unproto

For test purposes all different PACTOR-III waveforms can also be generated in the so-called unproto format, i.e. a continuous transmission without the requirement of a point-to-point connection. The following table shows the assignment between unproto parameter, resulting speedlevel and resulting packet type:

Parameter	Speedlevel	Packet type
30	1	short
31	2	short
32	3	short
33	4	short
34	5	short
35	6	short
36	1	long
37	2	long
38	3	long
39	4	long
40	5	long
41	6	long

Professional firmware 3.2 does not offer a decoding/receiving tool for PACTOR-III unproto transmissions.

1.1.3.4 EQualize (0-2, Default: 0)

Allows slight to moderate adjustment of the frequency response of the PACTOR-III transmit signal.

Some IF filters used in standard SSB transceivers already attenuate the edges of only 2 kHz wide signals due to a poor frequency response. As a countermeasure EQ allows to compensate for this effect. Please do only use the EQ command if you really know the actual transmit frequency response of your transceiver.

The assignment of the parameters:

- 0: No transmit equalizing.
- 1: Slight enhancement of the edge tones.
- 2: Moderate enhancement of the edge tones.

1.1.3.5 sys: MONitor (0-1, Default: 0)

Frequency response diagnosis tool in the sys: menu.

The meaning of the parameters (can only be changed if no connection is in progress):

- 0: Disables the “tone monitor”.
- 1: Enables the “tone monitor”.

The “tone monitor” should only be used for test purposes. It should not be used on a regular basis. It requires quite a large amount of processing power. This may cause system instabilities! Please disable the “tone monitor” after you finished the error diagnosis!

The “tone monitor” works as following:

The tuning display is used as a “spectroscope”, i.e. each tone of the various PACTOR-III waveforms is assigned to a single LED and displayed there: The more error is detected on the corresponding sub-carrier (tone), the more often the corresponding LED flashes red. (If the frequency error still is larger than 15 Hz, also a single green LED flashes during receive gaps.)

Low tones are displayed at the left side of the tuning bar, high tones at the right side. If more than 15 tones are used on a speedlevel (SL 5 and 6), some tones in the center of the spectrum are omitted.

With the aid of the “tone monitor” one can, for example, easily find out whether the receive signal is centered properly within the IF passband, etc. As a rule of thumb any long term asymmetry of the error pattern, e.g. frequent red flickering of the edge LED’s or a higher number of errors at one side of the spectrum, usually indicates a systematic problem on the transceiver side (transmitter or receiver, respectively).

1.1.3.6 The Level attribute for the PTC frequency scanner

Since not all scan channels may be suitable for PACTOR-III operation (narrow bandwidth channels!), the PTC frequency scanner allows a restriction to PACTOR-I/II by means of a channel attribute (see “red book”). If the attribute L2, e.g. #:L2, is assigned to a certain channel, all PACTOR connections on this channel are restricted to Level-I/II. If no Level attribute is assigned to a channel, the PTC scanner allows PACTOR-III connections on this channel. The attribute L3 (Level 3 allowed!) will also be accepted by the scanner but it is optional (not required).

1.1.3.7 Further specialities of the command set

- The LIN parameter is ignored on PACTOR-III connections.
- The UMLauts parameter is ignored on PACTOR-III connections.
- The CWID is disabled per default.

1.1.4 The meaning of the LED's

The meaning of the LED's is identical to the previous PACTOR-II definitions except a few extensions and minor adjustments. In order to indicate all of the 6 different speedlevels, the "DBPSK/DQPSK" and "HiSpeed/MaxSpeed" LED's have an extended meaning:

Speedlevel	DBPSK/DQPSK	Hi/MaxSpeed
1	red	-
2	green	-
3	-	red
4	-	green
5	red	green
6	green	green

The LED indicating the actual frequency offset is red as long as the frequency offset exceeds 10 Hz, else it gets green (usually after a short frequency adaptation period).

On the PTC-IIe, a PACTOR-III connection is indicated by red/green flashing of the PACTOR-I/II LED.

1.1.5 Hints for the PACTOR-III practice

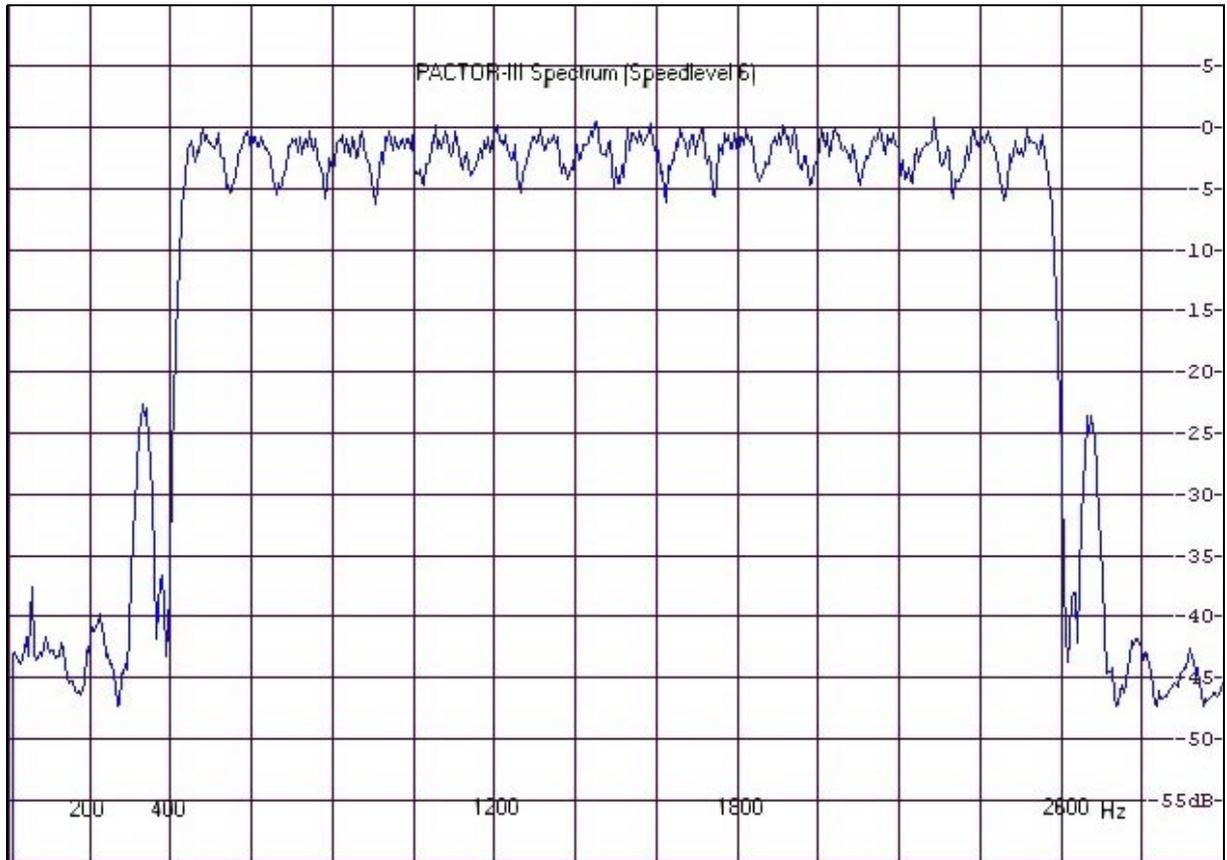
For optimum PACTOR-III data throughput, the transmit signal must be clean and undistorted. Make sure that ground loops and RF feedback effects are avoided in your installation. A 1:4 voltage divider placed directly at the transmit audio input of the transmitter may help to improve the effective transmit SNR. Then you have to set FSKA and PSKA to appropriate higher signal levels. PSKA levels lower than 80 are generally not recommended. If possible, minimize the wiring between the PTC and other devices: If the transceiver provides a power supply output (e.g. 13.8 V), do not use an extra power supply for the PTC but connect the PTC to the DC output of the transceiver. Use additional RF chokes wherever applicable.

Do not overdrive the transmitter (under no circumstances): The ALC level must not exceed the proper range!

Some "noise blankers" as well as other "noise reduction tools" tend to distort the PACTOR-III receive signal. In case of receiving problems try out if switching off the "noise blanker" etc. improves the throughput.

Make sure that the PACTOR-III receive signal is centered properly within the IF filter passband (see "tone monitor"). Adjusting the "passband tuning / IF shift" improves the throughput in some cases.

1.1.6 PACTOR-III spectrum



Spectrum of speedlevel 6, maximum possible PACTOR-III bandwidth!

Bandwidth of the main spectrum: 2200 Hz @ -40 dB.

Bandwidth including the first sidelobe (-23 dB): 2400 Hz @ -40 dB.

Bandwidth of speedlevels 1-5: < 2200 Hz @ -40 dB.

Please take into consideration that usual SSB transmitters only provide an IMD3 (third order intermodulation distance) worse than -30 dB. Thus better attenuation of the second and third sidelobes does not result in an improved transmit signal.

1.2 Hayes-compatible command interpreter, Hayes mode

1.2.1 General

The Hayes-compatible mode of the PTC-II(e) ensures compatibility to all PC applications, which usually operate with a telephone-modem. It makes the PTC-II behave as a phone-modem like piece of equipment and therefore accepts being controlled like a phone-modem.

The Hayes mode is mainly made for PACTOR-connections. Other (also supported) communication protocols should not be used in the Hayes-mode, although the possibilities are not explicitly disabled. The Hayes mode is easy to activate and deactivate, so that being limited to "PACTOR only" is not such a big disadvantage in practice. The software that operates phone-modems is mainly applicable only to data-modes.

1.2.2 Activating/Deactivating the Hayes-compatible mode

Per default, the Professional firmware starts up in Hayes-compatible mode: After powering up the PTC-II(e) the "NO CARRIER" message is sent to the terminal/PC.

The PTC-II(e) can be switched into the "normal" terminal/command mode by entering an ESC-character (see command ESCChar, usually ASCII 27). By means of this very simple switching, most programs which are actually written for "normal" mode, remain compatible with the Hayes-compatible mode (i.e. automatically switch the PTC-II into "normal" mode) since the very majority of terminal mode programs send an ESC-character to the PTC-II as first character anyhow.

The Hayes-compatible mode can also be terminated with the command string AT&Q or with AT#HAYOFF. (Of course, for this, the PTC-II must not be in so-called Hayes "online" mode (PACTOR connection in progress) at that time.)

From of the "normal" mode (cmd: prompt) the PTC-II can be switched back into the Hayes mode with the command AT or HAYON (e.g.: cmd: AT <Enter>).

Thus compatibility between programs from the telephone modem domain (Hayes-compatible programs) and the "normal" command mode of the PTC-II can also be easily achieved as most Hayes-compatible programs send an "empty" AT-command (AT<CR>) as very first command to the modem. Consequently, these programs automatically switch the PTC-II into Hayes mode at the very beginning of operation. Subsequent Hayes-compatible commands (AT...) are then correctly interpreted since the Hayes-compatible mode provides the Hayes command interpreter.

Activating and deactivating of the Hayes-mode in the "connected"-condition is not allowed! (There must not be an active PACTOR-connection when changing from "normal" mode to Hayes mode or vice versa!)

1.2.3 Data transparency

In order to ensure data transparency, the following settings must be made:

Term = 0

Box = 0

These are also the "default values".

The ADLf-parameter must NOT receive the value 2. (Default = 1).

The REMote-parameter has no meaning when the Hayes command set is active. The //-sequence is always ignored to ensure data transparency.

The umlaut conversion is always turned off in Hayes mode to minimise any possible transparency problems where the UMLlaut-parameter of the connected PTCs contains a different value.

1.2.4 SIO-handshake

As soon as one switches to Hayes operation from "normal operation", the PTC changes automatically from XON/XOFF-handshaking to hardware handshake with RTS/CTS. The hardware handshake for the transmitted data is activated at 800 bytes in the transmit buffer, and turned off again at 700 bytes. This relatively small buffer size has been chosen to minimize "timeouts" with higher level protocols (e.g. "ZModem").

The CD signal appears simultaneously with the usual "Scan-stop" signal at link initiation. On ending the link, the CD-signal is immediately inactive, even before the "NO CARRIER" message is given.

The DSR-pin is set to an active level (+10 V) on switching to Hayes mode.

1.2.5 Duplex simulation

In order to use the many programs and protocols from the telephone modem domain, the PTC-II offers a Duplex-Simulation. (The appropriate command is PDuplex.) The PTC-II ALWAYS operates with Duplex-Simulation in Hayes mode, ignoring the actual value of the PDuplex parameter.

Duplex-operation means that the PTC-II takes control of the required directional changeover required by the PACTOR protocol fully automatically, and tries to ensure the best possible efficiency of data transfer. The algorithm used for this is relatively simple:

1. The ISS (Information Sending Station) carries out an OVER if no transmit data available.
2. The IRS (Information Receiving Station) carries out an OVER if –
 - a) data is waiting in its own transmit buffer AND
 - b) an IRS condition has applied for at least 12 seconds. (This time can be changed using the PDTime-parameter.)

IMPORTANT: In order that the duplex-operation takes place smoothly and without jamming (illegally long waiting times), BOTH participants must operate with PDuplex activated!

1.2.6 Additional Specialities of the Hayes mode

- Changeover and QRT characters do not work.
- Switching to Hostmode with the JHOST sequence is impossible.
- Hardware handshake instead of software handshake. (Full data transparency is ensured providing the advice given above is observed.)
- Status polling with CHR(30) is de-activated.
(The status byte cannot be polled in Hayes mode!)
- The LFIgnore parameter does not work.
- All "prompts" are suppressed.

No link status messages are given: With an active Hayes-mode, many link-relevant messages are totally deactivated. These include:

```
*** MYCALL RECEIVED...
*** QRT RECEIVED...
*** TRANSMITTING CWID..
etc.
```

With a master-connect, after a successful link up, the message "CONNECT <HISCALL>" is suppressed.

- The "STBY" message is changed to "NO CARRIER".
- The connect-text is always turned off in Hayes-mode.
- In Hayes-compatible mode the "hello world"-message of the PTC-II is completely suppressed. Only the "NO CARRIER" message is sent to the terminal/PC after power-up.

1.2.7 Possible commands in Hayes mode

All command input in Hayes mode must end with a <CR>. All commands in Hayes mode must be prefixed with the preamble AT. (e.g. ATDPDL1ZAM, ATH, etc.)

In Hayes mode, the "normal" commands continue to be available as #commands – simply prefixed by a #-sign. E.g. the command AT#H shows the PTC-II help list. The format of #commands is identical to the “normal” (non-Hayes) commands. Be aware that #commands should only be used as a rare exception since some “normal” commands are useless or even harmful if entered during Hayes-compatible operation (e.g. switching to Amtor/Sitor or FAX/SSTV is not explicitly disabled). In order to work FAX/SSTV etc. simply leave the Hayes-compatible mode. You may re-enter the Hayes-compatible mode with the command AT or HAYON, see section 1.2.2.

When connected, the PTC-II works automatically in the so-called ONLINE-mode. This means that all incoming data is written to the transmit buffer.

The ONLINE-mode can be left by using the +++ sequence (with a 1 sec guard time), and re-entered with the ATO command. This is necessary for example to carry out a disconnect command (+++ATH).

All accepted commands are answered with OK by the PTC-II. Any errors are notified by the PTC-II with ERROR.

1.2.8 The implemented Hayes-commands in detail

1.2.8.1 Standard-commands

- AT A accepts a call after "RING" ", i.e. in practice the string "CONNECT <HIS-CALL>" is given.
- AT&D0 de-activates DTR-toggle function, see 1.2.10.
- AT&D1 activates DT-toggle function, see 1.2.10 (default: AT&D1).
- AT DP carries out a connect command. See the "normal" PACTOR connect command for possible arguments.
An extension with frequency information for the connected transceiver is allowed, separated by a comma. Example: ATDPDL1ZAM,3582.6

Connect attempts can be broken off by giving a <CR>.
- AT DT identical to DP.
- AT E0 de-activates the echo in command-mode.
- AT E1 activates the echo in command-mode (default: ATE1).
- AT &F restores the default-settings of all parameters from the ROM. The PTC is reset to its initial state. This command is recommended for being the first command of the modem-initialisation-string.
The following system properties and variables are exceptionally not affected by the by &F:
- the Hayes-parameter itself,
- all Free-Signal-specific parameters,
- all Scan- and. Transceiver-Control-parameters,
- the PTC-Logbook,
- the PTC-Mailbox.
- AT H carries out a disconnect-command. Also H0 or H1 are accepted.
- AT I provides "PTC-II" or "PTC-IIe".
A numerical parameter may be appended. Only the value 3 triggers a special function, all other parameter values are ignored: ATI3 shows a verbose modem identification string which contains the firmware version number, the BIOS version number as well as the date code of the firmware. The data fields are separated by a space character, e.g.: 3.1d 1.31 02.03.2001
- AT O In the linked condition, switches from command-mode back to the online-mode.
- AT +++ identical to ATO in command-mode. In online-mode: switches to command-mode providing the guard time (1 sec) is adhered to.
- AT Q responds "OK" but has no function.

AT &Q exits the Hayes-mode.

AT S0= sets the value of the S0 register. This value sets after how many ring characters (Signalled as "RING") the PTC-II automatically accepts an incoming link. If the S0 register contains the value 0, then the automatic call acceptance is de-activated. A call can then only be accepted via the A-command (ATA). (Default: ATS0=0).

AT S38= sets the value of the S38 register. Serves as configuration register for TCP/IP/PPP.

When bit is set:

Bit 0: activates the PACTOR-IP-Bridge mode (PPP und TCP/IP).

Bit 1: use data-encryption via PACTOR during PACTOR-IP-Bridge connections.

Attention: Data-encryption is only performed when bit 0 of S38 is set to 1 AND the Hayes-compatible mode is activated. In "normal" mode, data-encryption is generally disabled. If data-encryption is utilized, link-establishment to systems without data-encryption is impossible. Neither the "free signals" of non-encrypted systems nor the data packets for conventional link establishment can be received. (Of course, this is also valid vice versa: PTC modems configured for "non encryption" will neither detect encrypted "free signals" nor conventional data packets for link establishment.)

Bit 2: the physical callsign will be appended to the user-ID at link-establishment on the host-side. If the user for example has the user-ID "Mustermann" and callsign DL0XYZ, the host-PTC gives out the string "MustermannDL0XYZ" as the user-ID to the PC during authentication.

Bit 3-4: reserved. Should be set to 0.

Bit 5: primary DNS only. Only queries to the primary DNS are sent through the PACTOR-IP-Bridge, all other queries to name servers are tossed. Setting bit 5 is **highly recommended** if DNS is used (Bit 7 is set), as the primary DNS query usually "times out" very quickly and the following access to other name servers only introduces useless overhead (in most cases) which delays the response to the primary DNS query or even blocks the entire name resolution if the PACTOR link is very slow. (The name resolver on Windows systems usually times out after 90 seconds.)

Bit 6: disable port-limitation. When the bit is NOT set, then only data is transferred in UDP and TCP which belong to the following port-numbers or services: 23=Telnet, 110=POP3, 25=SMTP, 80=HTTP, 21=FTP, 20=FTP-Data, 53=DNS, 194=IRC.

Bit 7: UDP supported via PACTOR-IP-Bridge. This is necessary especially for name-server-requests, i.e. when names like <http://www.kielradio.de> or pop.kielradio.de are used for the access to an Internet service instead of numerical Internet addresses like 192.168.100.1.

Default of S-Register 38: 0.

Attention: As long as bit 0 of register S38 is set to 1 with activated Hayes-mode, all Packet-Radio-Tasks (AX.25-Ports) are "suspended", that means stopped. Addi-

tionally the listen-mode is disabled and AMTOR-ARQ as well as FEC-reception is masked.

AT S39= sets the value of the S39 register.

S-register 39 serves for administration of advanced link parameters

When bit is set:

Bit 0: the PTC automatically aborts ATDP- or ATDT commands in progress and outputs a "BUSY" string to the terminal/PC via RS-232 if establishing a connect to the desired host/distant PACTOR-system is currently not possible or not allowed.

There are two different "BUSY" conditions depending on the linking method: A) Conventional connect or B) connect utilizing the PACTOR Free Signal Protocol (FRee MOde 1 / AT*XM1).

A) During conventional connects, the so-called "channel busy detector" is always active and checks whether there already exists a PACTOR link on the actual HF-channel or not. If the channel is already occupied, the PTC reports "BUSY".

B) In FRee Mode 1 the PTC tests if valid Free Signals can be "heard" on the actual channel (i.e. if a Host is available). In case of "NO HOST" or "HOST BSY" the PTC reports "BUSY".

The "BUSY" message especially allows the use of automatic re-dialling as it is a widely-accepted convention from the telephone modem domain.

Bit 1-6: reserved. Should be set to 0.

Bit 7: GPS-position data (read from a GPS-device via Y-cable) is sent to the distant station during PACTOR link establishment – if the position data is not older than 20 minutes and furthermore the PTC is working in Hayes-compatible mode.

At the receiving end, a firmware version greater than 3.1 (e.g. 3.1d) must be utilized in order to make use of received position information. The position data is sent to the terminal/PC as additional data field within the CONNECT message. The format of the position data field is similar to usual NMEA-sentences. The position data field is always appended to the callsign of the calling (connecting) station separated by a space character:

```
CONNECT DL6MAA $5008.32,N,00832.97,E<CR><LF>
```

A dollar-sign (\$) forms the header of the position data, followed by the latitude always consisting of 4 pre-decimal digits (two digits for "degrees", two digits for "minutes") followed by two decimal "minutes" digits. Then "N" or "S" (for "North" or "South") follows, delimited by commas. The next section contains the longitude always consisting of 5 pre-decimal digits (three digits for "degrees") and 2 decimal "minutes" digits followed by "E" or "W" (for "East" or "West") separated by a comma. The CONNECT message is terminated by <CR><LF>.

Important: If bit 7 is set, the DTR-toggle function (see AT&D command) will automatically be disabled since the GPS-data is read from the DTR-pin of the RS-232 interface. Consequently, the DTR-toggle function cannot be provided anymore.

- AT S50= sets the value of the S50-register. Default: 192.168.88.1.
This register keeps the MY_IPA-Internet address in the usual way, with dots as separators. Example: ATS50=192.168.1.8. Domain names are NOT allowed as addresses. The meaning of the MY_IPA is explained in the PACTOR-IP-Bridge section.
- AT S51= like ATS50= but S51 keeps the HIS_IPA-Internet address.
Default: 192.168.88.2
- AT S52= like ATS50= but S52 keeps the DNS1_IPA-Internet address.
Default: 192.168.88.11
- AT S53= like ATS50= but S53 keeps the WNS1_IPA-Internet address.
Default: 192.168.88.12
- AT S54= like ATS50= but S54 keeps the DNS2_IPA-Internet address.
Default: 192.168.88.13
- AT S55= like ATS50= but S55 keeps the WNS2_IPA-Internet address.
Default: 192.168.88.14
- AT S0=? Shows the value contained in the S0 register.
(Also applicable for S-register 38, 39, 50-55.)
- AT V responds "OK" but has no function.
- AT X responds "OK" but has no function.
- AT Z responds "OK" but has no function.

1.2.8.2 Extended AT-commands

The following commands belong to special modem-parameters which are only applicable for PACTOR-modems. Also refer to the equivalent commands in the PTC-II manual (red book) for more details:

- AT *AP defines the APower-value (refer to APower-command). The valid range of the value is the same as for the APower-command. Example: AT*ap1
- AT *CS defines the CSDelay-value (refer to CSDelay-command). The valid range of the value is the same as for the CSDelay-command. Example: AT*cs3
- AT *CW defines the first parameter of the CWid-command (refer to CWid-command). The valid range of the value is the same as for the first parameter of the CWid-command. Example: AT*cw0 (switches off the CW-identification)
- AT *FA defines the FSKA-value (refer to FSKA-command). The valid range of the value is the same as for the FSKA-command. Example: AT*fa350
- AT *MA defines the MArk-value (refer to MArk-command). The valid range of the value is the same as for the MArk-command. Example: AT*ma1800
- AT *MC defines or deletes the optional string for the CW-identification.
This command is only accessible via the Hayes-mode (there is no equivalent command in the "normal mode") and is only available in the host-version of the firmware. The optional CW-ID-string is ONLY used during Free-Signal-transmissions (Free Mode 2) and is sent instead of the "Free Ident"-callsign. After a REStart the optional CW-ID-String is deleted.
The *MC-commando allows the following parameters:
Alphanumeric string up to 30 characters of length – Spaces must be entered as dots".“ and must not appear directly in the string.
When "=“ appears as argument then the optional CW-ID-String is deleted. (Afterwards the system uses the "Free Ident"-callsign for the CW-identification.) In the case that other Hayes-commands follow this command, it must be followed by a colon. Example: AT*MCCQ.CQ.DE.DA0
In this example the host transmits "CQ CQ DE DAO" as CW-ID.
- AT *MY defines the MYCall-callsign (refer to MYcall-command).
(Possible callsigns: see MYcall-command.) Example: AT*myDL3FCJ
- AT *PA defines the PSKA-value (refer to PSKA-command). The valid range of the value is the same as for the PSKA-command. Example: AT*pa240
- AT *PD defines the PDTimer-value (refer to PDTimer-command). The valid range of the value is the same as for the PDTimer command. Example: AT*pd8
- AT *SP defines the SPace-value (refer to SPace-command) The valid range of the value is the same as for the SPace command. Example: AT*sp1600

- AT *TO defines the TOnes-parameter (refer to TOnes-command). The valid range of the value is the same as for the TOnes command. Example: AT*to2
- AT *TX defines the TXDelay-value (refer to TXDelay-command). The valid range of the value is the same as for the TXDelay command. Example: AT*tx2
- AT *XA identical to „FRee AUto“.
- AT *XI identical to „FRee IDent“.
- AT *XM identical to „FRee MOde“.
- AT *XC identical to „FRee CWid“ (only available in the host-version).
- AT *XD identical to „FRee DUty“ (only available in the host-version).
- AT *XP identical to „FRee PWr“ (only available in the host-version).
- UPDATE special non-AT command that is also be recognized in Hayes-compatible mode. This allows firmware updates by means of ordinary update utilities (written for the “normal” command mode of the PTC-II). Adaptation of the utilities to the Hayes mode is usually not required.

The command interpreter also accepts command-sequences without spaces as delimiters, which is often used in Hayes compatible environment. The length of the whole command-sequence is only limited by the length of the command-buffer (255 Bytes). The end of the callsign-field at *MY-, DP- or DT-commands in a multiple-command-string must be declared by a colon (but only when more commands will follow).

Example: AT&fe0*myDL6MAA:s0=1

Hayes-commands are not case-sensitive.

1.2.9 Connect-Acceptance

If the PTC receives a connect, it notifies this with "RING" (as soon as the callsign of the partner station has been received). "RING" will be repeated every 2 seconds.

The call can be accepted with the command ATA, at which time, the PTC gives the message "CONNECT <HISCALL>". The term <HISCALL> represents the callsign of the calling station.

If the S0-register has been set to a value N being greater than 0 (using the AT S0= command), then the PTC automatically accepts the call after the N'th "RING".

If the call is not accepted after the 10th "RING" (either "manually" using ATA or automatically with S0 not equal to zero), then the PTC carries out a PACTOR disconnect.

1.2.10 Termination of a connection

DTR-toggle is evaluated as "HANG UP", i.e. the link is terminated. This convention is wide spread in Hayes compatible modems. Alternatively, the command ATH can be used to end a link (also see command AT&D and description of S-register 39).

After an ATH command, "OK" is displayed. The "NO CARRIER" message is suppressed after the link is ended.

1.2.11 Specialities with the usage of the PFSP-Protocol

With activated FRee MOde 2 and after a client-connect, "RING" will not be sent to the terminal/PC and the connect will be accepted immediately. The S0-register as well as the ATA-command don't have any meaning with FRee MOde 2 (host) or FRee MOde 1 is activated.

1.3 PACTOR-IP-Bridge

1.3.1 Principle of the PACTOR-IP-Bridge

The PACTOR-IP-Bridge (PIB) is a new Network-Integration-Protocol developed by SCS. It combines several sub-protocols in a functional and easy to use way. The dominant protocols in the Internet like TCP/IP, as well as the Point-to-Point-Protocol (PPP), which has become standard for establishing the link of Internet applications, are combined with PACTOR-II. The result of this intelligent protocol combination is a data-transparent and relatively fast Internet access via HF-radio using standardized user interfaces. The PTC-II appears to attached PC's like a Hayes compatible "telephone modem" (refer to "Hayes compatible mode") and locally takes over both, the complete PPP and TCP/IP handling. Except for a minimum fraction of protocol-overhead, the physical PACTOR-II link only carries useful data. The huge amount of overhead of the TCP/IP and PPP protocols (which are designed for broad banded wired links) is reduced to the absolute minimum required. By locally carrying out the PPP protocol between the PC and the PTC-II a further decisive advantage arises: Because of the very short timeouts, PPP used to be nearly impossible over slow communication channels with relatively large delays. These timeout problems are now all solved by the PACTOR-IP-Bridge. Summarizing the qualities of the PIB:

- TCP/IP-transparent and relatively fast Internet access via HF-radio.
- All Internet-services are accessible via PACTOR-II, e.g. E-Mail (SMTP/POP3), FTP, HTTP, ...
- Up to 4 Internet-channels ("sockets") over one physical PACTOR-link.
- Extreme compression of the TCP/IP- and PPP-"overhead".
- Full PPP-compatibility: Use of common client/server-software, like Netscape, Outlook, Eudora and others is possible.
- Easy embedding and configuration under all common operating systems.
- No "timeout"-problems on PPP and TCP/IP.

1.3.2 The configuration of a Windows-client for PIB-operation (Windows-configuration for the user of an HF-Radio-Internet-Service)

This configuration manual is valid for Windows 95 as well as for Windows 98. The windows or menus may look somewhat different, dependent on the selected operating-system and the language. In each case however, the operations to be carried out and the settings are always the same.

Important for Windows 95: Be sure that you have the latest version of the "Dial-Up Network" installed. You can receive it as a free update from the Internet, if required. The easiest way is to search for "MSDUN1.3", which is usually the name for this update-software. To make Internet-access possible, you also need to have the TCP/IP protocol installed. If necessary, this can be done with **Desktop→My Computer→Control Panel→Network**.

The configuration of the user/client-PC for operation with the PTC-II is to be done in two steps. At first a "Modem" needs to be installed, which means that Windows 95/98 needs to be "told" which additional hardware component is to be managed. The PTC-II behaves like a standard phone-modem and therefore can be checked in as one.

After having checked in the PTC-II as a standard modem, a new entry in the Dial-Up-Network needs to be created.

1.3.3 Installation of the PTC-II as Standard-Modem

Click on **Desktop→My Computer→Control Panel→Hardware** to start the hardware assistant:



Now click on "Next".

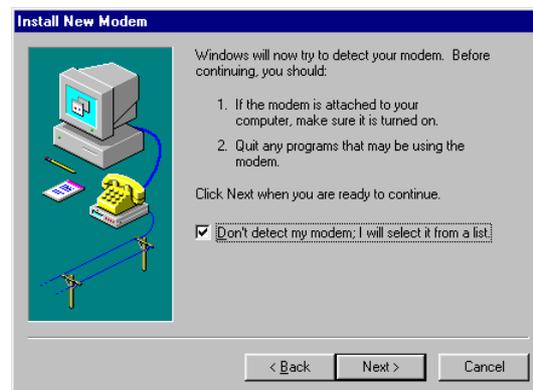
The following window appears:



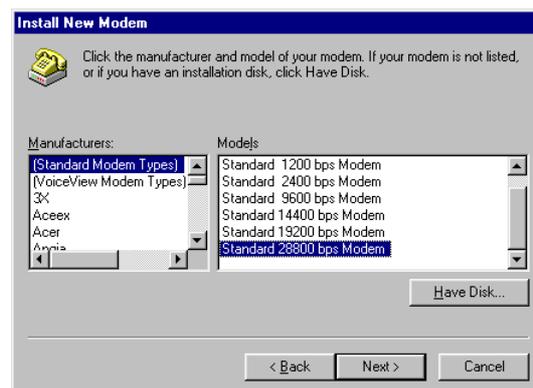
Click on “No”, to disable the automatic hardware recognition and afterwards on “Next”.



Choose “Modem” and click on “Next”.

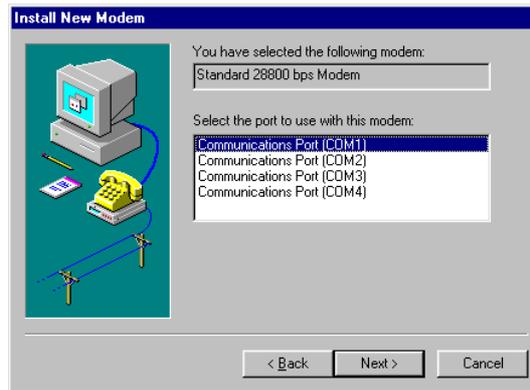


Tick “Select Modem”, to disable the automatic modem recognition, afterwards click “Next”.



Select the manufacturer “Standard modem types” and “Standard 28800-bps-Modem” as model. Then click on “Next”.

The hardware assistant asks you for the COM-port (serial port), on which the new modem (Standard-Modem PTC-II) shall be operated. Choose the COM port where you want to operate the PTC-II from:



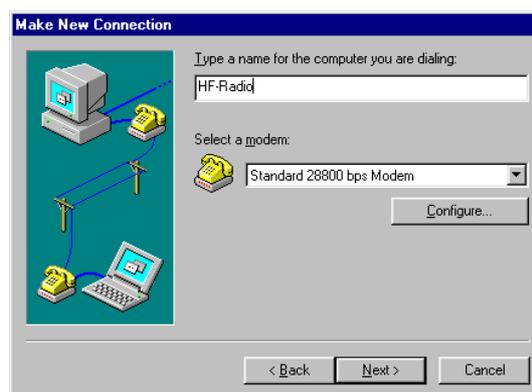
Click on “Next”. Now the installation of the new modem is completed.

1.3.4 Set-up of the Dial-up Network for the operation with the PTC-II

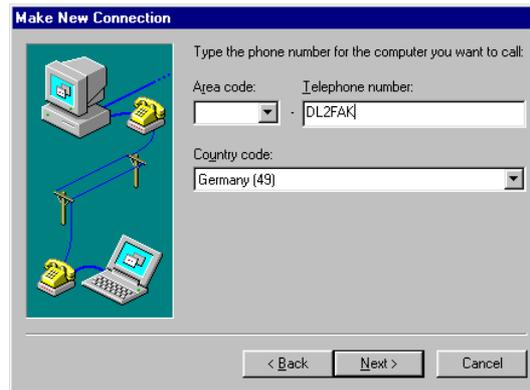
Open the Dial-up Network by clicking on **Desktop→My Computer→Dialup-Network**. To generate a new icon for a new connection, double-click at “Make New Connection”.



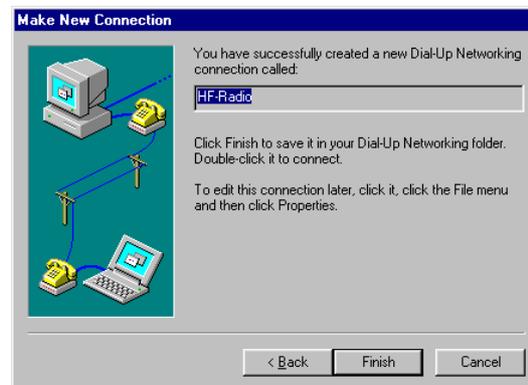
The first configuration window of the Dial-up Network appears:



Enter a name of your choice for the new connection, e. g. “HF-Radio”, and select the recently installed “Standard-28800-bps-Modem” as modem for the new connection. Afterwards click on “Continue”. It appears:



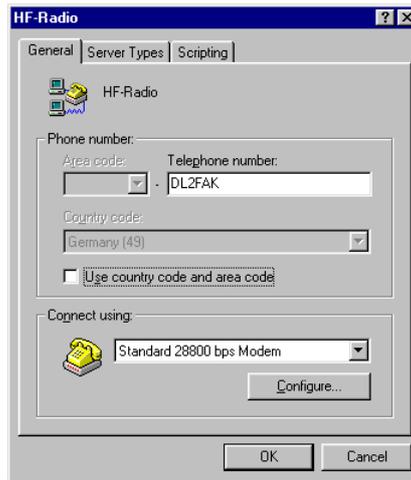
Enter the callsign of the service-provider (the coast-station), which you usually want to contact using the new connect, as a phone-number e. g. "DL2FAK". Area code and the country pre-dial can remain unchanged. (Normally, these settings are not used for contacts via the HF-Modem).



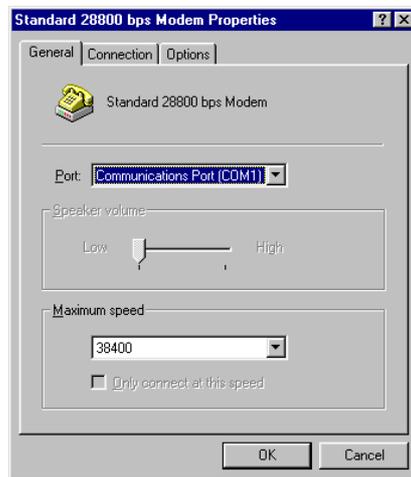
With this, the set-up of a new connect in the Dial-up Networking is completed. The new entry should now appear in the window of the Dial-Up Networking:



Now you still need to configure the new entry in the Dial-Up Networking, which means that some protocol adjustments need to be performed to achieve full compatibility to the PTC-II and your service provider. Click on the new entry using the right mouse-button, e. g. "HF-Radio" in the Dial-Up Networking. A small pull-down menu appears with the entry "Properties" at the lower end. Click on this entry and the following window appears:

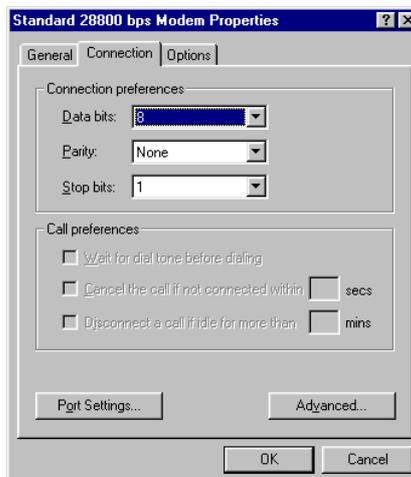


Remove the selection at “Use country code and area code...”, by clicking on it once. Then click on “Configure”.



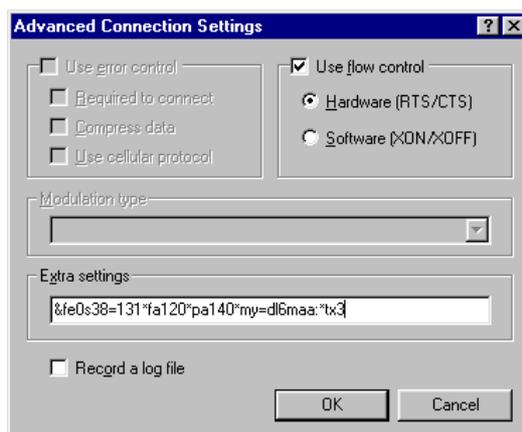
In the window that appears now, there is usually no subject to change. Click on “Settings” to reach the next configuration window.

Also here there is nothing to change. Click on “Port Settings” to reach more possibilities for



configuration.

This window “Advanced Connection Settings” is **very important** and you should ensure that all settings here are done properly and are correct. Tick the box “Dataflow-control” and make



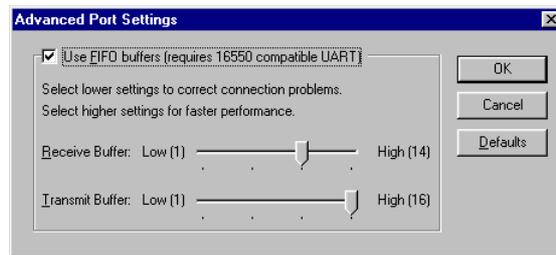
it active. Select “Hardware” by clicking on it once. You can disable the item “Record a log file”. The main configuration takes place by using a somewhat cryptic command-string, which has to be entered in the field “Extended Settings”. If a mistake happens here, then the PTC-II will not be able to connect the base-station via HF. The commands to be entered here depend mainly on the settings necessary for specific transceivers (e.g. audio output level or transmit delay time). A list of the possible commands can be found in the description of the so-called “Hayes-Mode” for the PTC-II in section 1.2.7 of this documentation. Only Hayes-compatible commands are allowed in the command line, otherwise Windows will not be able to control the modem correctly.

As the first command in the command-line **&f** is recommended, as it resets the PTC-modem to proper initial conditions. Afterwards the command **e0** can follow. This command disables the command-echo of the PTC-II. The command ***myXYZ** must appear in any case. With this, the PTC-II is provided with your (sea-)callsign. (Replace XYZ with your true callsign. In the case that more commands follow, then enter a colon after your callsign, e. g. XYZ:) Without this physical address, the PTC-II denies acceptance of connects as well as establishment of a connect to a distant station. Another very important setting is that concerning the S-register 38. With this, the PPP and TCP/IP protocol properties of the PTC-II are set. The minimum required setting for “Internet via HF-Radio” is **s38=1**. With this setting, the modem will be configured for PACTOR-IP-Bridge-connections. If in addition you want to browse in the WWW, or want to work with other Internet applications which use “names” (e. g. <http://www.scs-ptc.com>) instead of normal Internet addresses (e. g. 216.157.3.72), you also need to enable the protocol UDP via PACTOR. In this case you should choose the setting **s38=129**. If your service-provider is equipped with encrypted PACTOR-II, then you have to add 2 to the value of the S38-register, which means that you enter **s38=3** or **s38=131** in the command-line. If you don’t use data-encryption and try to connect to a service provider which utilizes data-encryption (or vice versa), the **connection cannot be established!** The transmission-levels (the tone-signals from the PTC-II, which are sent to the transceiver) can be adjusted with two commands: ***faXYZ** sets the value for FSK-transmissions. In PACTOR-II-mode only the link establishment is performed in this mode to achieve compatibility with the older PACTOR-I mode. A reasonable value for the ***fa**-value is around 1.5 to 2 times of the ***pa**-value. This one is to be set with the ***paXYZ** command, and controls the level for the PSK-transmissions, used for the PACTOR-II mode. The best value for both settings (to achieve best quality of the transmitted signal) is dependent on the transceiver that is being used. A pair of common values which works well on many transceivers is: ***pa240*fa120**.

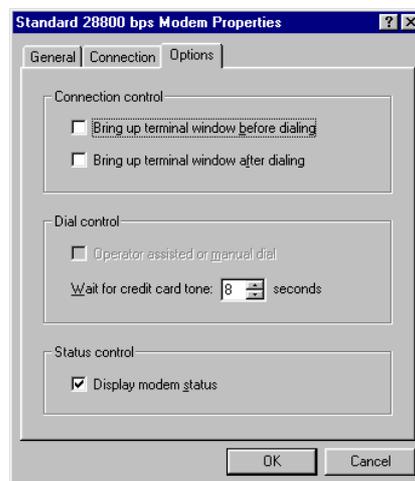
If you do not have information to the contrary for your transceiver, then type and enter the following command line: **&fe0*myXYZ:s38=129*pa240*fa120**. XYZ needs to be replaced by your callsign!

After having entered the command line, you can continue by clicking on OK, which brings you back to the last window. By clicking on “Connection” you reach the following window:

Usually you need to change nothing here as all modern PC's use FIFO's automatically. So keep the FIFO usage selected.

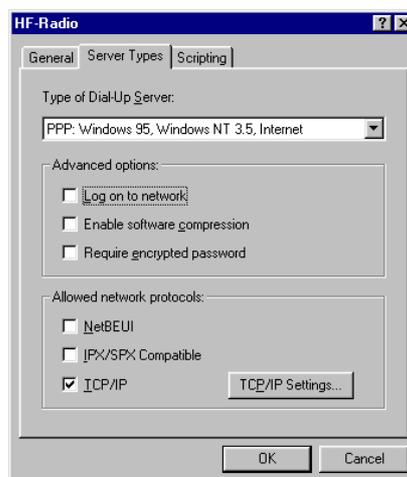


Click on OK, which brings you back to the previous window. Now click on “Options” to verify the settings:



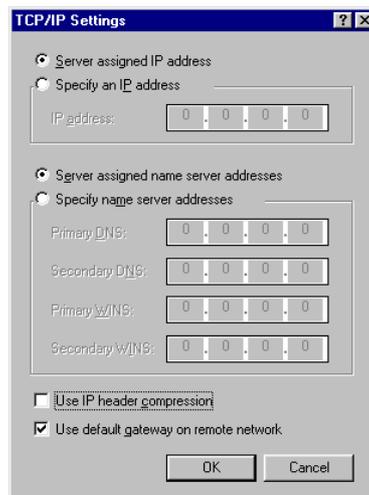
Also here there is usually no change required, so click on “OK” again to restore the main configuration window:

Now click on “Server Types“. Deselect everything except TCP/IP. If TCP/IP is not existent,



you need to install the TCP/IP protocol in the network (see above). As ”Type of Dial-Up-Server“ choose “PPP: Internet, Windows NT Server, Windows 95“ or a similar entry. In any case the entry should have the key-word “PPP” for “Point-to-Point-Protocol”.

To configure the TCP/IP protocol in detail click on “TCP/IP Settings“.



We recommend the configuration as shown above. Especially the selection of “Use default gateway on remote network” is very important to let Windows know, that all Internet requests to the outside have to be performed using the PTC-II and that PACTOR-IP-Bridge should take command.

Click on “OK” to go back to the previous window. Click on “OK” again to finish the configuration of “Dial-up Networking”.

1.3.5 Setting up a link to the service provider

Your computer is now ready to establish the first link to your HF service provider. Connect the PTC-II to the serial COM-port of the computer using a standard serial cable. Be sure that you use the same serial port you entered in the installation above.

For the connection between the PTC-II and the transceiver you need a special cable. Your service-provider or radio-shop will help you to configure the cable. If you want to make the cable by yourself, then refer to the “red book” manual of the PTC-II for details.

Now set the transceiver to the frequency where the base-station of your service provider is operating. Double-click on the new created icon in the “Dial-up Networking” e. g. “HF-Radio”. A window for the link establishment appears, where you are requested to enter the user-name and the password. Use and enter the values your service provider gave you. Select “Save password” so that you do not need to enter the password again each time you try to connect. The password is saved only after the connection has been successfully established.



Now click on “Connect” to start the connection to your service provider. The connect window closes automatically as soon as the link is established and a symbol is inserted in the task-line of Windows. If the link closes down again after some seconds, then the service provider does not accept your user details. If the connect remains, the PACTOR-IP-Bridge is ready to be used for Internet applications. You can now send and receive emails, start a web-browser or transfer files via FTP. You can shut down the connection at any time by double-clicking on the symbol in the task-line and then select “Disconnect”.

1.3.6 Configuring a (SuSE) Linux-Host for PIB operation

In order to configure a Linux-Host for PIB operation, you should be generally familiar with the Linux operating system and the basics of TCP/IP and PPP. Since the PTC-II behaves like an ordinary “telephone modem” and additionally takes over the complete PPP protocol, the configuration is straight forward and can be accomplished by using only the standard components provided by Linux. Make sure that you have loaded the special HOST VERSION of the PIB firmware into the PTC-II before starting the Linux configuration.

1.3.6.1 Configuring the MGETTY daemon

The configuration file for the MGETTY daemon can be found in the directory **/etc/mgetty+sendfax**. The usual file name is “mgetty.config”. MGETTY handles the basic Hayes compatible communication between a modem and Linux. For PIB configuration, mgetty.config should contain at least the following lines:

```
speed 38400
port ttyS0
data-only y
init-chat "" \d\d\d+++ \d\d\dAT&fe0*myXYZ:s38=131 OK
modem-type data
toggle-dtr yes
```

The first line assigns the baudrate on the RS-232 port. The second line assigns the serial port 0 (same as COM1 on Windows systems).

The “init-chat” line allows full configuration of the PTC-II modem itself. The Hayes compatible commands following the “AT” are sent to the modem every time MGETTY restarts, i.e. during the Linux boot process and every time a PACTOR-II connection is finished. Replace XYZ with your true station callsign. Modify the setting of register S38 in accordance with the requirements of your station – s38=131 is the basic setting for encrypted PACTOR-II operation and UDP-support. Add the commands *pa and *fa to achieve appropriate audio transmit levels for your transceiver, etc.

1.3.6.2 Configuring the PPPD (PPP daemon)

The configuration file for the PPP daemon can be found in the directory **/etc/ppp**. The usual file name is “options”. PPPD handles the “Point-to-Point-Protocol” between a “peer” (the PTC-II modem behaves like a “peer”) and Linux. For PIB configuration “options” should contain at least the following lines:

```
192.168.100.1:192.168.100.2
ms-dns 192.168.100.10
ms-dns 192.168.100.11
ms-wins 192.168.100.12
ms-wins 192.168.100.13
lock
require-pap
crtscts
```

The first line contains the IP-Address of the Linux host itself as well as the IP-Address Linux will assign to the PTC-II during (PACTOR) link establishment, separated by a colon. The PTC-II modem running at the host-side (using host firmware and being connected from outside) ALWAYS asks the (Linux) PC for assignment of ALL negotiable IP-Addresses, i.e. “his” IP-Address and the IP-Addresses of the primary and secondary DNS servers and WINS servers. Additionally, the PTC-II modem always wants to know the IP-Address of the (Linux) host it is connected to.

Modify these 6 IP-Addresses in accordance with the requirements of your system. The IP-Addresses above are only examples! Avoid conflicts with other TCP/IP services running on your Linux server using the same addresses. Be aware that these addresses may be used for direct access to the Internet when TCP/IP segments from the PTC-II are directly routed to a port connected with the Internet (e.g. an additional ISDN-port). Especially the address that is assigned to the PTC usually must be exchanged with the address that the “real” ISP (e.g. via ISDN) has assigned to the Linux Host. More advanced topics dealing with routing and appropriate translation of IP-Addresses (“Masquerading”) can be found in various text books about Linux and are beyond the scope of this introductory configuration manual.

The line “require-pap” tells the PPPD that it should ask the caller for Authentication using the “Password-Authentication-Protocol”. The host PTC-II ALWAYS assumes that the (Linux) PC will ask “him” for “his” User-ID and Password. Both strings are sent to the host PTC-II via the physical PACTOR-link from the client side right after link establishment. Make sure that the file “pap-secrets” in the directory `\etc\ppp` contains appropriate entries.

1.3.7 Limitations on Host/Server side

The “normal” Professional firmware (“client/user firmware”) only establishes a PPP-connect to the PC, when the call is initiated by itself. If a PTC-II(e) with client firmware receives a PACTOR-call from outside, then no PPP-connect to the PC will be made, thus a PACTOR-IP-Bridge connection is not possible. If you want to offer an HF-radio Internet service, you need the special host-version of the Professional firmware. Please also see section 3 of this manual.

1.4 The PACTOR Free Signal Protocol (PFSP) and its Use

1.4.1 Introduction

When trying to make a PACTOR link, a number of essential parameters must be set up, under extremely unfavorable signal conditions, in a short time and with high precision. These include the present frequency offset between the two SSB transceivers taking part, the exact time frame (to within 1 msec), the sideband in use (USB, LSB), and considerably more. This must also take place highly selectively: When radio station XYZ is called, then ONLY station XYZ must answer. PACTOR-II with "Memory-ARQ in Progress" offers a very high reliability when making a link, under the condition that no "multiple user access" is attempted - i.e. a number of service users (clients), call simultaneously on the same channel for a link to the server (host), and therefore interfere with each other. This can cause problems when using popular mailboxes or "E-mail hosts", where the collision probability is high, and can degrade the performance of the system considerably.

There can be various causes for collisions:

- a) The calling clients cannot hear each other.
- b) During an existing link, a client does not hear that a link is in progress due to local interference or a deep fade, and begins his call.
- c) During an existing and audible link, a client starts calling due to lack of experience, training or care.

Whilst point c) can be minimized by the appropriate training, coupled with possible sanctions against the appropriate user(s), points a) and b) remain. These cannot be minimized by any sort of training. A technical solution is also not possible, (such as automatic blocking of a call when a client modem sees that a link is already in progress).

In order to minimize the danger of collision on highly frequented channels and also to allow a fast and reliable link to be made, a new method of initiating a link is required. The PTC-II offers the so-called PACTOR Free Signal for this purpose.

1.4.2 The Advantages of the PACTOR Free Signal Protocol

The basic idea behind the "Free Signal" (FS) is that the host (e.g. a maritime coast station), advises all clients that at present there is no link in operation i.e. it is free, by transmitting an often repeated special signal. Clients hearing this signal may call. This method has long been employed by SITOR coast stations, only however using the duplex system. In this case, one channel is used for the FS, the other one is available for initiating the link. This simple "protocol" is neither economical of frequency usage, nor particularly good in minimizing collisions. For a half-duplex link, two channels are occupied, and there is still a considerable danger of collision. When the FS has not been sent for a longer period (e.g. due to a link in progress), it is highly probable that as soon as the FS is transmitted, a number of clients will call simultaneously. They have been virtually "synchronized" by the FS. The collision probability in this case is still dependent on the actual number of users, but in any event, can be unacceptably high.

The PACTOR Free Signal Protocol resolves both weak points of the usual FS and offers additional advantages:

- Only one simplex channel is required. The PACTOR FS is an integrated part of the link initiation protocol. The actual link initiation thus remains, despite limitation to one channel, very fast and reliable. The utilization of the single channel is very good.
- The client obtains from the host continuously updated information on the present channel loading by means of "service data" scattered within the signal. This information is combined within a switching algorithm in the client PTC, leading to a virtual disappearance of the "synchronization effect" mentioned above. The collision probability, now virtually independent of host loading, has been reduced to less than 1 percent. Even in the event of a collision, the PACTOR FS protocol offers a very high data integrity - data corruption is practically impossible. (The link initiation must only be repeated, no data will be corrupted or sent out in the (rare) case of PFSP collisions.)
- The FS contains the identity code of the host system. The client PTC can automatically determine the identity of the host from this signal. The user does not need to manually type a new identity code in order to make a link to a (possibly unknown) new host. It is only necessary in emergency, to give the frequency in order to choose a host. (Roaming between service-providers is possible).
- Because the FS is transmitted on the same frequency the actual link takes place on, the signal quality of the FS can be used to judge the expected quality of any possible link. The client is continually informed as to whether access to the host is possible or not. Advanced client PC software can use this information, for example, to determine the best time of day for linking to a particular host. The knowledge that a host is presently able to be reached with good link quality can be a considerable safety aspect, especially for small ships.

In short, it allows a practically collision-free, automatic access to a host, together with a relatively short average access time. Special training or instruction of the user to reduce collisions is no longer required.

1.4.3 Format and Robustness of the PACTOR Free Signal

The PACTOR FS is 0.88 sec long and is sent in 100 Bd FSK with a shift of 200 Hz. It sounds similar to the usual PACTOR connect packet. The time between FS transmissions can be set by the host. The client PTC can read the PACTOR FS by means of a new, **SCS** developed, coding method known as "Distance Spreading", in combination with "Memory-ARQ in progress" down to approximately -20 dB SNR in a 4 kHz noise bandwidth. The link initiation takes place with great reliability using the PACTOR FSP at the minimum SNR required by PACTOR-II of -18 dB in a 4 kHz noise bandwidth.

1.4.4 The Commands for Using the PACTOR Free Signal Protocol

1.4.4.1 Terminal Mode

The command **FRee** is available in terminal mode for configuring and using the PFSP. Entering this command without an argument causes the PTC to output a short help text to the computer terminal. (This is the identical text called up by using the **Help FRee** command).

The individual functions of the FRee command can be chosen using a function abbreviation as the first argument, e.g. **FRee MOde**. As is usual in describing commands or function codes for the PTC-II, only the letters written in capitals need to be typed. Instead of **FREE MODE**, the abbreviated **FR MO** can be used. If no other parameter is given, the PTC displays the present value for that function.

The following functions are available:

1.4.4.1.1 FRee MOde (0-1, default setting: 0)

This function can be called the "main switch" for using the PFSP. The FRee MOde command allows one to switch between the normal function, (where links are initiated using the usual PACTOR system), or the PACTOR FSP client mode. The client mode must be enabled so that an FS can be received, or to be able to connect to a host which is using the PFSP.

The PFSP-client mode is activated as follows:

cmd: FRee MOde 1 <Enter>.

(It is de-activated, with

cmd: FRee MOde 0 <Enter>.

returning the PTC to its normal operation.)

The display switches from **---STBY---** to **NO HOST**. The PTC waits for a valid FS according to the PFSP standard.

As soon as a valid FS is found, the display shows **XYZ AVL**. XYZ is the "FRee IDent"-code of the received FS and the distant Host (transmitting the FS), respectively. On the extreme right of the display is shown a larger or smaller "triangle". This displays the quality of the FS reception, (similar to many GSM mobile telephones), and is an indicator of how good a potential link to the host would be.

IMPORTANT: Only FS whose identification code agrees with that set using the "FRee IDent" command is used in the signal quality estimation, as **ONLY** the host whose ID in the FS agrees with the "Free IDent" parameter can actually be "connected" to. The function and use of the "FRee-IDent" parameter is explained in the commands "FRee IDent" and "FRee AUto".

XYZ AVL means logically "HOST AVAILABLE", i.e. that the host is free, and that if a link is wished for, it would be quickly established. Under these conditions, the PTC-II's Idle-LED or the Traffic/CD-LED (green) on the PTC-IIe is lit.

If the host is occupied, then the display shows **XYZ BSY**, which logically enough means "HOST BUSY". If a link is wished for under these conditions, it would only be carried out when the host is free again. The Traffic-LED on the PTC-II or the Error/RQ-LED (red) on the PTC-IIe is lit.

How one goes about actually calling for a link is explained below. The host status ("AVL", "BSY", etc.) can be ascertained using the command "**Free Status**" (see below). This is required especially for the PTC-IIe.

The **Free Mode** parameter cannot be changed during an existing PACTOR link.

The scanner is stopped in PFSP-client mode.

1.4.4.1.2 Free Ident

(HOSTID, 3-8 places/alpha-numeric. Default: MAILHOST)

The FS from the host contains the identification code of the host. Different service providers use different codes, so that even when simultaneous reception of multiple hosts takes place, a special host can be selectively chosen. Usually, the client PTC can extract the host identification code from every complete (error-free) FS received. This is automatically written into the **Free Ident** parameter. (The **Free Auto** parameter must be set to 1 for this to occur, see below). For the automatic processing and acceptance of the identification code of the host, an approximately 6 dB greater minimum signal/noise ratio is required than when a link initialization is made to a station whose ident code is known through its FS. (Noise also means interfering signals.) In practice this means that if the automatic host identification is not required, then **Free Auto** (see below) should be set to 0, and the ident code of the required host manually entered with the **Free Ident** command. This needs only to be carried out once. This ident code is given to users of a service by the respective service provider(s). Usually this is the international short wave callsign of the radio station.

If special client software, configured by the service provider is used, this usually configures **Free Ident** and **Free Auto** correctly. The end user only needs to set the correct frequency for the appropriate service provider's allocated channel.

1.4.4.1.3 FRee SStatus

Shows the status of a presently received host. If a valid FS is detected, (one whose ID agrees with the **FRee IDent** parameter), then the PTC gives out the following message (when in PFSP client-mode):

```
HOST STATUS REPORT
-----

HOST NAME: MAILHOST

ESTIMATED HOST ACCESS TIME: 4 SECONDS - IF AVAILABLE

HOST STATE: AVAILABLE

ESTIMATED LINK QUALITY: 5 (VERY GOOD)
```

The "HOST NAME" is that of the present **FRee IDent** parameter, and is thus identical to the ident code of the host presently available for a link. The **FRee IDent** parameter is either input from the user [or the program being used], or if **FRee AUto** is set to 1 and the FS is clear enough, then the **FRee IDent** parameter is extracted automatically.

The "ESTIMATED HOST ACCESS TIME" gives the average time required for a link to be set up between client and host, after the client initiates the call. This time depends on how busy the host has been within the last hours, or presently was/is. The calculation of this time takes place using a relatively complex mathematical model in the client PTC. It is however continuously updated through "service data" scattered within the FS by the host. The adjustment of the average access time to the situation on the channel is the key to the very low probability of collision mentioned before. This is so, even with very busy hosts. It is the heart of the so-called "Link Randomizing" and sets how quickly (on average) the client could use an FS for link initialization, by acknowledging with its own transmission.

The "HOST STATE" shows if the host is presently "AVAILABLE" or "BUSY", and is the same as the PTC-II display "HOST AVL" or "HOST BSY".

The "ESTIMATED LINK QUALITY" gives the estimated quality of a potential link to the host, gauged from the received FS. This mirrors the quality estimation shown by the "triangle" on the extreme right of the PTC-II display. The values range from 0-5, with the following ratings:

0:	CRITICAL	link virtually impossible
1:	VERY POOR	very low data transfer rate expected
2:	POOR	low data transfer rate expected
3:	MEDIUM	medium data transfer rate expected
4:	GOOD	high data transfer rate expected
5:	VERY GOOD	very high data transfer rate expected

The actual link quality is of course influenced by the antenna system and transmitter power of the client, as well as other external factors. The value displayed should only to be used as a guide, and must be combined with practical experience.

1.4.4.1.4 FRee AUto

(0-1, default: 1)

The "**FRee AUto**" 0/1 parameter de-activates or activates the automatic host identification. When activated, the PTC extracts the host identification from every correctly received FS, and stores this in the "**FRee IDent**" parameter. As soon as the host ident code is transferred, it is possible to request a link. The quality estimate of a potential link is then also with reference to this particular host. (Also see the commands "**FRee IDent**", "**FRee SStatus**" as well as "**FRee MDe**").

1.4.4.2 Hostmode

Basically, the same four commands are available for hostmode, as for terminal mode. The command and function abbreviations have however been adjusted to suit the hostmode and are thus reduced to only two bytes each. The usual hostmode conventions are valid.

The following command strings are possible:

FM (0-1, default: 0)

Analogous to **FRee MDe** in terminal mode.

FI (HOSTID, 3-8 figure/alphanumeric, default: MAILHOST)

Analogous to **FRee IDent** in terminal mode.

FS Analogous to "FRee SStatus" in terminal mode, however the status information is given in a hostmode compatible, compressed form, as a null terminated string. The string always contains 5 values, separated by a space character. E.g.:

2 18 0 5 MAILHOST

The meanings of these values:

1. Value: 0 = "NO HOST", i.e. no valid FS found to date. In this case, the four remaining values are without meaning and contain invalid information.
1 = "HOST BUSY".
2 = "HOST AVAILABLE"
2. Value: Gives the "ESTIMATED ACCESS TIME" in seconds
3. Value: The time-span in seconds, where no valid FS has been received since the last valid FS.
4. Value: Gives the "ESTIMATED LINK QUALITY" from 0 to 5.
5. Value: Gives the "HOST NAME", and therefore the present "FRee IDent" parameter.

FA (0-1, default: 1)

Analogous to **FRee AUto** in terminal mode.

1.4.5 Requesting a Link to the Present Host System

1.4.5.1 Terminal Mode

The PFSP runs essentially on the "physical" link level. It is thus ordered above the actual PACTOR link, so that on the user level (and for PC software) it is virtually transparent, and only a slight difference to the "normal" operation can be noted.

The client can start a link to a host with the usual "Connect" command. As, however, only a link to the host whose FS ident code agrees with the "FRee IDent" parameter of the client PTC is possible, the client **MUST NOT GIVE A CALLSIGN AS ARGUMENT** with the connect command. In practice, the PTC in PFSP client-mode, ignores the callsign as argument in a connect command. In terminal mode, the link initiation runs approximately so:

The user (or the PC software) sends a connect command to the PTC:

cmd: c <Enter>.

The PTC answers this command with the message:

```
*** ACCESS TO HOST MAILHOST IN PROGRESS
```

"MAILHOST" would here contain the wanted ident code, i.e. the name of the host that one has chosen with the **FRee IDent** parameter, and hopefully also whose FS is presently being received. (As usual, the client PTC leaves the command mode after the connect command. If further commands are required, they must be prefixed by an ESC character. The link request can be broken off with ESC D <Enter>).

When the host is "AVAILABLE", i.e. is sending its FS, the clients link request, dependent on the present "HOST ACCESS TIME", is accepted within a few seconds (in extreme circumstances a maximum of a few minutes) and a link is made to the host. As soon as the physical link is in place, the client PTC gives the message:

```
*** HOST LINKED - .... [Baud rate and time/date]
```

The link is now a completely normal PACTOR link, client and host exchange their actual callsigns (MYcall). As soon as client and host have identified themselves on this level, the connect message is given (as it is usual PACTOR practice):

```
*** CONNECTED TO DX0HST
```

(The host in this case having the "MYcall" of DX0HST. This has absolutely **NOTHING** to do with its FS ident code, required for the physical link initiation).

1.4.5.2 Hostmode

In hostmode, the link to a PFSP host is also started with a "C" command. As, however, a "C" command without argument in hostmode, brings the message "CHANNEL NOT CONNEC-

TED" (if no link is in progress), it is required that the "C" command be accompanied with some sort of argument. E.g.

cmd: C HOST <Enter>.

Everything else runs identical to the link initiation in terminal mode, except for the messages ***ACCESS TO... and *** HOST LINKED..., which are not given.

1.4.5.3 Hayes-compatible Mode

If the PTC-II operates in Hayes-compatible mode, link initiation via PFSP can be performed using the standard ATDP (or ATDT) commands for starting a call. The CONNECT message has the standard format, e.g. CONNECT DX0HST if DX0HST is the "MYCall" of the station that has been called. The argument of the ATDP (or ATDT) command is arbitrary (it is tossed) but must follow the rules of callsign arguments (alphanumeric, max. length 8). For more information see description of ATDT and ATDP commands as well as Hayes-compatible mode in general.

1.4.5.4 Link Initiation in Emergencies

In order to ensure fast access to the host with highest priority, a Connect command (or ATDP, ATDT command in Hayes-compatible mode) with the character "+" (PLUS) as argument must be given. E.g.:

cmd: C + <Enter>.

This is equally valid for terminal mode as well as hostmode and the Hayes-compatible mode. In case of an emergency call, the client PTC does not check the "HOST ACCESS TIME", instead it acknowledges the very next received FS, and therefore forces an immediate link, without consideration of other clients.

IMPORTANT: This "Emergency Connect" must only be used in exceptional circumstances, otherwise the collision danger, despite PFSP, is considerably increased. Improper usage of this emergency connect facility can lead to exclusion from a service.

1.5 Robuster Protocol for the Link Initiation ("Robust Connect")

The usual procedure for the PACTOR link initiation is based, for compatibility, on the so-called "Level-I connect", i.e. on PACTOR-I. Even though the relatively high performance of the PTC-II hardware allows more advanced techniques for the processing of very weak signals during the link initiation ("Memory-ARQ in progress / in advance"), the "older" method works reliably "only" down to around -15 dB @ 4 kHz. As PACTOR-II can reliably transfer data down to approximately -18 dB @ 4 kHz, the "Level-I connect" leaves a sort of connect "step" of about 3 dB: In order to successfully make a link, a markedly better signal is required than for maintaining an already existing PACTOR-II contact. Also, due to the Memory-ARQ technique, a weak signal needs considerably more time before a link is established - every decibel gain in robustness, accelerates the link initiation.

The new protocol for link initiation ("Robust Connect") uses a complex coding, developed by **SCS**, called Distance Spreading. It can produce a fast, reliable link, down to around -20 dB @ 4 kHz. The performance of the PACTOR-II protocol can now be fully utilized under all conditions. Incorrect links, due to very similar callsigns under very weak signal conditions, or by trying for a connect on an already occupied channel, are impossible when using the new protocol.

The Professional firmware allows both connect variants to be used. The correct protocol can be automatically chosen by the receiving station, or limited to one particular variant. If connect acceptance is limited to (let us say) the "Robust Connect", then all users of PACTOR-I are excluded from access. This can be an advantage with the newer throughput optimized networks or services. The choice of the receiver accepted connect variants (in the STBY condition) is made with the **CONType** command.

1.5.1 The CONType Command

(0-3, default: 3)

The CONType-command in the cmd:-menu defines which connect variant is accepted by the PTC-II in the receive condition, and thus leads to a link initiation. The argument value 0 to 3 have the following functions:

- 0: No connect is accepted. No link can be initiated "from outside".
- 1: Only the usual PACTOR-I connects (auto-protocol choice PACTOR-I and PACTOR-II) are accepted.
- 2: Only "Robust connects" (new protocol for the link initiation) are accepted.
- 3: All connect variants are accepted.

1.5.2 Starting a Link with the "Robust Connect" Protocol

A "Robust Connect" can be made using the usual connect command, in a similar way to the "longpath connect", by using a % character ("Robust Connect Operator") as prefix to the call-sign.

cmd: C %DL6MAA <Enter>.

Starts a call to DL6MAA using the "Robust Connect" protocol.

"Robust Connects" are at present **only** allowed within the normal PACTOR time frame (i.e. **not** in the longpath mode). A combination of the longpath operator ("!") and the "Robust Connect" operator ("%") is not possible. (E.g. the commands "C !%DL6MAA <Enter>" or "C %!DL6MAA <Enter>" are **not** allowed).

1.6 Support of CCIR 491 Numerical Selcals for SITOR

The CCIR recommendation 491 introduced 4- and 5-figure numerical selcals for SITOR. The Professional firmware supports this convention, and translates the 4- and 5-figure numerical selcals automatically into the appropriate 4-letter selcals. This takes place for the MYSelcal as well as the selcal for a connect command.

Examples:

```
cmd: MYS 01234 <Enter>.
```

Sets ones own SITOR-address to 01234.

```
cmd: CONNECT 12345 <Enter>.
```

Starts a SITOR call for station 12345.

Many coastal radio stations now work using the CCIR 491 recommendation. Automatic translation of the letter selcals eases access to these stations.

1.7 WRU Recognition and Answerback Function

Practically all SITOR coastal stations require the identification information of the calling station. This is obtained automatically by the coast station sending a WRU ("Who aRe yoU") character. This character has been generally defined as the "\$"-character. As soon as an "\$" is received at a station, it must send a previously defined identification text back to the coast station in order to identify itself. The form of this identification text, known as an "Answerback" differs between coast stations, and in the Professional firmware, it may be set with help of the ANSwer command.

1.7.1 The ANSwer Command

The ANSwer command allows an up to 255 character long SITOR "Answerback" text to be defined.

Example:

```
cmd: ANS This is DL6MAA <Enter>.
```

sets the "Answerback" string to "This is DL6MAA".

Default: SITOR/PTC-II.

2. Licensing the Professional Firmware

The Professional firmware is offered as shareware. Twenty free PACTOR links are allowed, where the various special features of the Professional firmware can be evaluated. After this period, the firmware must be licensed if one wishes to continue using it. If there is no further interest, the normal amateur firmware can be loaded into the PTC-II again.

After the testing phase is finished (20 links), the transmit function (PTT) as well as the audio output is disabled. Hence no more PACTOR links can be established!

Before you load the unlicensed Professional firmware into your PTC-II, make SURE that you have got a standard firmware (“Amateur firmware”) which can be reloaded into the PTC-II after the Professional firmware has expired!

The licensing is performed by using the 16-digit serial number (in case of all PTC-IIpro and PTC-IIe manufactured in 2002 - in this case there must be an **SCS** serial number label on the bottom side of PTC-II housing) or the PACTOR MYCALL, and the LICENSE command. As usual, the own amateur radio or maritime callsign has to be defined as MYCALL before one can initiate a link. This callsign serves (for example) as identification for a coastal radio station.

The PTC-IIpro does ONLY accept licenses based on the serial number! Please do not order a MYCALL license if you own a PTC-IIpro!

A licensed Professional firmware only allows a maximum of TWO different callsigns that have to be specifically licensed by **SCS** as MYCALL. All non-licensed callsigns are rejected by the MYcall command!

The MYCALL constraint/restriction does not apply in case of serial number licenses.

The license code MUST be ordered ONLINE through the licensing form on our secured server (Web store) at <http://www.scs-ptc.com>. Please do not send E-mail or letters requesting for the license code!

For licensing, fill in the serial number or 1 to (generally) 2 callsigns, respectively, your E-mail address as well as your billing / credit card information. Then you will receive your 12-letter license code as a reply via E-mail. (See the online-price list for the actual retail price. As of May 2002, the price is: 149,- USD.)

The actual licensing of the Professional firmware takes place by typing in the LICENSE command, the serial number or callsign(s) to be licensed, and then the appropriate letter string as argument.

Example of serial number license:

```
cmd: LICENSE 8102B04000EDE363 QIVCFWTERCAY <Enter>.
```

Example of MYCALL license:

```
cmd: LICENSE DL2FAK DL3FCJ QIVCFWTERCAY <Enter>.
```

(Note: The letter string given in the above examples is invalid!)

Alternatively you can simply send the license file you got from **SCS** to the PTC-II through a terminal program. The file contains the appropriate licensing command.

If the licensing is correct and accepted by the PTC-II, it answers with OK. If an incorrect or invalid input is given, it answers NOT OK.

In the example given above, after being successfully licensed, the callsigns DL2FAK or DL3FCJ may be chosen with the MYcall command, and defined as MYCALL. After licensing, the Professional firmware can be used with these three callsigns without any further restrictions.

Entering the LICENSE command without argument yields a list of the licensed callsigns.

The license remains valid for at least one update of the Professional firmware.

3. Host-Version of the Professional Firmware

The Professional firmware with PFSP server function and PACTOR-IP-Bridge host function is only given on a licensed basis to special customers. If you are considering to operate a PACTOR-IP-Bridge (HF-radio Internet service provider) service and/or PFSP-host, please contact **SCS** by letter, fax or E-mail.

3.1 PACTOR-IP-Bridge, Host-Version

The host-version of the Professional firmware provides, in contrast to the "normal" client-version, full PPP-capability when a connect is initiated by a remote PACTOR system (client). The host-version is required if you want to provide an HF-radio Internet service based on the PACTOR-IP-Bridge. It must be installed on the Host/Server-PTC-II(s). Of course, clients/users only need the conventional ("normal") client-version of the Professional firmware for accessing a PACTOR-IP-Bridge Internet service.

3.2 Additional PFSP-Functions of the FRee command

3.2.1 Terminal mode

3.2.1.1 FRee MOde

(0-2, default: 0)

The expansion of the **FRee MOde** parameter of 0-2 allows activation of the PFSP Host-operation. As soon as the parameter is changed to 2, the PTC-II starts continuously sending out the FS and waits for a client to call. The ident code of the FS must be set before the start of the FS transmission, using the **FRee IDent** parameter. The host **MYcall** parameter must also have been set with the **MYcall** command. The PTC display shows **TX FREESIG** when in PSFP host operation. The Send-LED is continuously lit. The Traffic-LED is only lit when the transmitter is actually active. The scattering of "service data" within the FS is indicated by the display showing **TX SERVICE**. The CW-ID (if activated - see below), is indicated with **TX CW-ID**.

A connect command is ignored in PFSP Host-operation. As soon as a client obtains a link to the host, the host gives the message :

```
*** CONNECTED TO CALLSIG
```

"CALLSIG" here is the callsign that has been defined in the client PTC as "MYcall".

The scanner is de-activated during PFSP Host-operation.

The **FRee MOde** parameter can be reset to 0 when no PACTOR link is in operation. This ends the PFSP Host-operation and the FS transmission.

3.2.1.2 FRee DUty

(0-9, default: 1)

The transmission of the 0.88 sec long FS is carried out inside a 1.25 sec time frame. A full utilization of the frame is not absolutely necessary or advantageous. The host radio station usually has use of better antennas and greater transmitter power as a normal client system. It is therefore enough to transmit one FS every 3 x 1.25 sec - the host then having more time to recognize a weak signal from a client. The danger of collision is hereby even further reduced, and the energy balance on the host side is improved. How often the FS is actually sent, can be set with the **FRee DUty** parameter within relatively wide limits. The value of the parameter sets how many FS in a 1.25 sec time frame between the actually transmitted FS are "omitted". With a value of 0, the PFSP host sends an FS every 1.25 sec. With a value of 2, an FS is sent every 3.75 secs (2 FS time frames of 1.25 seconds are omitted, the third being sent.) In practice, a **FRee DUty** value of between 2 and maximum 3 is recommended to give a good compromise between low client access time, minimal collision probability and a good energy balance.

3.2.1.3 FRee PWr

(10-100, default 100 [%])

The FS is an FSK signal, therefore the **FSKAmpl**-setting is also valid for the FS. In PFSP link initiation, an FSK packet immediately follows the FS. The separate **FSKAmpl**- and **PSKAmpl**-settings also allow a transmitter power adjustment to be made (generally a reduction) of the FS compared to the power used during a running PACTOR link. If one does not wish to change the FSKAmpl setting, perhaps because the PTC-II is used at certain times as an PFSP host, but at other times is used for other purposes, then there is the function abbreviation **PWr**. This has been included for clarity under the **FRee** command, to be used for FS power adjustment.

The value of the **FRee PWr** parameter sets how high the output amplitude of the FS actually is (in percent) compared to the **FSKAmpl**-value. E.g. if the **FSKAmpl** is set to 200 (mV) and "**FRee PWr**" to 50 (%), so the PTC produces an FS with an **FSKAmpl**-value of 100 mV).

3.2.1.4 FRee CWid

(0-60, default: 3 [minutes])

Configures the CW identification during the FS transmission. If **FRee CWid** is set to 0, a CW identification never takes place during the FS transmission. Values between 1 and 60 produce a CW identification every 1 to 60 minutes. The actual **FRee IDent** parameter (host ident code) is used, and transmitted at 150 BPM (30 WPM) in "AUDIO-ONLY" mode, using the center frequency between the actual "Mark" and "Space" values.

The "normal" CW-ID (**cwid** command in cmd:-menu) is switched off during a link which has been started using the PFSP.

3.2.2 Hostmode

The hostmode is the same as has been described for terminal mode. The additional PFSP-host firmware commands have however been suitably abbreviated for hostmode use:

FM (0-2), default: 0) Identical to "FRee MOde" in terminal operation.

FD (0-9, default: 1) Identical to "FRee DUty" in terminal mode.

- FP** (10-100, default 100) Identical to "FRee PWr" in terminal mode.
- FC** (0-60, default: 3) Identical "FRee CWid" in terminal mode.