F T V Version 1.0

WEFAX, FAX, SSTV, RTTY and CW software for Sound Blaster compatible hardware.

CONTENTS

1. INTRODUCTION

FTV can be used to receive images from Weather Satellites and Terrestrial Facsimile Stations, text transmissions from radio telex services, Morse code, as well as Amateur Radio FAX, SSTV, RTTY and CW signals. It can also transmit Amateur Radio FAX and SSTV. No external hardware, other than a radio, is required, as all the necessary signal processing is implemented in software. The main features include:

- WEFAX, FAX, SSTV, colour SSTV, RTTY and CW operation.
- Transmits 6 FAX modes, 8 monochrome SSTV modes, 10 colour SSTV modes.
- FAX operation supports APT signal recognition and scheduled reception.
- No external decoder or converter box is required.
- Signal analysis is provided on all modes.
- Many parameters are adjustable while receiving.
- Full recovery from wrong mode settings is possible.
- Program works in real time (about 1 second 'DSP' time lag)

2. SYSTEM REQUIREMENTS

The minimum system requirements are:

- 80386 processor with hard disk
- EMS manager with 256 kilobytes of expanded memory *
- VESA compatible SVGA graphics card
- Sound Blaster compatible sound card

* EMS memory requirements depends on modes & resolutions used.

3. INSTALLATION

The files supplied on the floppy disk are compressed, and have to be installed onto your hard disk before FTV can run. To install the software, insert the floppy disk in drive A: and type "A:INSTALL". The software will be installed in a sub-directory named C:\FTV.

Windows 95

FTV runs satisfactorily under Windows 95 with the following limitations:

- Direct-X must be installed.
- It runs only in full-screen mode.
- Shelling to DOS while receiving results in signal loss.
- Task-switching (Pressing Alt-Tab) while receiving or transmitting also results in signal loss.

If Direct-X is not installed, you need to use a special MS-DOS shortcut before you can use the program. This shortcut makes the computer reboot in a special mode when FTV is going to be used.

This shortcut has been provided as "FTV.PIF". This file is copied to the C:\ WINDOWS\DESKTOP folder by the install program, and it may be conveniently manipulated into the Start menu, as well as used directly to launch FTV.

MS-DOS

If you are using MS-DOS 5.0 or 6.0, you need to include the following line in your CONFIG.SYS file:

DEVICE=C:\DOS\EMM386.EXE RAM

The above line provides Expanded Memory Services (EMS) needed by FTV. To run the program from DOS, type "FTV" in the C:\FTV sub-directory.

Plug & Play Sound Cards Under MS-DOS

If you have a Plug & Play Sound Card, make sure the card is initialized properly before loading FTV. This may require the use of a Plug & Play Configuration Manager and/or other utilities supplied with your card.

For example, if you have a Creative Sound Blaster AWE64, you must run CTCM. This program is a Plug & Play Configuration Manager.

4. CALIBRATION SETTINGS

Before FTV can successfully decode images for the first time, it must be supplied with a calibration parameter. The software will most probably not work properly if this is not set up; specifically, received pictures may be severely slanted, and the Automatic Mode Recognition facility will malfunction.

Many sound cards have crystal oscillator blocks which provide excellent stability, but their frequency can be ±5% of the value marked. Because of this, a correction parameter has to be provided by the user.

Start by decoding a station known to transmit at 120 LPM. Use (M)ode (R)ate to set to 120 LPM. Receive a picture, and trim the line rate until the picture is not slanting. Check out the adjusted line rate by using (M)ode (R)ate again, only this time don't enter a value, just press ENTER.

Calibration parameter = 120 / (Adjusted LPM rate)

Use (S)etup (D)emodulator (C)alibration to set this parameter, and trim it until no slant is visible when the rate is set to exactly 120 LPM.

Once the value of this parameter has been arrived at, load FTV with the c:NNN command line option. This may be more conveniently achieved by using a MS-DOS batch file.

Keep in mind that the LPM rate and other parameters may be adjusted while receiving without ill effects. The cursor keys are assigned the 'Slant adjust' function by default. Just press the left or right cursor keys for small adjustments. Larger adjustments are made by using Ctrl-Left or Ctrl-Right.

One last complication: the clock calibration parameter needs to be different for AM and FM. This presents no problem as long as the user is aware of it, in any case, the difference is small enough to be easily recovered by using the 'Slant adjust' functions.

5. PROGRAM START UP AND TROUBLESHOOTING

Start the program by typing FTV. The program will run an integrity test. If an 'Internal Error' is issued, it means the distributed files have been modified in some way, possibly by a naughty virus, in which case it is advisable to reboot from a clean floppy and run a virus scan on your hard disk!

The program starts by testing the audio hardware & EMS memory manager. If errors are encountered with the sound card, the program will warn you about it, but it will not abort, making it possible to try out most features (except reception / transmission itself).

If your computer does not have EMS memory, you will have to add a memory manager to your 'config.sys' file, as outlined in section 3. About 120 kilobytes of EMS memory are required for every minute of received audio. So, for 15 minute weather charts, around 1.8 megabytes are needed at maximum resolution. If you do not have a lot of free EMS memory, you may increase the Demodulator 'Sampling Window' parameter from 0.5 ms to 1 ms or more, with a corresponding degradation of resolution. This parameter is accessed through (S)etup (D)emodulator (W)indow.

If all goes well, the program will switch the display to graphics mode. The default file 'ftv.tga' will be automatically loaded. The default graphics mode is 640 x 480, 256 colours. If you press Enter, a blue menu bar with yellow text will appear at the top of the screen.

If none of this happens, it is possible that your graphics card is not compatible with the program. You may press (F)ile, followed by (Q)uit, to exit the program. If the display is unstable, press Ctrl-Alt-Del immediately to minimize the risk of damaging your monitor.

Some Super-VGA BIOS do not have VESA support built in, in which case the program may report an error like "Mode not supported on this card". If this happens, check your graphics card drivers disk for a VESA BIOS Extension utility. This is a resident program which you install before using applications that need VESA support. I know this is necessary for OAK VGA's, for example.

6. EXPLORING THE PROGRAM

Menus

- The main menu is displayed by pressing Enter.
- Menu selections are made by pressing the relevant capital letter.
- The main menu and its sub-menus may be closed by pressing Escape.

Cursor keys and Tab functions

The left / right cursor keys are assigned different functions by using the Tab key. When used in conjunction with the Ctrl key, a coarse adjustment is applied. In the case of the Pan function, up / down cursor keys also work.

Function	Description
Mode	Select a standard operating mode
Rate	Adjust line rate (slant adjust)
Phase	Adjust horizontal shift
Start	Adjust frame start
Finish	Adjust frame finish
Pan	If zoomed, pan left, right, up or down.

Help screen and short cut keys

The help screen, outlining all short cut keys, may be displayed by pressing F1.

Exercise 1: Pan and zoom

Here are some things you can try with the default picture loaded:

1. Press End a couple of times to zoom in (magnify),
2. Press Tab, and select Pan (by using the Tab key itself, or by pressing P),
3. Use the cursor keys to pan around the image,
4. Press Ctrl-Home to zoom out (view all).

Exercise 2: Loading a picture

If the main menu is not displayed, press Enter until it does. Press (F)ile (L)oad, select the file 'testcard.raw', and press Enter.

Exercise 3: Video control functions

This picture contains special patterns which will allow us to explore various features of FTV. Try out the following video control functions:

1. Press F5 to increase the brightness, Shift-F5 to decrease,
2. Press F6 to increase the contrast, Shift-F6 to decrease,
3. Press F7 to invert the picture, and once more to restore,
4. Press Ctrl-F6 to set to Lithographic mode,
5. Press Ctrl-F5 to restore Brightness and Contrast to default setting.

Exercise 4: Noise reduction

Now that the picture has been restored, we will explore the Noise Reduction feature. The third block from the top, inside the circle, consists of a black background, filled with simulated noise, with increasing intensity, from left to right. Such impulse type noise can be filtered by FTV. As the process is similar to low pass filtering, it has an effect on fine detail, as will be seen on the mesh pattern in the block above.

Use (P)rocess (N)oise, and note how the higher intensity noise is eliminated. The Noise Reduction threshold is adjustable, and the lower the threshold, the greater the filtering. The default setting is 100.

Exercise 5: Image manipulation

It is possible to carry several image manipulation procedures, concerning the orientation of the image, alignment with the display, and cropping.

The way the image is displayed is accessed through the View menu.

1. (V)iew (O)rientation (X)-mirror will mirror the picture,
2. (V)iew (O)rientation (Y)-flip will turn the picture upside down,
3. (V)iew (O)rientation (H)orizontal will rotate the picture,
4. (V)iew (O)rientation (D)efault will restore the normal view,

The following procedure is fundamental for FAX operation:

1. Press Tab, and select Rate (by using the Tab key itself, or by pressing R),
2. Press the right cursor a few times, and note how the picture slants. Using Ctrl-Right results in a coarse adjustment.
3. Press the left cursor a few times, to restore the picture. Don't forget that you can use Ctrl-Left for a coarse adjustment.

Similarly, the picture may be shifted horizontally:

1. Press Tab, and select Phase (by using the Tab key itself, or by pressing H),
2. Press the right cursor a few times, and note how the picture shifts. Using Ctrl-Right results in a coarse adjustment.
3. Practice restoring the picture as above.

Sometimes, the top and/or bottom parts of the picture need to be cropped. Start and Finish (when pressing Tab) provide a way to crop the top and bottom of the picture.

Exercise 6: Loading a NOAA weather satellite image

Load the file 'noaa.raw'. The image consists of two monochrome frames, as sensed by two separate channels on the satellite, infra red on the left, and visible on the right. Note also that the image orientation is not correct.

Let us start by selecting the visible channel. Press (V)iew (P)an, followed by Alt-2 to select ½ of the picture. We actually want the right half, so press the right cursor key a few times until the selection has moved squarely on the right. Press Enter to complete the selection.

Incidentally, after having pressed (V)iew (P)an and zoom, the following functions are available:

1. Use cursor keys to move or size the selection (Tab toggles between Pan & Zoom),
2. Use Home to enlarge the selection, End to reduce the selection,
3. Use 1,2,3,4 to select a segment, row-wise,
4. Use Alt-1,2,3,4 to select a segment column-wise,
5. Press Enter when ready.

These functions have one main shortcoming: there is no allowance for picture orientation. So you will only zoom to the intended area when orientation is set to default. In addition, pan & zoom functions don't have any effect on colour SSTV images.

Once the intended segment is displayed, use F5 & F6 to increase the brightness and contrast. Use (V)iew (O)rientation (X)-mirror and (V)iew (O)rientation (Y)-flip to set the correct picture orientation. The picture should now show a clear view of Europe, the Mediterranean, and North Africa. Note that the Island of Malta (246 sq. km), and Gozo (67 sq. km) are distinct.

Here is proof that you don't need mega-bucks or exotic equipment to receive such an image. I received this picture using an unsuitable turnstile antenna (cut for 145 MHz), a home-brew RF converter (which converts 137-138 MHz down to 95-96 MHz), and a regular FM broadcast receiver (Sangean ATS803A).

Exercise 7: Loading a colour SSTV picture

Load the file 'lady.raw'. This picture was received off-air and saved directly to disk.

The sync response can be set by using Shift-F8, to Free-run, Standard or Super. Set to Free-run mode and note its benefits - the ragged edges, particularly around the callsign banner and left margin, smoothen up. Free-run mode is recommended for off-air operation. Its disadvantage is that synchronization will not be achieved unless the Line Rate is precisely set.

Press Ctrl-Right once, to temporarily uncalibrate the Line Rate. You will notice that the bottom left part of the picture changes colour. Further uncalibration will of course result in a completely garbled picture. FTV has a special function to the rescue, Phase/sync lock (Ctrl-F8), which will analyze the image and trim the Line Rate accordingly. This function may have to be invoked more than once, for severe cases. Try it now!

For SSTV colour modes, I have provided two display modes. TrueColour mode provides 256k colours, providing very accurate colour rendition, but the resulting picture is of reduced brightness. Dithered mode results in a picture of normal brightness, but colour rendition is not so good. Press Ctrl-F7 to toggle between TrueColour and Dithered modes.

For those of you who do not know how colour SSTV works, try (M)ode (F)ax. This will redisplay the picture as a FAX, and three separate frames, corresponding to green, red and blue, appear. Inverting the image (F7) will reveal a bright white vertical band at the screen margins, which is the synchronization (sync) signal.

The sync signal is used as a marker at the start of each line, and the primary colour segments follow in sequence. A composite colour picture is then assembled by FTV.

Exercise 8: Loading a tape-recorded colour SSTV picture

Load the file 'sealand.raw'. This picture was recorded on a tape cassette.

In the old days, it was only possible to store images on tape! Unfortunately, when playing back tape recorded SSTV images, they sometimes acquire characteristic wavy effects. This is due to wow & flutter and tape stretch.

Press (M)ode (F)ax to see how warped the picture really is! Then press (M)ode (C)olour to restore the picture.

Regarding sync response (Shift-F8), Super is recommended for tape recordings.

7. OPERATION

Something on Sound Cards

If you are using a stereo sound card, it is a good idea to apply the signal to both channels. This may be easily done by shorting the tip & ring of the stereo jack plug that goes into the sound card.

The connection may be direct, or through a 1:1 transformer. Using a transformer reduces the likelihood of RF noise from the computer getting into the radio. In any case, use screened leads.

All Sound Blaster compatible cards should work with this program. However, it may be necessary to set up your mixer before using FTV, so that on record, the correct input is

selected. It is also possible to shell to DOS temporarily and run the mixer utility program that came with your card. The received audio monitor is controlled by the F10 key.

WEFAX reception

The WEFAX video sub-carrier is a 2.4 kHz AM signal. As a consequence, it requires careful gain settings, unlike FM. Automatic Gain Control (AGC) will distort the signal, precluding the use of the Microphone input. The Line Input will have to be used instead.

1. To switch to AM mode, use (M)ode (D)emod (A)m.
2. To switch to FAX mode, use (M)ode (F)ax
3. Then, press (R)x to start reception.

The 'Tuning Scope' is displayed. The input level is displayed on top, along with memory status. Set the input level, by adjusting the volume knob on your radio, so that the signal fills the gray region without reaching into the blue or red regions. The gray region represents a range of 0% (bottom) to 100% (top) modulation.

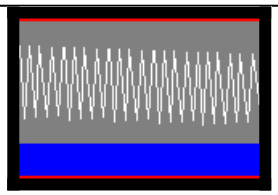
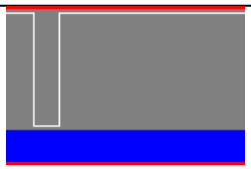
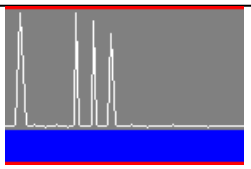
Press Escape to quit the 'Tuning Scope'. The received signal is displayed in real-time. You may work on the image while it is still being received, for example, the Rate, Phase, Brightness, Contrast and Orientation may all be adjusted, and the signal may be analyzed too. When reception is complete, press st(O)p, and you may then save the image.

FAX reception

The FAX video sub-carrier is a 1.9kHz FM signal, with a deviation of ±400Hz. Unlike AM, gain settings are not critical, and AGC will have a beneficial effect. The use of the Microphone input is recommended, but using the Line Input is also possible.

As FAX is the default mode, in practice, receiving FAX is as simple as loading the program and pressing (R)x. Automatic Mode Analysis will do the rest. If required, FTV may be forced to use FAX mode by pressing (M)ode (F)ax.

The 'Tuning Scope' is displayed. The input level is displayed on top, along with memory status. Keep the input level close to 100% by adjusting the volume knob on your radio. Check visually that the signal is not clipped, and is located squarely in the gray region. The gray area represents a range of 1.5kHz (bottom) to 2.3kHz (top).

		
The start signal, where the carrier is modulated by a 300 Hz tone	The phasing signal, consisting of a white line, interrupted by a black pulse.	A FAX chart, with white symbols on a black background.

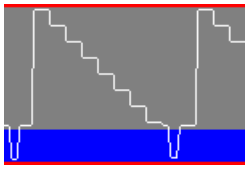
Press Escape to quit the 'Tuning Scope'. On leaving the Tuning Scope, Mode Analysis is automatically applied; if a FAX signal is detected, the Mode, Line Rate and Phasing will be adjusted.

The received signal is displayed in real-time. You may work on the image while it is still being received, in the same way as for WEFAX.

If the wrong side-band is selected, a negative image will result, however this may be easily rectified by pressing F7 (Invert).

SSTV reception

SSTV reception is similar to FAX. Again, receiving SSTV is as simple as loading the program and pressing (R)x. Automatic Mode Analysis will do the rest. If required, FTV may be forced to use SSTV mode by pressing (M)ode (S)stv.



Tuning SSTV signals requires more care than FAX. The correct side-band must be selected, such that the sync pulses appear in the blue region of the 'Tuning Scope'. A staircase signal is shown opposite; this is a commonly encountered pattern used to test the gray scale.

On leaving the Tuning Scope, Mode Analysis is automatically applied; if an SSTV signal is detected, this will set the Mode and Line Rate. It will also trim the noise band preceding the image.

When Mode Analysis (F8) or Phase / sync lock (Ctrl-F8) are conducted on a static image (raw file loaded from disk, or after Rx has been stopped), both preceding and trailing noise bands are cropped, if both are within 20% of the image size. The line rate is also trimmed.

SSTV line sync mode (Shift-F8) controls the way the image is synchronized.

Colour SSTV reception

Colour SSTV reception is similar to monochrome SSTV. Again, press (R)x, and Automatic Mode Analysis will do the rest. If required, FTV may be forced to use Colour SSTV mode by pressing (M)ode (C)olour.

Two functions have been provided specifically for Colour SSTV. These include:

1. Gamma correction (F7)
2. TrueColour / Dithered (Ctrl-F7)

If a frame starts with noise, automatic Phase / sync lock (Ctrl-F8) may not be enough to achieve line lock. This is particularly true when the noise in question consists of fragments of other transmissions. In such a case, trim the top of the frame manually until line lock is achieved.

It is recommended to save Colour SSTV frames in RAW format, if you intend to view or manipulate them with FTV.

FAX / SSTV transmission

Only TGA files may be transmitted. The procedure is as follows:

1. Load a TGA file,
2. Press (T)x to display the transmission menu,
3. Use left/right cursor keys to select a mode,
4. Press (T)ext if you would like to show/hide/edit the text banner,
5. Press Enter to start transmission (Press any key to abort the transmission).

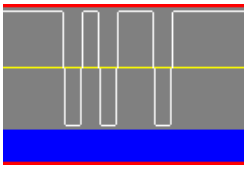
Set the output power level on your transmitter conservatively. FAX and SSTV are 100% duty cycle modes, with transmissions lasting several minutes; solid state transmitters will get quite warm in the process.

Care must also be taken not to over-modulate your transmitter. Adjust the Mic Gain control while keeping an eye on the ALC meter. If output level from the sound card exceeds the level needed by the transmitter, an external potentiometer may need to be inserted between the sound card audio output and the transmitter microphone input.

RTTY reception

Press (M)ode (B)audot. The display reverts to text mode, and FTV is in a state of continuous reception. Logging appends to the file 'ftv-rtty.log'. The functions available are shown below:

Key	Label	Description	Settings
F1	Baud rate	Set baud rate	30-300 baud
F2	Polarity	Set keying polarity	Normal / reverse
F3	Unshift	Controls how shift is released	Normal / On space
F4	Errors	Controls if errors are displayed	Shown / masked
F5	Restart	Clears buffer and restarts reception	-
F6	CatScan	Shells to CatScan program	-
F7	Logging	Logs data to disk	-
F8	Analyze	Signal analysis	-
F9	Scope	Tuning scope	-
F10	Quit	Return to FTV	-
Tab	-	Toggle between Baudot and Morse	Baudot / Morse

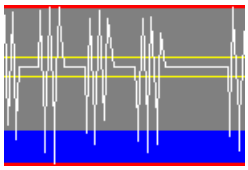


A single RTTY character is shown opposite. The initial (idle) state is Mark. This is followed by a start bit, followed by five symbols '10110', followed by a stop bit (shown extended).

CW reception

Press (M)ode (M)orse. The display reverts to text mode, and FTV is in a state of continuous reception. Logging appends to the file 'ftv-rtty.log'. The functions available are shown below:

Key	Label	Description	Settings
F1	Speed wpm	Set keying rate	5-50 wpm
F2	Auto	Set to estimated keying rate	-
F4	Errors	Controls if errors are displayed	Shown / masked
F5	Restart	Clears buffer and restarts reception	-
F6	CatScan	Shells to CatScan program	-
F7	Logging	Logs data to disk	-
F9	Scope	Tuning scope	-
F10	Quit	Return to FTV	-
Tab	-	Toggle between Baudot and Morse	Baudot / Morse



The Morse letter V (dot-dot-dot-dash) is shown opposite. Note that here, the signal is considered active when it is within the two yellow lines.

Further information

One thing that in rare cases may need setting up is the (S)etup (D)emodulator (G)rid filter. Incorrect setting of this parameter will result in a faintly perticible grid of very widely spaced dots. The coarseness of these dots increases with slower PC's. On my computer, which has a 486DX 33MHz CPU, it is set to 2. Increase this parameter until the grid no longer appears when a 1.9 kHz sine wave of about 1V r.m.s. is injected into the sound card.

8. ADVANCED FEATURES

Automatic FAX reception

Automatic FAX reception provides a way to realize unattended monitoring of a service. It relies on the 300Hz start tone and 450 Hz stop tone that are part of the APT (Automatic Picture Transmission) format. Received images are saved automatically to disk.

Scheduled FAX reception

Scheduled FAX reception provides a way to monitor specific products by using a schedule file. The schedule file may include calls to other DOS programs, for computer aided receiver control. For example, in conjunction with the Cat-Scan program, a frequency

database may be queried and the strongest signal in a group of frequencies selected automatically.

Schedule files have an SKD extension, and may be loaded either from the command line, using the F:<file> option, or by using (A)uto (S)cheduled-rx. Schedule files consist of plain text, with commands in the following format:

Command		Description
T	<time start> <duration> [info]	Set time (UTC)
X	<command line>	Execute DOS command
R[d]	<Lpm> <Modulation> [info]	Receive picture(s)
S	<time>	Start over (typically after 00:00)

Parameters
Time format is hhmm
The D option ignores APT signals & dumps the entire received signal to disk. Otherwise, regular APT reception is used.
Modulation is AM or FM.
The INFO field is meant for annotation purposes. It is appended to the log file entry.

When invoked, FTV will locate the first applicable entry in the schedule. As all times are in Zulu, the TZ environment variable must be set. An example schedule file follows:

```
T  0230 15 "GYA - 0230 - BROADCAST SCHEDULE"   (1)
X CatScan GYA LSB F                            (2)
R 120 FM                                       (3)

T 1600 18 "NAM - 1600 - SAT Image VT 1545Z"    (4)
X CatScan 8080.0 LSB F                         (5)
Rd 120 FM                                      (6)

S 0000                                         (7)
```

1. Let us assume that the above schedule is invoked at 0100Z. FTV will wait until it is 0230Z.
2. It will then invoke the CatScan program, to set up the receiver. (In this case, CatScan will look up the frequency database, extract the various frequencies associated with callsign GYA, and get the strongest signal. It will set the radio to LSB and apply the appropriate 1.9kHz shift).
3. FTV will enter receive mode, at 120 Lpm, FM. Start and stop signals will be monitored and multiple pictures saved separately. At 0246Z, FTV will stop receiving. If an incomplete picture is present, it is saved.
4. FTV will wait for 1600Z.
5. It will again invoke CatScan (it will set the radio to 8080.0kHz LSB and apply the appropriate 1.9kHz shift).
6. FTV will enter receive mode, at 120 Lpm, FM. This time, start and stop signals are ignored and the entire 18 minutes are dumped to disk. At 1619Z, FTV will stop receiving.
7. FTV will wait for 0000Z. The schedule will then restart.

FAX browser

Pictures saved during Automatic FAX reception and Scheduled FAX reception may be browsed using the (A)uto (B)rowse function. It is possible to delete unwanted pictures, and to manipulate and save the desired ones. The log of received pictures is kept in the file 'ftv-auto.log'.

9. LICENSE

Conditions for use

This program is licensed for Amateur Radio use only. It may be copied and used by all radio amateurs as long as it is distributed in whole and without profit. The collection of files on the distribution disk must be distributed in an unmodified form. Unlicensed commercial distribution is prohibited.

The author provides absolutely no warranty. The program is supplied "as is", and you may use it at your own risk. In no event will the author be liable for any damages arising out of the use of this program. An integrity test has been built into the program to reduce the likelihood of virus infection.

Bug reports, suggestions and feedback are welcome. For contact information, see below.

Registration and ordering

If you wish to support FTV, you may choose to register your copy of the software. Your registration, while aiding the continued evolution of the program, entitles you to free upgrades when newer versions are released.

To order your registered copy, send a self addressed label together with a cheque for 25 US$ to my postal address below. Don't forget to write down your callsign, name and address clearly, for registration purposes. Latest information will be supplied with the disk.

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