

# USER MANUAL OF THE WAVECOM W 4010 DATA AND TELEGRAPH DECODER

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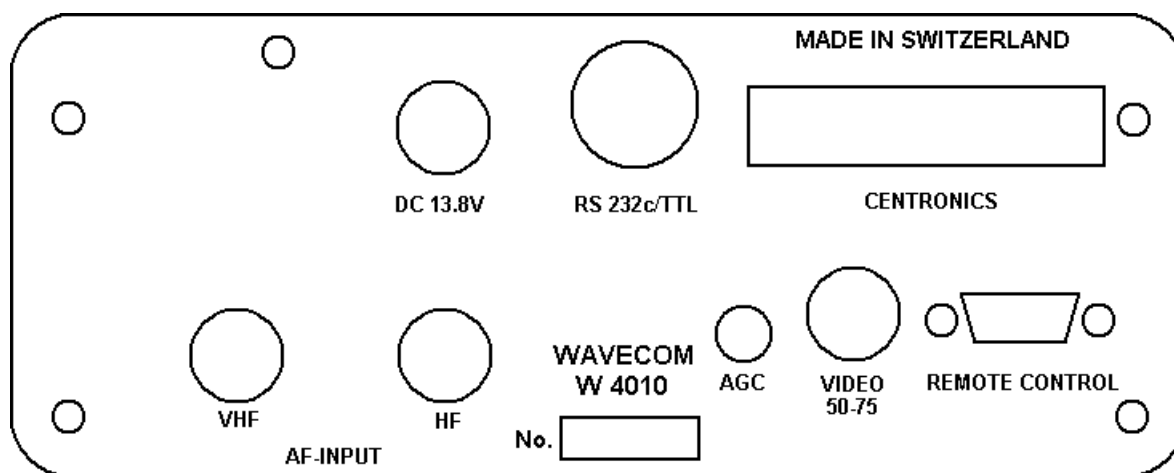
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## 1. INSTALLATION



### 1.1 POWER SOURCE CONNECTION

On the rear panel is a small (2.1 mm) coaxial jack; the inner conductor has PLUS and the outside MINUS polarity. Connect the supplied cable to a regulated 12 to 14 Volt power source and pay attention that the red wire goes to the POSITIVE (+) pole and the blue to the MINUS (-) pole.

The utilization of modern CMOS semiconductors results in a low power consumption of only 0.5 A. The decoder requires a stabilized voltage source. WAVECOM recommends the use of a somewhat larger than necessary supply, if possible, about 2 to 3 Ampere output.

The W 4010 decoder has an internal fuse that protects not only against overcurrent, but also against wrong polarity.

### 1.2 RECEIVER CONNECTION

The W 4010 demodulator needs audio from the receiver with a level of about 0.1 Vpp, up to a maximum of 5 Vpp. Many receivers have line or tape recorder outputs which have fixed levels, and it is recommended to use these because their outputs are independent from the volume control. The large AGC range of the decoder permits using it with almost any receiver.

For the connection to the receiver, use the supplied cable which is shielded and has RCA plugs on both sides. An adapter will have to be used for 2.5 or 3.5 mm coaxial receiver jacks.

### 1.3 VIDEO MONITOR INTERFACE

Use the supplied RCA-RCA shielded cable to connect the video output to the 75 Ohm input of the composite video monitor. The video card has a 75 Ohm terminated output of 1.5 Vpp which can be used by all commonly available monitors.

A modulated TV output is deliberately not available, since TVs do not have the necessary bandwidth to give sharp and clear text.

### 1.4 VIDEO DISPLAY SELECTION

Choose module A by pushing the module key while watching the monitor. Thereafter push [F1] to obtain the menu to setup the parameters. The [F1] key allows **configuring the video** 40 characters × 18 lines or 80 characters × 24 lines.

The **cursor mode** can be adjusted with [F2]: no cursor, cursor no blinking, cursor slow blinking, cursor fast blinking.

The **video synch frequency** can be adjusted with [F3] to 50 Hz or 60 Hz.

In case of unreadable video text switch the W 4010 Off, switch On, push [F1] and then [F3]. The programmed values are stored in a non-volatile memory and keep stored even without power.

## 1.5 PRINTER PARALLEL INTERFACE

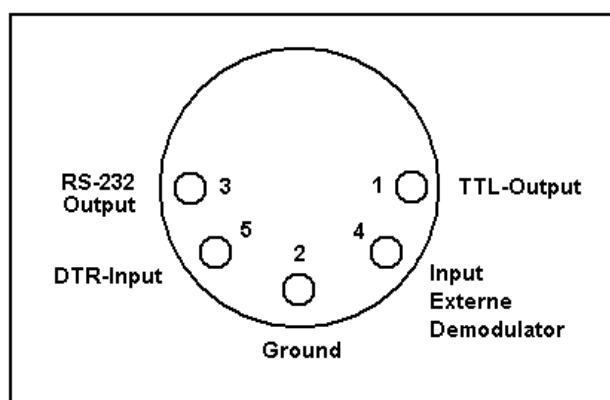
Before interconnecting the printer with the W 4010, make sure both units are turned off. The 36-pole Centronics printer output jack is located on the decoder's rear panel and is connected via the standardized Centronics cable to the similar jack on the printer. The printer can be used immediately thereafter. Although the Centronics printer signals have been internally filtered against RFI emissions, it is recommended to use shielded cables only.

Some services use high Baud rates with the result that not all printers can keep pace. Before buying a printer, make sure it can print as fast as the service which you wish to receive, otherwise characters will be lost when the buffer is full.

## 1.6 SERIAL RS-232 INTERFACE

The RS-232 serial connector is the 5 pole DIN type and the diagrams below show the electrical connections and give a typical connection example. Shielded cable is recommended, although it is not absolutely necessary.

The baud rate and data format of the equipment connected to the serial port and the WAVECOM decoder has to be identical. The serial port parameters for the decoder default to 300 baud, 8 data bits, and 1 stop bit. The decoder offers the possibility of inverting the data shift, should this eventually be necessary. To invert the polarity, open the case and change the position of the jumper, right front, towards the front panel.



5-pole serial connector, DIN type

### EXAMPLE OF A CONNECTION FOR A PRINTER

W 4010 DIN-Connector		Printer 25 POL RS-232	
GND	2	7	GND
DATA	3	3	RS-232 INPUT
DTR	5	20	DTR

The DTR line signals the decoder whenever the printer cannot accept any more characters. If this handshaking is not necessary in a particular case, this connection does not have to be made. Xon/Xoff handshaking is not supported.

The information from the TTL parallel output is identical with that from the serial port except that this output has a level of 0 to +5 Volts.

## 1.7 CONFIGURING THE BAUD RATE AND DATA FORMAT FOR SERIAL COMMUNICATION

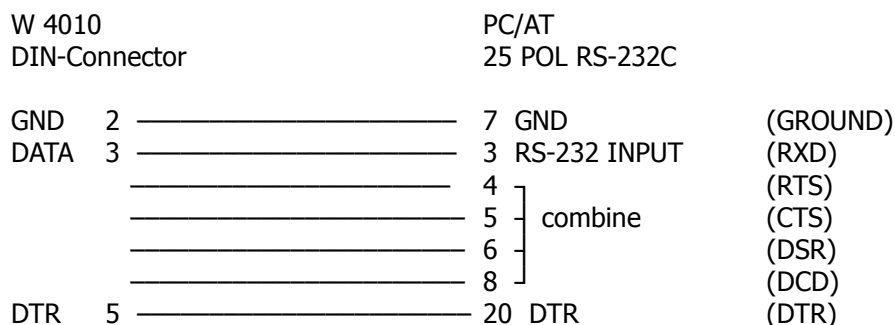
Choose module A by pushing the module key while watching the monitor. Thereafter push [F2] to obtain the menu to setup the **communication parameters**. The [F1] key allows configuring the **Baud rate** to either 300, 600, 1200, 2400, 4800, or 9600 Baud.

The number of **data and stop bits** can be adjusted with [F2] to either 7 data bits / 1 stop bit, 7 data bits / 2 stop bits, 8 data bits / 1 stop bit, 8 data bits / 2 stop bits.

The **parity** can be adjusted with help of [F3] to NO, ODD, or EVEN.

The programmed values are stored in a non-volatile memory and stay stored even without power. By means of [F1], [F2], and [F3] the operator can easily configure the WAVECOM decoder to communicate with any RS-232C equipment.

#### EXAMPLE OF A CONNECTION FOR A PC/AT



In order to transfer the data's of the serial interface, it is necessary to load a terminal Program in a PC. With the terminal Program you can save the data's on a disk.

### 1.8 USING AN EXTERNAL DEMODULATOR

In order to connect an external demodulator you must first open the case. Locate jumper #3 and change it from the left-hand position (internal demodulator) to the right-hand position (seen from the front panel). The external demodulator can now be connected to the 5-pole DIN rear panel jack. The external demodulator input can be driven with either TTL or RS-232 level signals.

### 1.9 HOW TO INSTALL THE SOFTWARE MODULES

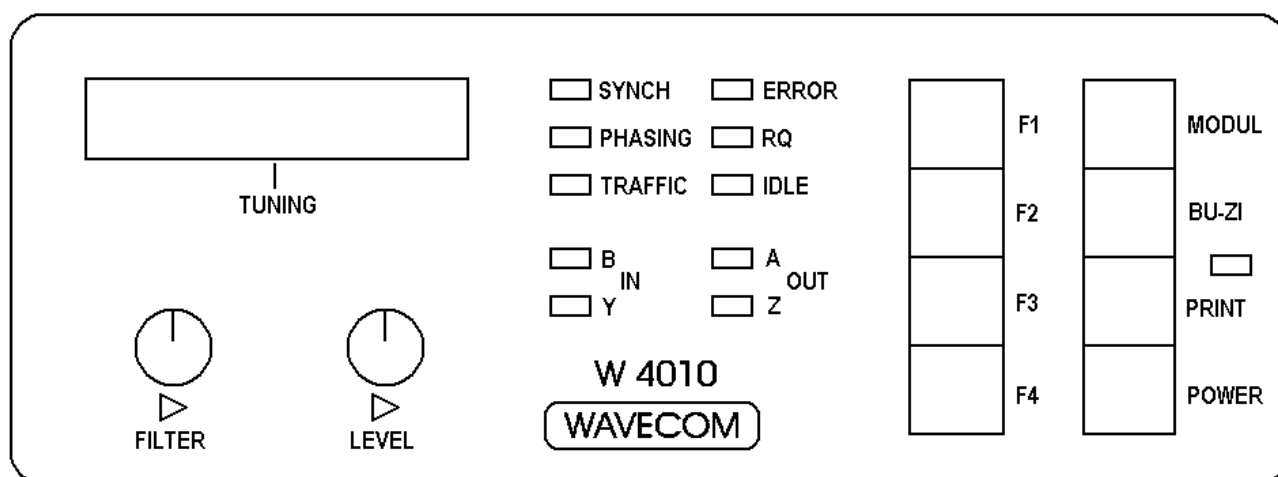
Before undertaking any changes in the equipment make sure the power is disconnected.

The EPROM memory chips have an easily seen indentation on one end. When inserting the EPROM, this indentation must point to the front of the equipment. Also the EPROM markings should be oriented similar to that of EPROM A. The EPROM has to be inserted in the proper sense, otherwise it probably will be destroyed!

Set the DIP switch, located behind module C, as follows:

DIP switch pole	1	2	3	4	
ON	OFF	OFF	OFF		1 module inserted
OFF	ON	OFF	OFF		2 modules inserted
OFF	OFF	ON	OFF		3 modules inserted
OFF	OFF	OFF	ON		4 modules inserted

## 2. OPERATING CONTROLS



### 2.1 KEYPAD FUNCTIONS

#### Key

[F1] [F2] and [F3]

[F4]

[MODUL]

[BU-ZI]

[PRINT]

[POWER]

#### Function

are multi function keys and the video display indicates the actual function.

With [F4] key you can go to the next operation mode.

Selects between modul A, B, C and D.

Each press of this button changes from one case to the other (ie: Figures to Letters).

When the print key is pressed, the received characters will be sent to the Centronics and RS-232 serial output.

Switches on power of the W 4010.

### 2.2 LED FUNCTION

#### LED

[SYNCH]

[PHASING]

[TRAFFIC]

[ERROR]

[RQ]

[IDLE]

[B-IN]

[Y-IN]

[A-OUT]

[Z-OUT]

#### Function

Indicates phase selection

Indicates phase selection for SITOR-ARQ system

Indicates that data is being received by the microprocessor

Data being received by microprocessor does not meet specification selected by mode

Indicates reception of REQUEST cycles

Indicates reception of a IDLE bit pattern (ie: just maintaining synchronization with the other end of the link)

Indicates reception of mark tone

Indicates reception of space tone

Indicates serial RS-232 high level output

Indicates serial RS-232 low level output

### 2.3 FILTER CONTROL

The model W 4010 has a continuously variable bandpass filter which is independent of the baud rate or shift thereby allowing optimal signal filtering. This filter offers the operator many advantages.

The variable-width bandpass filter is similar to the quartz filter used in shortwave receivers. However, the W 4010 variable-width bandpass filter differs in two ways:

1. The bandwidth is fully adjustable from 10 Hz to 2300 Hz. The advantage is that the bandwidth can be optimally adjusted for all received shifts.
2. The W 4010 bandpass filter has an attenuation of over 27 dB when the input frequency exceeds the filter corner frequencies by more than 200 Hz. This filter response is an optimum compromise between unwanted signal attention and intersymbol distortion caused by filter group delay. The reason for this is

that very strong signals cause the receiver AGC to reduce the strength of the desired signal to that of the noise.

When receiving a strong and interference-free signal, this filter is not necessary and the adjustment knob can be turned fully counter-clockwise to disable it. During reception of very strong signals, turning the knob to the right has little effect because the signal is stronger than the filter attenuation. There is no disadvantage to this since the filter is not necessary for strong, interference-free signals.

In case there is interference from a nearby station, the knob can be turned clockwise until the point is found where the interference is nulled out and at the same time the LED shift indicator shows a wide, clean shift. With a little practice, the optimum point can be found quickly. Reception fails only when the shortwave receiver has become overloaded. At this point the only remedy is a good crystal filter in the receiver; an audio filter is not a cure for overloading in the HF receiver stage. A crystal filter is especially important for CW reception since interference is often closer in frequency than 200 Hz. Depending on the quantity of signals within the receiver bandwidth, adjust the audio filter bandwidth for optimum results.

## 2.4 LEVEL CONTROL

The Model W 4010 has a continuously adjustable squelch circuit which acts upon the signal amplitude: when a signal is below the preset level, it is squelched out completely. Above this level it passes through the squelch with no attenuation. This is especially important for CW because the squelch can be adjusted in accordance with the interference level. In fact, the squelch is necessary to prevent interference from reaching the decoder circuitry during Morse pauses, which would of course cause characters to be falsely decoded.

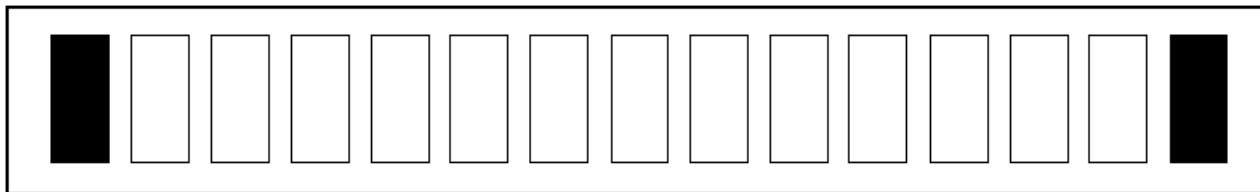
The squelch works in the modes CW, ARQ, and packet-radio, but in all other modes the knob has no effect. The squelch has no effect when the knob is turned fully counterclockwise, whereas when turned fully clockwise the squelch effect is the strongest.

In ARQ and packet-radio modes the squelch causes the LED display to center itself during the pauses and makes tuning of these narrow-shift modes much easier.

## 2.5 BAR-GRAPH DISPLAY

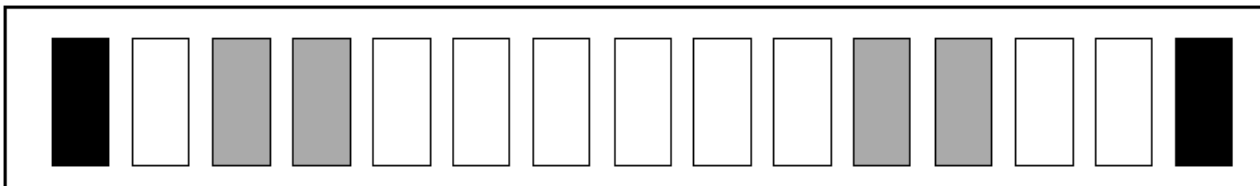
Find a RTTY signal and turn the filter knob counter-clockwise (filter disabled) and adjust the frequency of the receiver so that flickering LEDs move towards the outside and are symmetrical to the middle. With a shift of 170 Hz the outmost LEDs should light up, but with a shift of less than 170 Hz the inner LEDs will indicate maximum deviation.

### TUNING A FSK SIGNAL



With F7-B signals look for the two inner tones. These can be recognized by the two LEDs with somewhat brighter intensity. Tune the receiver so that these two inner tones are symmetrical to the middle. Remember that F7-B (F6) signals do not tolerate much mistuning since the tones are only 100 Hz apart. The receiver must have a high frequency stability and should have the ability to tune in fine steps of about 10 Hz.

### TUNING A F7B SIGNAL



With Morse signals there is only one tone and with no signal the LED display moves to the right. CW keying should move the display past the middle over to the left-hand side. The frequency for CW is the more or less standard 800 Hz, which sounds rather low. With interference, adjust the minimum amplitude squelch such that the display is moved only by the CW tone. Also the audio filter can be adjusted to the narrowest bandwidth as necessary.

The transmission of a weather-chart has a typical noise, a noise which one soon learns to recognize. The transmission is accompanied by a certain movement of the tuning display. Most stations work with a broad-band shift of  $\pm 400$  Hz which causes a larger movement of the display, but a few stations use a narrow-band shift of  $\pm 150$  Hz with resulting smaller display movement.

## 2.6 WEATHER CHART TRANSMISSION SYSTEM

Weather charts can be transmitted by radio by fixing them to a rotating drum. A light sensor which moves slowly along the length converting the intensity of reflections into voltages. These voltages are converted into tones which can be transmitted, respectively received.

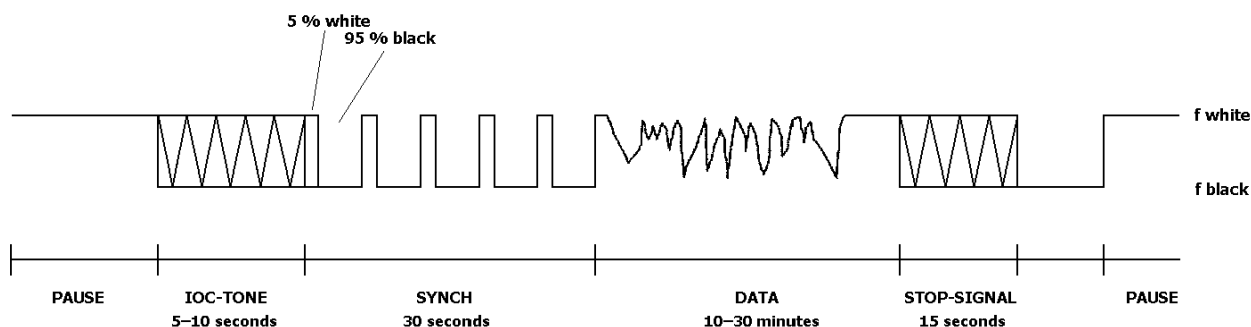
On the transmit side, the speed of drum rotation is called RPM and the speed at which the sensor moves along the length of the drum is called Index of Cooperation (IOC).

On the receive side, it is not only necessary to know the RPM and the IOC, but also when a chart transmission starts and when it ends. This information is conveyed by a series of control tones before and after a chart transmission.

The first tone in the series is a signal of 300 or 675 Hz and gives the IOC value. This tone continues for 5 - 10 seconds and can be used to accurately tune in the receiver. Following this, the frequencies representing black and white are transmitted alternatively at a rate of 1 - 2 Hz for a period lasting 30 seconds. This part of the tone series conveys the RPM and allows the receiving station to synchronize permitting the image to be printed in the middle of the paper.

Afterwards the transmission of the weather chart commences. The received output can be printed on a graphics-capable printer via the CENTRONICS parallel print port. Both 9-pin and 24-pin printer can be used in A4 portrait mode. Since weather pictures are continually printed, the printer must be capable of printing 150 characters per minute.

After the end of the picture, the stop signal is sent. This consists of an 450 Hz tone with a length of 5 seconds, followed by the tone frequency representing black which lasts 10 seconds.



## 2.7 HANDLING OF THE REMOTE CONTROL

The new Remote Control of the W 4010 enables the communication between the decoder and a computer (PC/AT) via a serial RS-232- interface. The commands sent by the computer to the decoder will be interpreted inside the W 4010 and transposed into the equivalent unit settings.

The PC additionally can receive teletype data via the RS-232-interface, exhibit them on the monitor and save in a file.

The well-known PC-program RADIO MANAGER for WINDOWS of the company SHOC supports all functions automatically. The RADIO MANAGER can now remote receiver and decoder, what before only was possible with the professional W 4100.

The operation of the decoder via the keys is also possible during the remote operation. The software registers the manual settings. The changed parameters can be asked via the interface and be evaluated by the PC.

But the user can also write his own software or even can steer the W 4010 from the WINDOWS terminal program.

The configuration of the serial W 4010 Remote Control-interface always has to suit to the settings of the PC. To that belong the baud rate, number of data- and stoppbit and the parity. The configuration of the W 4010 interface happens in a special mode via the keys at the front panel. The data are kept in a nonfluent memory (EEPROM) and even stay after a power lack.

The configuration menu becomes activated by pressing the key MODUL when the W 4010 is being switched on. The setting possibilities are shown self-explaining on the monitor. To leave this mode, the decoder is simply switched off.

Additionally to the known teletype modes, the W 4010 knows the switching to the new mode JV-FAX. The data links will, like specified by JV-FAX, be switched to the W 4010 demodulator. With this, the W 4010 can be used as a demodulator for black-white faxpictures. The command JV-FAX must only be given in DOS, due to the switching of the data lines.

The communication between PC and the W 4010 occurs by a firm set of commands and answers. The content of all commands will be transmitted in ASCII.

#### CONFIGURATION OF THE REMOTE CONTROL INTERFACE

To enter the configuration menu, the MODUL key has to be pressed while switching the W 4010 on.

<b>Key [F1]</b>	<b>Baud rate</b>	150 Baud 300 Baud 600 Baud 1200 Baud 2400 Baud 4800 Baud <b>9600 Baud</b> 19200 Baud	
<b>Key [F2]</b>	<b>Length/Stoppbit</b>	<b>7/1</b> 7/2 8/1 8/2	<b>7 Databits, 1 Stoppbit</b> 7 Databits, 2 Stoppbits 8 Databits, 1 Stoppbit 8 Databits, 2 Stoppbits
<b>Key [F3]</b>	<b>Parity</b>	<b>none</b> even odd	<b>no parity</b> Even parity Odd parity
<b>Key [F4]</b>	<b>Stationaddress</b>	<b>0 - 15</b>	
<b>Key [BU-ZI]</b>	<b>Store Parameters</b>	Storage of the configuration	

To leave this menu, switch the W 4010 off.



## CONFIGURATION EXAMPLE FOR THE WINDOWS-TERMINAL PROGRAM

In the menu "settings" following data have to be programmed under **TERMINAL-SETTINGS** and **DATA TRANSMISSION**. This data have, of course, to suit to that of the W 4010.

Data transmission	Connection to COM 1 Transmission rate to 9600 Baud Databits to 7 Stopbits to 1 Parity none Hardware record or no record	
Terminal emulation	TTY (common)	
Terminal settings	Terminal-Modi X	line formatting
	X local echo	
	CR ---> CR/LF X	Receipt and transmission
	column to 80	

The configuration of the serial RS-232 interface and the presetting of the unit's address can be effected at the configuration menu.

The software of the W 4010 does not answer with an echo sign to the host. When operating with the terminal program (on a PC) the terminal should be configured at *AUTO—ECHO*.

After the receipt of the string "**PORTxx=ON<CR>**" the W 4010 switched to mode **REMOTE**. The expression "xx" stands for the unit's address from "0" to "15".

All the keys are in function further on. The W 4010 registrates all manual inputs.

After the receipt of the string "**PORTxx=OFF<CR>**" the W 4010 does not answer any more. The software only answers to commands after the receipt of the command PORTxx=ON. So it is possible to use several units at the same RS-232 interface or to use the PC-interface itself for several times.

Each command string from the PC to the W 4010 has to be acknowledged by 'Carriage Return'. The 'Carriage Return' is shown as <CR> in the above example. The W 4010 works the sign string down, executes the necessary actions and answers with a ">" at the PC (the apostrophes do not get transmitted).

If the command is not defined or there is an error in it, the W 4010 transmits the sign '?>'. The software works with capital and/or short letter.

By adding a question-mark at the end of a command the PC can ask all settings from the W 4010. The W 4010 transmits the corresponding setting to the PC after the questioning, respectively finished by <CR> and the last sign '>'.

As an answer to a still not defined settings question the software answers with the message "UNDEF<CR>".

PC transmits <—————>	W 4010 answers
"MODE = ARQ-E <CR>"	" > "
"MODE? <CR>"	"ARQ-E <CR>"

The command "DATA" steers the output of the received teletype data from the decoder over the remote interface to the PC.

At the command "DATA" following has to be noticed:

- after transmission of the command "PORTxx=OFF", also the output of the data stops.
- when switching between "PORTxx=OFF" to "PORTxx=ON" the output of the data continues, if "DATA=ON" Has been set before.

## REMOTE CONTROL COMMANDS

<b>PORTxx</b>	=	ON (xx is the unit's address) OFF
<b>MODE</b>	=	ARQ-E ARQ-N ARQ-M2-242 ARQ-M2-342 ARQ-M4-242 ARQ-M4-342 ARQ-N ARQ6-90 ARQ6-98 ASCII ASY-ANALYSIS AUTOSPEC BAUDOT CW-MORSE DUP-ARQ FEC-A INFO JV-FAX LEN-ANALYSIS PACKET-RADIO POL-ARQ SI-ARQ SI-FEC SITOR-AUTO SITOR-ARQ SITOR-FEC SPREAD-51 SWED-ARQ SYN-ANALYSIS WEATHER-FAX UNDEF
<b>BAUDRATE</b>	=	Full number in Baud, depends on the chosen mode
<b>PRINT</b>	=	ON OFF
<b>POLARITY</b>	=	NOR INV
<b>REPETITION</b>	=	FOUR EIGHT
<b>DATA</b>	=	ON OFF
<b>LANGUAGE</b>	=	ITA-2 TASS-CYRILLIC 3-SHIFT-CYRILLIC 3-SHIFT-GREEK
<b>IOC</b>	=	288 576
<b>RPM</b>	=	60 90 120

<b>SCREEN</b>	=	24×80 18×40
<b>CHANNEL</b>	=	AUTO A B C D
<b>STATUS</b>	?	Answer: TRAFFIC IDLE SYNC RQ ERROR UNDEF
<b>ADW</b>	?	Answer: changed data of the analog input: 0 ... 255 = 0 ... 2.5 VOLT

### HINTS

**The switching to JV-FAX must only happen in DOS.**

The W 4010 switches the necessary lines for JV-FAX on the demodulator. This switching of the RS-232-steering lines leads to disturbances in WINDOWS.

The voltage range of the A/D converter can be adapted to other data between 0 and 5 volts by changing the reference diode.

## 3. OPERATION AND CODE STRUCTURES

### 3.1 LIST OF SOFTWARE 5.0 CODES

MODULE A	SITOR-ARQ SITOR-FEC BAUDOT-AUTO BAUDOT-VARIABLE ASCII CW-MORSE PACKET RADIO WEATHER FAX Speed Check	MODULE B	ARQ-E ARQ-E3 ARQ-N ARQ-M2 ARQ-M2-242 ARQ-M4 ARQ-M4-242 DUP-ARQ POL-ARQ Speed Check
MODULE C	FEC-A SI-ARC SI-FEC SWED-ARQ ARQ6-90 ARQ6-98 AUTOSPEC SPREAD51 Speed Check	MODULE D	PRESS 300 BUSINESS 300 INFO 300 BUSINESS 50 SYNCHRONOUS ANALYSIS ASYNCHRONOUS ANALYSIS LENGTH ANALYSIS Speed Check

### 3.2 SOFTWARE MODULE A

#### SITOR ARQ AND FEC

[F1]	SITOR AUTO	Automatic synchronization in both modes
[F2]	ARQ OR FEC ONLY	Only synchronized with ARQ or FEC
[F3]	ALPHABET SELECTOR	Selects ITA-2, Cyrillic or Greek
[F4]	FORWARD SEQUENCE	go to next operating mode
[F4]+[F3]	REVERSE SEQUENCE	go to previous operating mode

After the equipment is turned-on, EPROM A is enabled. The video display now tells you that the possibility exists to set the parameters for the serial port, video interface or weather-fax setup. The key [F4] must be used to choose ARQ-FEC.

Turn both knobs, filter and level, fully counter-clockwise and look for an ARQ signal. The level adjustment serves as a tuning help because with it the tuning display goes to the center during block pauses and the frequency deviation can be seen clearly. After tuning has been finished, it is recommended to return the level adjustment to its neutral position to enable the reception of very weak ARQ signals. The level adjustment is not needed with FEC signals and is therefore switched off for this mode. Nearby undesired signals can be nulled out with the filter; it can easily be seen on the tuning display when the filter Page 14 is optimally adjusted. Narrowing the filter bandwidth is always an advanced FEC signals. If this is not desired, then one of these modes can be selected. LSB or USB can be programmed since the software automatically recognizes the signal polarity.

The [BU-ZI] key switches between RTTY letters/numbers should this happen to be false. The switch causes no signal interruption, but is only effective when a signal is actually being received. The optimum FEC software is also able to synchronize without the specially transmitted line end Rq-Idle repetition. This enables synchronization without having to choose FEC-selective and FEC-collective.

SITOR is a simplex ARQ system where both stations alternately send on the same frequency. The CCIR Rec. 476-4 defines a period of 450 ms and the two stations are called: tage when strong, nearby signals or interference disturb the desired signal. In automatic mode, synchronization can be achieved with both ARQ and FEC.

#### DEFINITION FOR SITOR-ARQ

ISS Information Sending Station  
IRS Information Receiving Station

The WAVECOM software always decodes the Information Sending Station.  
The SITOR/AMTOR 7-bit alphabet uses a 3:4 mark to space ratio, however it is not identical to the alphabet No. 3.

- The Baud rate is always 100 Baud, i.e. 10 ms bit length.
- The ISS sends 210 ms blocks of 21 bits.
- The IRS sends 70 ms acknowledgement pulses.
- The two IRS acknowledgement pulses, called CS1 + CS2, confirm error-free reception; the repetition of the same control character tells the ISS to repeat the last block, respectively the last 3 characters.
- If the ISS does not receive an acknowledgement, it sends an RQ block.
- The following illustrates the transmission mode of both stations:

ISS	123456712345671234567		123456712345671234567
IRS		1234567	
	<— 210 ms —>	<70 ms>	<— 210 ms —>

#### SITOR FEC

This mode is defined in CCIR Rec. 476-3, Mode B, and is a round table operation without an acknowledgement to the transmitting station. The SITOR FEC has two ways of addressing the receiving stations: one is the collective mode which transmits to many stations, the other is the selective mode which transmits to on-

ly one station. This mode consists of a continuous 100 baud data stream with the SITOR alphabet and the shift is standardized at 170 Hz.

Each character is sent twice with the second transmission following 35 bits after the first. Only error-free characters reach the output. If both characters have errors then the special character \_ is used to indicate error recognition.

### BAUDOT AUTO

[F1]	SPEED CHECK	Displays the baud rate
[F2]	AUTO MODE	Automatic synchronization
[F3]	BAUDRATE SELECTOR	Selects the fixed, standard Baud rates
[F4]	FORWARD SEQUENCE	go to next operation mode
[F4]+[F3]	REVERSE SEQUENCE	go to previous operating mode

The BAUDOT AUTO mode permits the full-automatic reception of stations transmitting Baudot at standard Baud rates of 45, 50, 57, 75 and 100 Baud. After tuning has been finished, the software determines if the signal is a Baudot signal. If so, the software shows the baudrate and polarity on video status line and character output is enabled. However, if after ten measurements no positive results can be obtained, an error message will be displayed.

Additionally the [F2] key can be used to manually change the Baud rate.

The key [BU-ZI] can also be used here to change among the character cases, but only after the first characters have appeared.

The Baudot code is the most widely used code due to the large installed base of teletype machines. The Baudot code is the code described in ITA No. 2, in which each character has only one start bit and 1, 1.5, or 2 stop bits.

```
s 1 2 3 4 5 m
: :      Stop bit with mark polarity
: 5 data bits
Start bit with space polarity
```

Every Baudot character has a length of 7, 7.5, or 8 bits. Baudot is an asynchronous code which means a character can be transmitted at any time by itself. If the Baudot-Auto mode is used, the number of stop bits, as well as standard baud rates, are recognized. The Baudot-Variable mode can be used to receive stations with non-standard Baud rates.

### BAUDOT VARIABLE

[F1]	SPEED CHECK	Displays the baud rate
[F2]	ALPHABET SELECTOR	Selects ITA-2, Cyrillic, or Greek
[F3]	BITINVERSION SLECTOR	Selects the 32 possible different bit inversion patterns
[F4]	FORWARD SEQUENCE	go to next operating mode
[F4]+[F3]	REVERSE SEQUENCE	go to previous operating mode

The half-automatic BAUDOT VARIABLE mode permits the reception of stations transmitting Baudot at any baud rate of 30 to 300 baud.

After tuning in the station, the first thing to do is to measure the baud rate by pushing [F1]. This measures the rate within 1 Baud. Afterwards, pushing [F2] or [F3] will measure the speed and shift exactly. Within a short time either the Baudot characters will appear or a message with the hint that the received signal is not a Baudot signal.

The key [BU-ZI] can also be used here to change among the character cases, but only after the first characters have appeared. The decoder recognizes whether the character set has two or three character cases so that all of them can be chosen.

Key **[F2]** permits choosing one of the four following character sets: ITA-2, Tass-Cyrillic , Third Shift Cyrillic and Third Shift Greek. Third Shift Cyrillic signals are often heard and can be recognized by the continuous switching of the numbers case. The search for the correct character set is made easier because the complete screen display is switched instantly.

As the printer output consists only of non-capital characters, the print-out of these special character sets is limited, and the printer must also be capable of printing the character set.

Bit inversion is used as a simple form of encryption for Baudot signals. Bit inversion is where one or more of the 5 bits have been permanently inverted, thereby giving 32 different possibilities. The key **[F3]** permits choosing among these, and the bit combination is shown in the status line. So that it can be easily seen if the correct combination has been found after using **[F3]**, the letters/numbers case shift is automatically changed to the default.

## ASCII

<b>[F1]</b>	SPEED CHECK	Displays the baud rate
<b>[F2]</b>	AUTO MODE	Automatic synchronization
<b>[F3]</b>	BAUDRATE SELECTOR	Selects the fixed, standard Baud rates
<b>[F4]</b>	FORWARD SEQUENCE	go to next operating mode
<b>[F4]+[F3]</b>	REVERSE SEQUENCE	go to previous operating mode

The default for ASCII mode is 7 data bits and 110 baud. An ASCII signal can have, together with the parity bit, a total of 7, 8, or 9 bits. The eighth bit and the parity bit are suppressed because the character set consists only of 7 bits.

Key **[F1]** allows the measurement of the baud rate, while **[F3]** permits the manual selection of the desired rate. The reception of ASCII signals with uncommon baud rates is possible by choosing the ASCII variable mode. F7-B signals with 4 frequencies are the exception because large errors can be present. Here it is better to select a fixed baud rate in advance.

After the baud rate has been chosen, the software determines if the signal is an ASCII signal with the programmed parameters. If so, the character output is enabled. However, if after ten measurements no positive results can be obtained, an error message will be displayed. Check the results with different parameters for data and parity bits. Because ASCII code does not have alphabet cases to shift between, the **[BU-ZI]** key has no effect.

This code is based upon the Alphabet No. 5 and is utilized mostly for data transmissions between computers, terminals, and modems. The ASCII code has a start bit, usually 7 data bits, a parity bit and one or two stop bits.

```

s 1 2 3 4 5 6 7 p m
: :           : Stop bit with mark polarity
: :           Parity bit
: 7 Data bits(usually)
Start bit with space polarity

```

## CW-MORSE

<b>[F1]</b>	ALPHABET SELECTION	Set alphabet
<b>[F2]</b>	MODE RECALL	Configure new parameters
<b>[F3]</b>	MODE RECALL	Restart mode
<b>[F4]</b>	FORWARD SEQUENCE	go to next operating mode
<b>[F4]+[F3]</b>	REVERSE SEQUENCE	go to previous operating mode

The software for the operating mode CW MORSE has been completely rewritten and now automatically decodes transmissions from 30 to over 400 characters/second. The data low-pass filters are automatically adjusted corresponding to the measured CW speed. The software now functions much better with hand-send transmissions.

Remember the software first searches for valid keying values, checking the validity of these parameters immediately after release of data. Since noise and interference affect the search for valid parameters, it can happen that the software restarts. After adjusting the receiver, this can be prevented by pressing the [F2] key. Experience has shown that best CW reception is obtained when the filter pot is adjusted to 3 o'clock and the level pot to about 9 o'clock. A considerable increase in decoder performance is obtained by reducing the audio input level to under 100 mV.

When tuning in a CW signal, the LED display should move completely to the left. Remember tune for the relatively low frequency of 800 Hz. If the display doesn't react, then touch up the level knob, turning it counter-clockwise. Once the level knob has been mastered, the filter bandwidth can be reduced by turning the filter knob clockwise. This reduces the interference and makes the adjustment of the level knob easier. If the bandwidth is made too small, the receiver tuning becomes very critical and difficult. Each operator should adjust the bandwidth to that which he feels to be the most effective position. With a little practice, CW signals can be decoded errorfree even with strong interference.

The Morse code is one of the oldest forms of data transmission. An experienced telegraph operator can receive Morse code even under the most difficult conditions. For this reason CW is still widely used today. Even modern state-of-the-art circuitry cannot decode Morse as well as an experienced operator. Time distortion of the dits, dahs, and pauses, together with interference, generate unrecognizable combinations. However, the sharp filter, the continuously variable minimumamplitude squelch, and the powerful software permit the decoding of many CW signals.

## PACKET-RADIO AX.25

[F1]	BAUD RATE SELECTOR	Switches between 300, 600, or 1200 Baud. With 300 Baud, audio input 2 is active; and with 600/1200 Baud, audio input 1 is active.
[F2]	CALL MONITORING MODE	Selects call sign of station to be copied, or all stations
[F3]	DELETE U AND S FRAMES	Enables elimination of certain frames
[F4]	FORWARD SEQUENCE	go to next operating mode
[F4]+[F3]	REVERSE SEQUENCE	go to previous operating mode

When packet radio mode is selected, the defaults are 1200 baud and copy all packets. On the two meter band, 1200 baud in FM is usually used, and on shortwave 300 Baud in SSB with AFSK. A commonly used shortwave frequency is: 14.103 MHz 3 kHz.

The LEVEL and FILTER adjustments are not active with the VHF input. The AFSK signal with 1000 Hz shift undergoes separate filtering and decoding. The squelch on the FM receiver should be used.

For operation on shortwave, the decoder uses a quadrature demodulator, and the FILTER and LEVEL adjustments are active. The LEVEL adjustment can normally be set counter-clockwise, but can be used as a tuning aid. The postdemodulation filter has a higher frequency which means the LED tuning display will flicker.

The software offers the possibility of eliminating the U and S control packets by using the [F3] key as a toggle switch. If used, only I (information) packets will be displayed.

With packet radio many stations can be active on the same frequency. Stations are "connected" together and the other channel activity has no influence on stations that are connected together.

The WAVECOM decoder offers the advantage that all traffic of a certain station can be monitored without monitoring the rest of the channel activity.

After choosing the packet-radio mode, it becomes active with monitoring mode as default. The last two or three station call signs are continuously stored in memory and can be selected with the [F2] key. Originator, recipient, and possible first repeater can be selected one after the other. After going through these 3 possibilities, the monitor mode is selected again where all packets are received. Whenever the Packet-Radio mode is chosen, the stored call signs are deleted. Until packets are received again, key [F2] has no function.

The call sign of the selected station appears in the command line, and only packets that have this call sign will reach the output, regardless whether from originator, recipient, or possible first repeater. It is therefore possible to monitor all activity of a certain station or repeater.

The amateur radio standard AX.25 has been derived from the commercial standard (CCITT X.25, ISO HDLC). Amateur packet radio has spread rapidly, due to the initiative of an American club T.A.P.R. Packet-Radio is a synchronous transmission. The data is usually sent as ASCII characters.

With packet radio information is conveyed in blocks (frames) as follows:

Flag	Address	Control	Data	FCS	Flag
------	---------	---------	------	-----	------

A flag, consisting of the sequence 01111110, is sent at the beginning and at the end of every block.

The address can have up to 80 characters, usually only 16 or 24 are used (direct connection or via 1 repeater). The AX.25 standard has several different frame types, three of which are the I, S and U frames. Information is almost always transmitted in I frames, seldom in U frames. The S and U frames are used in controlling and monitoring the transmission progress. The data field can contain up to 256 characters, and as the transmission is transparent all characters and character combinations are allowed. The FCS field contains the check sum.

### WEATHER-FAX

[F1]	AUTO/MANUAL
[F2]	DRUM SPEED 60 / 90 / 120 RPM
[F3]	IOC 288 / 576
[F4]	go to next operating mode
[F4]+[F3]	go to previous operating mode
[F1]+[F2]	PHASE LEFT <<
[F2]+[F3]	PHASE RIGHT >>
[BU-ZI]+[F1]	FINE SPEED UP
[BU-ZI]+[F2]	FINE SPEED DOWN
[BU-ZI]+[F3]	PRINTER SELECT
[BU-ZI]+[F4]	FORM FEED ON/OFF
[BU-ZI]	POLARITY POS-NEG

A large number of stations around the world transmit weather charts at certain times. To print a picture it is important that the printer has paper in it and is in the status ON LINE. Additionally the W 4010 push button **[PRINT]** will have to be pushed (the LED **[PRINT]** MUST glow).

If it is desired to print the next picture, leave the W 4010 in the AUTO MODE, which is the default mode after turn on. A weather picture needs 10 - 40 minutes and when the next picture starts, the LED **[TRAFFIC]** will glow as the picture is being printed.

If it is desired to receive a chart transmission that has already started, choose an IOC value (usually 576) as well as a drum speed. Thereafter push the **[F1]** key. A scale will first be printed and this can be used to correctly position the picture by using the PHASE key. In case the picture image is in negative (i.e. white on black), choose the other sideband and tune in again. Weather FAX transmissions are sent in upper sideband (USB or FAX). Before transmission is started, the key **[BU-ZI]** can be used to enable reception on LSB. When the picture is finished printing, the W 4010 sends form feed to the printer after prints the information "WAVECOM W 4010 WEATHER-FAX" on a row.

**AUTO:** The **[F1]** key is used to switch between automatic and manual chart reception. If switched to automatic, the W 4010 chooses the correct values for IOC and RPM as well as starting a print-out of the synchronization signal, the **[TRAFFIC]** LED glows; the **[SYNCH]** LED glows when the transmission begins.

**MANUAL:** This mode starts the printout by hand. For a short time, both **[SYNCH]** and **[TRAFFIC]** LEDs glow, thereafter only the **[TRAFFIC]** LED glows. The values of IOC and RPM must, however, be manually set beforehand. If the key **[F1]** is pushed again the print-out is terminated. The status line displays *AUTO* as the mode.

**DRUM SPEED:** Used to adjust the drum speed RPM during reception by choosing 60, 90 or 120 RPM. The chosen speed appears in the status line.



**IOC MODUL:** Used to adjust the Index of Cooperation (in German: MODUL) to either 288 or 576; the selected IOC being displayed in the status line. The IOC must be chosen before the synchronizing tones of 300 & 675 Hz. An IOC of 576 is by far the most commonly used value.

**POLARITY POS-NEG:** The key [BU-ZI] selects either positive or negative image polarity, the selected value being displayed in the status line. Negative polarity offers advantages for the reception of satellite pictures.

**PHASE LEFT / PHASE RIGHT:** When the print-out is started by hand the converter has not received the synchronization at the start of the transmission. In this case it is easily possible that the picture is not in the middle of the paper. After manually starting, the W 4010 prints out a scale across the entire width of the paper.

Use these keys to position the picture correctly. For example, when the left margin of the picture is under the symbol <<5, push the keys [F1]+[F2] five times. The selected value is displayed in the status line. The reaction of the printer is delayed, however, with the delay determined by size of the printer buffer.

**FINE SPEED UP / FINE SPEED DOWN:** The FAX picture is only synchronized at the beginning of transmission. If there is a small difference in drum speed and the W 4010, the picture will start to drift in one direction or the other. These fine speed (FS) keys can be used to compensate and correct this difference.

When the mode WEATHER-FAX is first used, the FS value is preset to 220. In the mode WEATHER-FAX CALIBRATION, pushing the key [F1] also presets the FS value to 220. The FS value is displayed in the status line. If the picture is too far left, FS must be reduced; if too far right, FS must be increased. Since the FS value is memorized, it only has to be adjusted once. If the FS value is changed, the printer output can be disturbed for a short time.

**FORM FEED ON/OFF:** Form feed on or off can be selected by using [BU-ZI] and [F4].

**PRINTER SELECT:** A 9- or 24-pin printer can be selected by using [BU-ZI] and [F3].

EPSON LQ-500	EPSON LQ-400	EPSON FX-80
STAR NL-10	STAR LC-10	STAR LC-24
BROTHER M1109	SEIKOSHA SL-80AI	Centronics GLP II
NEC P6	NEC CP6	NEC P6+
NEC P7	NEC CP7	EPSON FX-800

#### *Additional hints:*

In the mode WEATHER-FAX large amounts of data have to be processed and therefore the graphic data is output only to the parallel print port and not to serial port.

The following are to be selected before the [TRAFFIC] LED glows:

- Drum speed RPM
- IOC MODUL
- Printer (9 or 24 pins)
- Polarity (pos. or neg.)

Adjustments made after this point lead to undefined printer outputs.

### **3.3 BAUD RATE MEASUREMENT AND IAS BAUD RATE**

The [F1] key, when displayed in the menu, initiates a baudrate measurement. The measurement result often indicates which signal type is being received. The first measurement stage is a rapid, preliminary measurement which can differ from the effective baudrate. If a more accurate measurement is not desired, pushing the [F2] or [F3] key causes a return to the respective operating mode.

if the key [F1] is pushed again, the IAS-BAUDRATE measurement starts. IAS means ISO-ASYNCHRON and SYNCHRON. Baudot signals with one half stop bit can not be measured with this software. The software performs signal calculations in large steps with the display changing in short intervals. After a short time, the display PRECIS MEAS. appears, which means that only small variations with respect to the actual baudrate are being measured. The measurement time in PRECIS MEAS. should be about 10 minutes.

If the preliminarily entered baudrate has too large a difference with respect to the actual baudrate, the IAS-BAUDRATE measurement can take a very long time. The keys [F2] and [F3] can step the baudrate up or down.

The baudrate adjustment via keys [F2] or [F3] is also important for simplex ARQ signals, which often can not be measured. With preselection of the IAS-BAUDRATE, simplex ARQ signals can be measured (SITOR-ARQ, SI-ARQ, SWED-ARQ, DUP-ARQ).

Measurements to 1/1000 Baud can be false due to differences in the quartz oscillators. These false measurement can be compensated and corrected using a CONSTANT. The best calibration reference is the FEC-A long wave signal. Measure this signal for 10 minutes with IAS-BAUDRATE. Now use the key [BU-ZI] to adjust the QFC-FACTOR (abt. 10 to 40) as close possible to 96,0000 Baud. The key [BU-ZI] has a repeat function.

### 3.4 OTHER FUNCTIONS

#### Multiple Scroll Inhibit (MSI)

Eliminates multiple scrolls (line feeds) on the screen and printer. A paper and screen space saving device when the sending station sends more than one. Press the appropriate keys [BU-ZI] and [F2] to indicate MSI ON or MSI OFF on status line.

#### Unshift on Space (UOS)

When 'on' the Unshift on Space causes the data output to automatically shift to 'Letters' case upon receipt of a "space" character. Press the appropriate keys [BU-ZI] and [F1] to indicate UOS ON or UOS OFF on status line.

#### Polarity Display

Press the appropriate keys [BU-ZI] and [F3] indicates NOR or INV polarity on status line if the microprocessor is synchronized.

#### Video display 40×18 and 80×24 lines

Each press of [BU-ZI] and [F4] buttons changes from one video mode to the other.

### 3.5 SOFTWARE MODULE B

#### ARQ-E

[F1]	SPEED CHECK	Displays the baud rate
[F2]	BAUDRATE SELECTOR	Selects standard or variable Baud rates(as obtained from the [F1] measurement)
[F3]	MODE RECALL	Redisplay of the mode as well as resynchronization
[F4]	FORWARD SEQUENCE	go to next operating mode
[F4]+[F3]	REVERSE SEQUENCE	go to previous operating mode

After choosing ARQ-E, the Baud rate is set to the default of 96 Baud, however this can be changed with function key [F2]. The Baud rate measured by using function key [F1] remains stored (for all modes) until a new measurement is performed. After the decoder has synchronized to the ARQ-E signal it displays the repetition cycle (4 or 8) which gives clues concerning the same radio net. The function key [F3] should be pushed after every station or frequency change.

The synchronous full-duplex single-channel ARQ (automated request) has become an important communications mode. Single-channel ARQ uses a parity check to recognize transmission errors. The procedure is that the receiver returns a question mark to the transmitter for each detected error. The transmitter then retransmits the last 3 or 7 characters which it precedes with a question mark. To keep the 2 stations synchronized, both stations transmit carrier and information continuously. If there is no information, then a bit pattern (Idle character) is used for modulation.

### ARQ-E3

[F1]	SPEED CHECK	Displays the baud rate
[F2]	BAUDRATE SELECTOR	Selects standard or variable Baud rates (as obtained from the [F1] measurement)
[F3]	MODE RECALL	Redisplay of the mode as well as resynchronization
[F4]	FORWARD SEQUENCE	go to next operating mode
[F4]+[F3]	REVERSE SEQUENCE	go to previous operating mode

The ARQ-E3 mode is very similar to the ARQ-E mode, however, differs in the utilized alphabet. ARQ-E3 is easily recognized because in the mode ARQ-E the sequence FFFF occurs often. The 4 or 8 polarity reversals are recognized and the equipment adjusts itself automatically. The [F2] key adjusts the baudrate; should this be unknown, the [F1] key initiates baudrate measurement.

### ARQ-N

[F1]	SPEED CHECK	Measure Baud rate
[F2]	BAUD RATE SELECTION	Configure Baud rate
[F3]	CYCLE SELECTOR	Configure acknowledgement cycle length
[F4]	FORWARD SEQUENCE	go to next operating mode
[F4]+[F3]	REVERSE SEQUENCE	go to previous operating mode

The operating mode ARQ-N is a full duplex system using the ITA-2 alphabet with parity check. The [F3] key can be used to set the length of the acknowledgement cycle. Usually the RQ-cycle with 4 characters is used, the software uses this as a default. Transmissions are usually at 96 Baud; 72, 144, or 192 Baud are also possible. Baud rate measurements can be called up by using the [F1] key. Press [F2] to set the correct Baud rate for data capture.

### ARQ-M2 AND ARQ-M4

[F1]	SPEED CHECK	Measure Baud rate
[F2]	BAUD RATE SELECTION	Configure Baud rate
[F3]	CHANNEL SELECTOR	Selects division channel or auto mode
[F4]	FORWARD SEQUENCE	go to next operating mode
[F4]+[F3]	REVERSE SEQUENCE	go to previous operating mode

The software preselects 96 Baud for ARQ-M2 and 192 Baud for ARQ-M4. Additionally the [F2] key can be used to manually change the Baud rate. It is possible that a station receives messages in one TDM channel while the others are constantly in idle or RQ condition. The [F3] key is used to select subchannels A & B, respectively A, B, C, and D, or automatic selection of a busy channel.

These modes, also known as TDM, ARQ-28 or ARQ-56, follow the recommendations of CCIR 342-2. These modes multiplex 2 or 4 data tributaries into one data transmission.

The 7-bit code which is utilized for information transfer also permits error recognition. All characters of the CCITT code no. 3 have a 3:4 ratio between mark and space bits. ARQ-M2 and ARQ-M4 mode are full-duplex and use the same error-correcting protocol as ARQ-E. The division channels can be divided into sub-channels which usually have 28 or 56 bit periods. Data capture can be changed, without data interruption, from one division channel to another.

### ARQ-M2-242 AND ARQ-M4-242

[F1]	SPEED CHECK	Measure Baud rate
[F2]	BAUD RATE SELECTION	Configure Baud rate
[F3]	CHANNEL SELECTOR	Selects division channel or auto mode
[F4]	FORWARD SEQUENCE	go to next operating mode
[F4]+[F3]	REVERSE SEQUENCE	go to previous operating mode

The ARQ-M2-242 and ARQ-M4-242 systems correspond to the CCIR recommendation REC. 242. This system combines two or four data channels in a single transmission. It uses a 7-bit code with which transmission errors can be recognized. All characters of the ITA-3 alphabet have a 4 to 3 ratio. The Time-Division-Multiplex (TDM) system operates full duplex and the error-correction procedure operates like ARQ-M2, complying with Rec. 342-2.

The software preselects 96 Baud for ARQ-M2-242 and 192 Baud for ARQ-M4- 242. Additionally the [F2] key can be used to manually change the Baud rate. The [F3] key is used to select sub-channels A & B, respectively A, B, C, and D, or automatic selection of a busy channel.

### DUP-ARQ

[F1]	SPEED CHECK	Measure Baud rate
[F2]	BAUD RATE SELECTION	Configure Baud rate
[F3]	POLARITY SELECTOR	Configure polarity
[F4]	FORWARD SEQUENCE	go to next operating mode
[F4]+[F3]	REVERSE SEQUENCE	go to previous operating mode

DUP-ARQ is a new system of semiduplex data transmission. The system additionally has an automatic channel selection: before starting the transmission, the best possible short-wave channel is chosen and during the transmission regularly checked. Within a frequency range, the system can select from 5 different channels using steps of 400 Hz. DUP-ARQ uses the channel like a simplex system: both stations alternately send 5-character blocks and a Hamming check sum. If a transmission error appears, a nonacknowledgement is sent and the last data block is repeated. A frequency offset often occurs between stations A and B because of the automatic channel selection. If only one station is sending data, the other sends an idle bit-pattern. If errors occur, block repetition (RQ) cycles are initiated.

The software uses 125 Baud as a default since this is the most common speed, but the [F2] key can be used to change the speed. The polarity (sideband) is changed with the [F3] key and causes no loss of synchronization.

### POL-ARQ

[F1]	SPEED CHECK	Measure Baud rate
[F2]	BAUD RATE SELECTION	Configure Baud rate
[F3]	MODE RECALL	Retrieves the operating mode
[F4]	FORWARD SEQUENCE	go to next operating mode
[F4]+[F3]	REVERSE SEQUENCE	go to previous operating mode

The POL-ARQ is a duplex system with two transmission frequencies, usually operating at a speed of 100 Baud. The system uses the errorcorrecting SITOR-ARQ alphabet. If only one station is sending data, the other sends an idle bitpattern. If errors occur, block repetition (RQ) cycles are initiated.

The [F2] key can be used to change the speed, while the [F3] key recalls the operating mode POL-ARQ with operational menu.

## 3.6 SOFTWARE MODUL C

### FEC-A

[F1]	SPEED CHECK	Displays the baud rate
[F2]	BAUDRATE SELECTOR	Selects Baud rates manually
[F3]	MODE RECALL	Redisplay of the mode as well as resynchronization
[F4]	FORWARD SEQUENCE	go to next operating mode
[F4]+[F3]	REVERSE SEQUENCE	go to previous operating mode

The idle condition is easily recognized by means of the signal's regular mark/space shift (about 40/60 %). However, in idle condition it is neither possible to synchronize nor to measure the Baud rate.

This forward error correcting system uses the same alphabet as the single-channel ARQ system. Every second bit is used for error correction and the characters consist of 14 bits. The errorcorrecting code not only corrects single errors, but also error bursts, in fact error bursts of up to 1 second can be corrected.

The code scheme is illustrated as follows:

```

1c2c3c4c5c6c7c1c2c3c4c5c6c7c1c2c3c4c5c6c7c1
Idle 10000011111111100000111111111000001111111

```

where c are extra error-correcting bits

A steady idling cannot be decoded since the decoder has no errorcorrecting bits. Errors are displayed with the underline character .

<b>SI-ARQ</b>
---------------

[F1]	LENGTH SELECTOR	Block length preset for 4, 5 or 6 characters
[F2]	BAUDRATE SELECTOR	Selects standard or variable Baud rates
[F3]	MODE RECALL	Redisplay of the mode as well as resynchronization
[F4]	FORWARD SEQUENCE	go to next operating mode
[F4]+[F3]	REVERSE SEQUENCE	go to previous operating mode

ARQ CCITT-3 sounds very similar to AMTOR-SITOR, except one has the impression of a slower Baud rate due to the longer blocks for characters and pauses. The standard speed is 96 Baud and the block length is usually 5 or 6 characters. A Baud rate measurement is very difficult because there is no signal between the character blocks. Therefore, interference causes measurement errors.

This system is similar to the SITOR ARQ system, it is a single frequency simplex system. Transmitted block can have a length of 4, 5 or 6 characters. A cycle is twice as long as the block length. If the ISS receives the acknowledgement, then the next block is transmitted with opposite phase. The transmission rate can be chosen from among several Baud rates. The Wavecom software always receives the ISS (Information Sending Station).

The timing of the 2 stations looks like: five 7-bit characters transmitted - one 7-bit acknowledgement received - five inverted 7-bit characters transmitted etc.

<b>SI-FEC</b>
---------------

[F1]	SPEED CHECK	Displays the baud rate
[F2]	BAUDRATE SELECTOR	Selects Baud rates manually
[F3]	MODE RECALL	Redisplay of the mode as well as resynchronization
[F4]	FORWARD SEQUENCE	go to next operating mode
[F4]+[F3]	REVERSE SEQUENCE	go to previous operating mode

Every SI-ARQ station can also transmit in this FEC-Broadcast mode, and the Baud rate most commonly used is 96 Baud. SI-FEC sounds very similar to SITOR-FEC.

This is another code for broadcasting which does not require an acknowledgement from the recipient. Each character is transmitted twice, the second time in inverted form and if recognized as error-free, the decoder releases it for output. However, if the transmitted character is received with an error, then the decoder outputs the underline character .

<b>SWED-ARQ</b>
-----------------

[F1]	SPEED CHECK	Displays the baud rate
[F2]	PHASING	Resynchronisation
[F3]	MODE RECALL	Redisplay of the mode as well as resynchronization
[F4]	FORWARD SEQUENCE	go to next operating mode
[F4]+[F3]	REVERSE SEQUENCE	go to previous operating mode

The length of the transmitted blocks, the switching of the block lengths, and the data length are detected automatically. The status line show the block lengths as short, middle, or long. The detection of block length switching can be lost in case of heavy interference on the communications channel, in which case the key [F2] should be pushed. The operating menu can be displayed with the MODE RECALL key which also initiates a new synchronization.

The SWED-ARQ utilizes 3 different block lengths. The short block corresponds principally to the mode SITOR-ARQ. The system increases the block lengths automatically to middle or long when the communications channel is good, while automatically reducing the block length as interference appears on the channel. To increase the information transmission rate of a good quality channel, the middle block length makes it possible to transmit and receive information at a rate of 75 Bauds, and with long block at a rate of 100 Bauds.

### ARQ-98

[F1]	SPEED CHECK	Measure Baud rate
[F2]	PHASING	Rephases
[F3]	MODE RECALL	Retrieves the operating mode
[F4]	FORWARD SEQUENCE	go to next operating mode
[F4]+[F3]	REVERSE SEQUENCE	go to previous operating mode

ARQ6-90 is a simplex ARQ system similar to SITOR-ARQ with traffic blocking and acknowledgement on the same frequency. The system uses 200 Baud as well as the SITOR alphabet with each block transmitting 6 characters.

Pressing the [F2] key causes signal to be rephased, while pressing the [F3] key recalls the operating mode ARQ6-90. The polarity of the received signal is automatically recognized.

### ARQ6-90

[F1]	SPEED CHECK	Measure Baud rate
[F2]	PHASING	Rephases
[F3]	MODE RECALL	Retrieves the operating mode
[F4]	FORWARD SEQUENCE	go to next operating mode
[F4]+[F3]	REVERSE SEQUENCE	go to previous operating mode

ARQ6-98 is a simplex ARQ system similar to SITOR-ARQ with traffic blocking and acknowledgement on the same frequency. The system uses 200 Baud as well as the SITOR alphabet with each block transmitting 6 characters.

Pressing the [F2] key causes signal to be rephased, while pressing the [F3] key recalls the operating mode ARQ6-98. The polarity of the received signal is automatically recognized.

### AUTOSPEC

[F1]	SPEED CHECK	Displays the baud rate
[F2]	BAUDRATE SELECTOR	Selects Baud rates manually
[F3]	MODE RECALL	Redisplay of the mode as well as resynchronization
[F4]	FORWARD SEQUENCE	go to next operating mode
[F4]+[F3]	REVERSE SEQUENCE	go to previous operating mode

This FEC-Broadcast mode has a standard speed of 68.5 Baud.

The Bauer error-correcting code is a synchronous code with 10 bits per character. The first five bits are identical with the ITA No. 2, and the second five bits are a repetition of the first. However, when there is even parity, the second 5 bits are transmitted inverted. The Bauer code is capable of correcting single-bit errors, characters with more than one error are displayed with an underline character "\_".

## SPREAD-51

[F1]	SPEED CHECK	Measure Baud rate
[F2]	BAUD RATE SELECTION	Configure Baud rate
[F3]	MODE RECALL	Retrieves the operating mode
[F4]	FORWARD SEQUENCE	go to next operating mode
[F4]+[F3]	REVERSE SEQUENCE	go to previous operating mode

The [F2] key can be used to change the speed, while the [F3] key recalls the mode with operational menu.

To achieve an increased security against burst errors, SPREAD51 spreads the transmission over a longer period of time. After every bit of the 10-bit Bauer codes, 50 data bits of other characters follow while new characters start after a 10-bit distance. Normally 102.7 Baud is used, seldomly 68.5 Baud. The software synchronizes on traffic or idle characters and automatically recognizes the polarity.

## 3.7 SOFTWARE MODULE D

The long wave transmissions of PRESS 300, INFO 300, BUSINESS 300 and BUSINESS 50 are terminated.

## SYNCHRONOUS-ANALYSIS

[F1]	SPEED CHECK	Displays the baud rate
[F2]	LENGTH SELECTOR	Changes block display length
[F3]	DISPLACE ONE BIT	Changes the block display by one bit
[F3]+[F2]	SPREAD SELECTOR	data interleave spread selector
[F4]	FORWARD SEQUENCE	go to next operating mode
[F4]+[F3]	REVERSE SEQUENCE	go to previous operating mode

RTTY signals can be analyzed with synchronous bit analysis method, but some specialized background knowledge is required.

First analyze the baud rate with "Baud rate check" and make sure that deviations are less than 0.3 Baud. The software makes sure that there is no bit-slip. The bit stream can be stopped with the [BU-ZI] key and written down in order to find certain hints and clues with respect to parity, character distribution and repetition, etc. The signal idle condition can offer important clues with respect to the character length that is utilized.

## ASYNCHRONOUS-ANALYSIS

[F1]	SPEED CHECK	Displays the baud rate
[F2]	SHIFT POLARITY	Reversal of shift polarity
[F3]	START-STOP LENGTH	Presetting of character lengths from 5 to 9 bits; start-stop errors result in the underline _ character being displayed
[F4]	FORWARD SEQUENCE	go to next operating mode
[F4]+[F3]	REVERSE SEQUENCE	go to previous operating mode

This method can quickly verify whether a station is transmitting with asynchronous characters or not. For a complete verification all character bit lengths ([F3]) and both shift polarities ([F2]) must be attempted. The underline character \_ is used to indicate non-agreement between the received signal and the programmed start-stop values.

### 3.8 BAUDRATES

BAUDOT ITA-2	45, 50, 75, 100
ASCII ITA-5	110, 150, 300
SITOR ARQ	100
SITOR FEC	100
PACKET RADIO	SHORTWAVE 300 VHF/UHF 1200
ARQ-E	48, 64, 72, 86, 96, 192, 288
ARQ-E3	96, 100, 192
ARQ-N	96
ARQ-M2	96, 200
ARQ-M2-242	96
ARQ-M4	192
ARQ-M4-242	192
DUP-ARQ	125
POL-ARQ	100
FEC-A	96, 144, 192, 300
SI-ARQ	96
SI-FEC	96
SWED-ARQ	100
ARQ6-90	200
ARQ6-98	200
AUTOSPEC	68.5
SPREAD51	102.6



## 4. TECHNICAL SPECIFICATION

### 4.1 HARDWARE

Case:	Steel with dimensions of 200 × 250 × 80 mm, 2.5 kg
Front panel:	LEDs for Traffic, Sync, Phasing, Error, Idle, Rq, Input B-Y, Output A-Z, and Print On Keys for [F1] / [F2] / [F3] / [F4] On-Off / printer on-off / [BU-ZI] / menus Tuning LED 16 element bar graph Knob for variable filter Knob for minimum-amplitude squelch
Rear panel:	Coaxial low-voltage jack with 2.1 mm pin for 12-14 Volts 5-pole jack with RS-232-C interface, including DTR, serial output, TTL external input, TTL or RS-232 RCA jack for short-wave audio input RCA jack for VHF/UHF audio input Printer output jack, Centronics type Video output, 75 Ohms, Composite/BAS
Processing:	CPU: 8-bit CMOS, clocked at 4 MHz 2 or 8 KB NOVRAM 4 EPROMS 27256 5 programmable 16-bit timers
Video:	80 characters × 24 lines or 40 characters × 18 lines CPU 8-bit, 12 MHz 4 character sets ASCII, both upper + lower sets CCITT-2, Tass-Cyrillic, Third Shift Cyrillic, Third Shift Greek
Interface:	RS-232 serial computer or printer interface with Data Terminal Ready (DTR) and 255 byte buffer Baud rates: 300, 600, 1200, 2400, 4800, or 9600 Baud Data format: 7 or 8 bits / Parity Odd, Even or None, 1 or 2 stop bits Jumper for shift inversion Centronics printer interface with 255 byte buffer Input for external demodulator TTL or RS-232
Demodulator:	Quadrature demodulator with 1750 Hz center frequency, automatic switching to 800 Hz with Morse microprocessor-controlled switched-capacitor 6-pole digital low-pass filter F7-B (F6) demodulator for 100 Hz shift 1200 Baud PLL packet radio demodulator
Filter:	variable bandwidth filter composed of elliptic high-pass and low-pass filters, each with 4-poles, RTTY bandwidth 10 - 2300 Hz, limits: 600 and 2900 Hz, CW bandwidth 10 - 800 Hz, limits: 400 and 1200 Hz
Level pot:	variable minimum-amplitude audio squelch for CW, ARQ, and packet radio
Audio level:	the level should be between 0.1 and 5 Vpp max.

## 4.2 SOFTWARE MODULE A

Baud rate check	fast Baud rate determination, typically 1 % error IAS Baud rate typically 0.01 % error
SITOR	Baud rate 100 Baud automatic recognition between ARQ or FEC and SEL/COL automatic polarity recognition Automatic RQ elimination
BAUDOT	automatic lock-on standard + variable Baud rates from 30-300 Baud bit inversion decoding 4 character sets, including Cyrillic and Greek automatic polarity recognition
ASCII	standard + variable Baud rates from 30-300 Baud selectable 7, 8 or 9 bit data length automatic polarity recognition
CW-MORSE	Automatic lock-on for speeds from 15-300 BPM EB, AR and SK recognition/ special characters standard Morse and Cyrillic character sets
PACKET RADIO	300, 600 or 1200 Baud automatic switching for SW, VHF, UHF inputs call sign selective monitoring non-information packets can be ignored
WEATHER-FAX	Graphic printout with 9- or 24 pin printers automatic drum speed selection 60, 90 and 120 rpm automatic IOC selection 288 and 576 automatic start synchronization automatic stop synchronization drum speed fine correction wide band demodulator

## 4.3 SOFTWARE MODULE B

Baud rate check	fast Baud rate measurements, typ. 1 % error IAS Baud rate typically 0.01 % error
ARQ-E	Baud rates: 48, 64, 72, 86, 96, 144, 192 Baud rate, variable: 30 to 300 Baud Automatic repetition cycle recognition and RQ elimination automatic polarity recognition
ARQ-E3	Baud rates: 48, 72, 96, 100, 192 Baud rate, variable: 30 to 300 Baud Automatic repetition cycle recognition and RQ elimination automatic polarity recognition
ARQ-N	Baud rates: 48, 72, 96, 144, 192 Baud rate, variable: 30 to 300 Baud Automatic repetition cycle recognition and RQ elimination automatic polarity recognition
ARQ-M2	2 division channels (1/1 mode)
ARQ-M4	Baud rates: 86, 96 and 200 Baud 4 division channels (1/1 mode)

	Baud rates: 172 and 192 Baud rates, variable: 30 to 300 Change of division channel without data interruption automatic selection of a busy channel automatic repetition cycle recognition and RQ elimination automatic polarity recognition
ARQ-M2-242	2 division channels (1/1 mode)
ARQ-M4-242	Baud rates: 86, 96 and 200 Baud 4 division channels (1/1 mode) Baud rates: 172 and 192 Baud rates, variable: 30 to 300 Change of division channel without data interruption automatic selection of a busy channel automatic repetition cycle recognition and RQ elimination automatic polarity recognition
DUP-ARQ	Baud rate 125 Baud Baud rates, variable: 30 to 300 automatic repetition cycle recognition and RQ elimination
POL-ARQ	Baud rate 100 Baud Baud rates, variable: 30 to 300 automatic repetition cycle recognition and RQ elimination automatic polarity recognition

#### 4.4 SOFTWARE MODULE C

Baud rate check	fast Baud rate measurements, typ. 1 % error IAS Baud rate typically 0.01 % error automatic polarity recognition
FEC-A	Baud rates, fixed: 96, 144, and 192 Baud rate, variable: 30 to 300 Baud automatic polarity recognition
SI-ARQ	programmable 4, 5, or 6 bit block length Baud rates: 96, 144, and 192 Baud rate, variable: 30 to 300 Baud automatic RQ elimination and resynchronization automatic polarity recognition
SI-FEC	Baud rates: 96, 144, and 192 Baud rate, variable: 30 to 300 Baud automatic polarity recognition
SWED-ARQ	Baud rate 100 Baud automatic detection of block length automatic detection of block length switching automatic RQ elimination and resynchronization automatic polarity recognition
ARQ6-90	Baud rate 200 Baud automatic RQ elimination and resynchronization automatic polarity recognition ARQ6-90 Baud rate 200 Baud automatic RQ elimination and resynchronization automatic polarity recognition
AUTOSPEC	Baud rates: 68, 102.6 and 136 Baud rate, variable: 30 to 300 Baud

automatic polarity recognition

SPREAD51

Baud rates: 68, 102.6 and 136  
Baud rate, variable: 30 to 300 Baud  
automatic polarity recognition

#### 4.5 SOFTWARE MODULE D

Baudrate check      fast Baud rate determination, typically 1 % error  
IAS Baud rate typically 0.01 % error

Synchronous  
bit-analysis      Capable of analyzing 30 to 300 Baud  
display of each bit  
7 to 96 bit data display  
automatic resynchronization

Asynchronous  
analysis      capable of analyzing 30 to 300 Baud  
start/stop analysis, display of each bit  
programmable 4 to 21 bit character length

## 5. MISCELLANEOUS

### 5.1 TROUBLE SHOOTING

Equipment symptom	Possible cause
Equipment shows no function at all	Check power supply and fuse
Tuning display blinks with no signal	Supply voltage too low, must be a minimum of 12 VDC
Equipment resets arbitrarily	Unstable supply voltage or intermittent contact
No serial or parallel outputs	Push [PRINT], LED must glow Check if peripheral is "on-line" Check DTR hand-shaking line (ready means a + voltage of 3 to 12 Volts)
No TTL output	Check to see if peripheral (or cable short) is loading the line too much
Incorrect character output to peripheral equipment	Check if both Baud rates set to same speed Check if data format is correct Check if shift jumper is set correctly
Character loss on parallel or serial output interface	Check whether DTR signal is OK Check speed capability of printer with slower signals
Tuning display non-distinct	Check filter knob position, eventually turn counter-clockwise Check ground of audio input
Tuning display is not capable of showing full deviation	Turn level knob counter-clockwise Check display deviation with other signals Audio input level too low, try taking audio from the loud-speaker
Video display is not correct	Try a different monitor Check that the synch frequency is set correctly Check that the horizontal hold is set correctly Check the contrast and brightness Turn the W 4010 off - then on, press [F1] then [F3]

### 5.2 FUSE REPLACEMENT

Remove the two screws on each side of the case and then remove the top and bottom covers. The fuse holder is located on the right-hand side of the PCB near the rear, and the fuse can be pulled easily from the holder. Use only a small fuse of 5 × 20 mm dimensions with maximum 2 A, rated as fast-blowing.

If, after first checking the correct polarity of the supply voltage, the fuse blows again, the problem is in the equipment. Never replace the fuse with one of higher rating or with an aluminum foil short, since this will damage the equipment further.

### 5.3 SIGNAL INTERFERENCE

All microprocessors and various peripherals can generate broad-band radio-frequency interference (RFI), which may be radiated by the interconnecting cables. The WAVECOM equipment is engineered to reduce this RFI to a minimum by utilizing RF chokes on all outputs. A metal case is used to shield the circuitry, and as a further RFI preventing measure, each PCB is individually shielded with copper foil. Video monitors and print-

ers also can cause strong RFI. Therefore, the following precautions can be taken concerning the receiver installation:

**Antenna:**

A poorly installed antenna or receiver feedline is one cause of interference. Interference is seldom present when a long-wire antenna, installed in the clear, together with shielded cable are used. However, if a simple active antenna is used in the neighborhood of the decoder or monitor, interference can be expected, especially at higher frequencies. In general, active antennas are more susceptible to interference.

**Receiver:**

Often RFI is radiated directly into the receiver because it does not have sufficient shielding. Many receivers need a 50 Ohm load on the antenna input and are very susceptible to interference if this is not the case. An antenna tuner (so-called match box) can be used to transform the antenna impedance to 50 Ohms.

**HF cabling:**

All the antenna lines inside a house should be run with shielded HF cable.

**AC line interference:**

Often video monitors and other electronic equipment radiate into the AC line and enter the receiver or active antenna via their power supplies. This type of interference can be reduced by means of an AC line filter.

**Ground:**

The best ground is the cold water metal pipe as the hot water pipe is not always grounded. A good receiver ground is always recommended, not in the least for your own safety.

**Placement of the decoder:**

Despite the decoder's double shielding, it is still possible that interference persists in the near vicinity of the receiver. It helps in this case to change the location of the decoder with respect to the receiver. Interference from video monitors can often be remedied only by using this method.

## 5.4 WARRANTY CONDITIONS

**Warranty**

Wavecom Elektronik AG offers a warranty of 12 months after the date of sale. If the product was purchased from WAVECOM or an authorized representative and then fails to be in good working order during this one year warranty period, defective components will be repaired or replaced free of charge.

No liability to the customer or third parties can be taken for direct or indirect losses, lost profits, or other special, incidental, exemplary or consequential damages arising out of the use of or inability to use such product. Non-authorized modification of the product invalidates the warranty. This warranty does not include service to repair damage from improper installation, improper connection to peripherals, external electrical fault, accident, disaster, misuse, abuse, or modifications to the product not approved in writing by WAVECOM. All other expressed and implied warranties for this product including the warranties of merchantability and fitness for a particular purpose, are hereby disclaimed.

The transportation costs for equipment returned to WAVECOM for repair has to be paid by the customer. If you do not insure the product, you are responsible for any loss or damage in transit. WAVECOM pays for the transportation back to the customer, if the equipment is still in warranty.

WAVECOM products meet the technical specifications valid at time of manufacture. WAVECOM is responsible neither for equipment interconnection nor modification or upgrade of its equipment after time of sale. Wavecom Elektronik AG reserves the right to make technical changes and modifications to its products at any time without prior notice.

**Handbook**

Information in the handbooks may be changed at any time without prior notice. No liability to the customer or third parties can be taken for direct or indirect losses, lost profits, or other special, incidental, exemplary or consequential damages arising out of errors in the handbook.

**Software**

The software in WAVECOM decoders is, and remains, the property of WAVECOM ELEKTRONIK AG. The customer cannot buy the software, but is given a limited license to use it. This intellectual property is interna-

tionally protected and any duplication, without the written permission of WAVECOM ELEKTRONIK AG, is forbidden and illegal. Any unauthorized duplication invalidates all warranty rights and revokes the license to use the software.

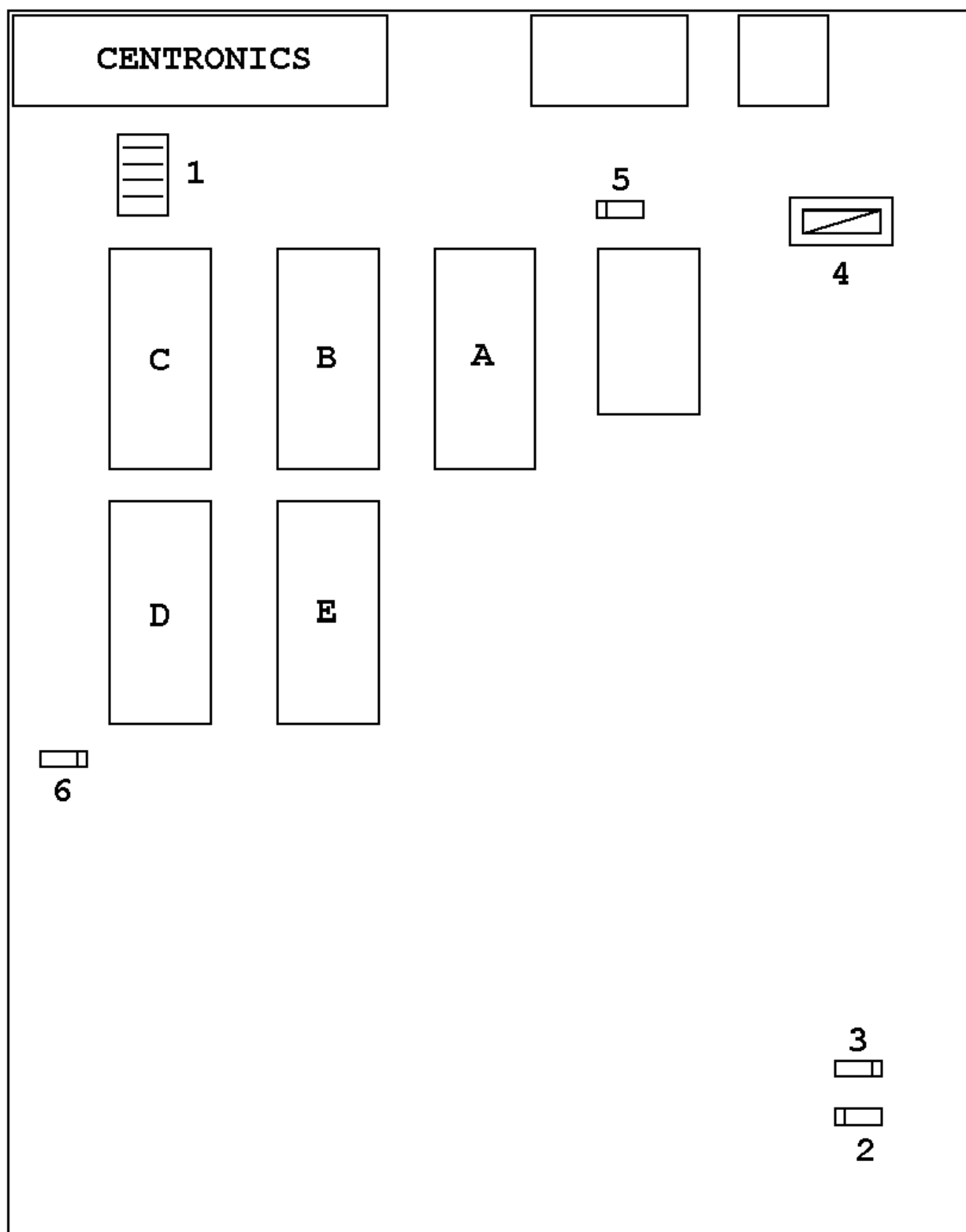
#### **5.5 MANUFACTURER AND ALL EXPORT SALES**

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## 6. ILLUSTRATIONS

### 6.1 ILLUSTRATION OF THE PROCESSOR BOARD LAYOUT

- 1 = Module selection DIP switch
- 2 = Normal/inverted shift jumper; normal is the right position
- 3 = Internal/external demodulator; internal is the left position
- 4 = 2 Amp fuse
- 5 = Jumper selection for larger 8KB NOV-RAM
- 6 = Jumper selection for larger system memory of 256 kbit
- A - E = Software modules A through E





## 6.2 ILLUSTRATION OF THE CONNECTOR PLACEMENT

### COAXIAL LOW-VOLTAGE INPUT

Inner conductor: positive 12 to 14 Volts

Outer conductor: Ground (or negative polarity)

### 5-POLE DIN JACK

Pin 1 = serial TTL demodulator output

Pin 2 = ground

Pin 3 = serial RS-232/V.24 output

Pin 4 = external demodulator input

Pin 5 = DTR (Data Terminal Ready) input

### RCA JACK #1

Inner conductor: audio input from VHF/UHF packet-radio, hot side

Outer conductor: audio input from VHF/UHF packet-radio, ground side

### RCA JACK #2

Inner conductor: audio input from HF radio, hot side

Outer conductor: audio input from HF radio, ground side

### RCA JACK #3

Inner conductor: video output, hot side

Outer conductor: video output, ground side

