Technical Information

Operating Instructions

# PZF511

## Impressum

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## General information

The German long wave transmitter DCF77 started continious operation in 1970. The introduction of time codes in 1973 build the basic for developing modern radio remote clocks.

The carrier frequency of 77.5kHz is amplitude modulated with time marks each second. The BCD-coding of the time telegram is done by shifting the amplitude to 25% for a period of 0.1s for a logical '0' and for 0.2s for a logical '1'. The receiver reconstructs the time frame by demodulating this DCF-signal. Because the AM-signal is normally superimposed by interfering signals, filtering of the received signal is required. The resulting bandwidth-limiting causes a skew of the demodulated time marks which is in the range of 10ms. Variations of the trigger level of the demodulator make the accuracy of the time marks worse by additional +/-3ms. Because this precision is not sufficient for lots of applications, the PTB (Physical and Technical Institute of Germany) began to spread time informations by using the correlation technique.

The DCF-transmitter is modulated with a pseudo-random phase noise in addition to the AM. The pseudo-random sequence (PZF) contains 512 bits which are transmitted by phase modulation between the AM-time marks. The bit sequence is build of the same number of logical '0' and logical '1' to get a symmetrical PZF to keep the average phase of the carrier constant. The length of one bit is 120 DCF-clocks, corresponding to 1,55ms. The carrier of 77.5kHz is modulated with a phase deviation of +/-10° per bit. The bit sequence is transmitted each second, it starts 200ms after the beginning of a AM second mark and ends shortly before the next one.

Compared to an AM DCF77-receiver, the input filter of a correlation receiver can be dimensioned wide-bandwidth. The incoming signal is correlated with a reconstructed receiver-PZF. This correlation analysis allows the generation of time marks which have a skew of only some microseconds. In addition, the interference immunity is increased by this method because interference signals are suppressed by averaging the incoming signal. By sending the original or the complemented bit sequence, the BCD-coded time information is transmitted.

The absolute accuracy of the generated time frame depends on the quality of the receiver and the distance to the transmitter, but also on the conditions of transmission. Therefore the absolute precision of the time frame is better in summer and at day than in winter and at night. The reason for this phenomenon is a difference in the portion of the sky wave which superimposes the ground wave. To check the accuracy of the time frame, the comparison of two systems with compensated propagation delay is meaningful.

## Features PZF511

The PZF511 is a high precision receive module for the DCF77-signal build in eurocard size (100mm x 160mm). The 61mm wide front panel contains an eight digit alphanumeric display, three LEDs and two keys as control actuators.

The microcontroller of the system correlates its receiver-PZF with the incoming pseudorandom sequence and decodes the time information of the DCF-telegram simultaneously. The controller handles input and output functions of the PZF511 and synchronizes the internal realtime clock.

By evaluating the pseudorandom phase noise, the PZF511 is able to generate time frames with thousand times the accuracy of standard AM-time code receiver. The precise regulation of the main oscillator of the radio clock is possible therefore. So, the PZF511 can be used as a standard frequency generator besides the application as a time code receiver. Four fixed and one settable TTL-level standard frequencies are available at the rear VG-connector. The synthesizer frequency exists as an open drain output and a sinewave signal also.

As an addition to the previous PZF510 the PZF511 generates an IRIG timecode that is available at the rear VG-connector both as a modulated AM and as an unmodulated DCoutput.

Furthermore the PZF511 provides active-low as well as active-high TTL pulses per minute and per second. To distribute informations concerning date, time and status, three independant serial interfaces (RS232) are used which are configurable in a setup menu.

Like mentioned before, the PZF511 includes a battery-backed realtime clock which runs crystal-precise if the main power supply fails.

Important system parameters are stored in a battery-backed RAM or non-volatile (EEPROM) memory.

If an update of system software becomes necessary, the new firmware can be loaded via serial interface (COM0) without removing the PZF511 for inserting a new EPROM.

## Installation PZF511

To achieve the technical data given in chapter 'technical specifications', the following points must be observed.

## Operating voltage

The clock operates with a single +5V supply. The output voltage should be well regulated because drifting supply voltages reduce the short time accuracy of the generated frequencies and timing pulses. The power supply lines should have low resistance and be connected using both pins a and c of the rear connector.

## Antenna

The external ferrite antenna AW02 is connected to the receiver by using a 50 ohm coax cable. If reception is sufficient, the length of the cable can be up to several hundred meters without any problems. An antenna amplifier is available for very long antenna cables.

## Assembly of antenna

The antenna has to be mounted as exactly as possible. Turning it out of the main receive direction will result in less accurate time frames. The antenna must be placed in longitudinal direction to the DCF-transmitter (Frankfurt). The nearness to microcomputers should be avoided (PZF511 included) and the antenna should be installed with a minimum distance of 30cm to all metal objects, if possible. A distance of several meters to TV- or computermonitors must be kept.

After switching the PZF511 to the menu 'FIELD', the adjustment of the antenna can be executed. The displayed value is proportional to the received field strength. The best method of mounting the antenna is to look for the minimum field strength and turn the antenna by 90° to maximum then. A high field strength on its own is no guarantee for good conditions of receiption, because interfering signals within the bandwidth of the receiver also have an effect on the displayed value.

The maximum interference immunity can be found by looking at the autocorrelation coefficient (in percent) in the menu 'PZF-STAT'. The displayed value should be close to 100% for best receiption.

## Front panel


## Pilot lamps

The 'Feld'-LED is switched on if a DCF-signal with at least minimum field strength needed for the correlation receiption is detected at the input of the receiver.

The 'Syn.'-LED indicates that the autocorrelation coefficient decreases beyond a value that is needed and a correct receiption is not possible therefore. This happens if a strong interferer within the bandwidth of the receiver is present or the transmitter is switched of.

If the 'Freil.'-LED is on, it was not possible to synchronize the internal realtime clock to DCF-time. This condition occures for at most two minutes after switching on the PZF511, because two DCF-telegrams are checked for plausibility before the data is taken over. Short disturbance of receiption can cause this state too.

## Display

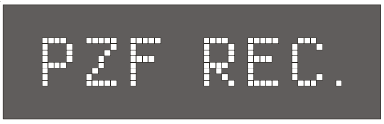
The eight digit alphanumeric display shows important information concerning status and time. The setting of system parameters is also done with the help of the display.

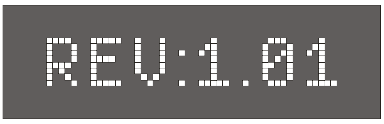
## Control keys

It is possible to change the displayed information (time, date or status information) by two keys. The 'Menu'-key selects one of several menus. After presing the 'Set'-button the belonging information appears on the display. Furthermore, the keys are used to set user-specific parameters in several submenus.

## Menu items

The type of DCF-clock and the software revision are displyed first after power-up. The following informations are readable before the PZF511 switches to time-display automatically:

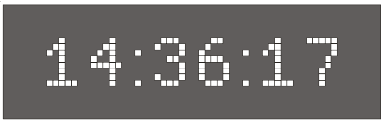



The handling of any queries will be simplified if the software revision is given by the user. The following menus are available then:

## Menu TIME

In this menu the current time is displayed (this is the default after power up).

## Menu DATE

After the Set button is pressed, the actual date appears on the display.

`DATE:` `30.01.06`

## Menu DAY o.W.

The day of the week will be displayed in this menu.

`DAY o.W.` `MONDAY`

## Menu PZF STAT

Information on the decoding of the pseudo-random sequence is available in this menu.

`PZF STAT`

The following texts may be displayed:

`RC: 00` `CHECK:12`

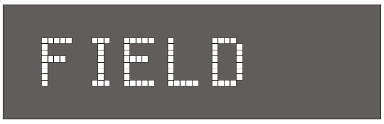
This message indicates that the system tries to achieve a coarse synchronisation. This procedure starts after power-up or worse receiption for more than ten seconds. If the coarse synchronisation was successfull, the receiver enters the state of fine-correlation. The system tries to lock the received PZF as exact as possible to generate a precise time frame. The display shows the correlation coefficient at the end of each second, which can be up to 100%. A high value for the coefficient should be achieved by choosing a suitable position for the antenna.

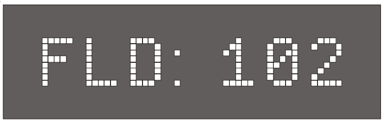
`FC: 87%`

The essential part of the tracking is completed five seconds after "FC: xx%" appeared and the generation of pulses per minute and per second starts. Tracking steps of three microseconds are possible each second until the internal realtime clock is synchronized (two minutes max.). Afterwards, corrections of the time frame are executed per minute only. The direction of these steps is displayed by the characters '>' or '<' behind the digits of the correlation coefficient.

## Menu FIELD

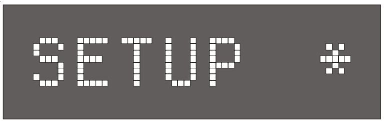
The digitized value of the field strength is displayed in this menu. There is a logarithmic relation between this value and the field strength. This menu is useful for mounting the antenna, like described in chapter 'Assembly of antenna'.






## Menu SETUP

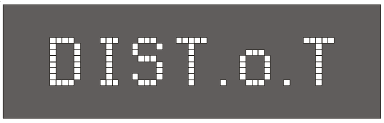
The user-specific parameters of the PZF511 are set in this menu. To avoid the erroneous change of these parameters, it is not possible to enter the submenus by a simple pressing of the Set-button. The first submenu is entered if the Set-button is pressed until the character '*' is displayed behind the text SETUP and the Menu-key is actuated then.

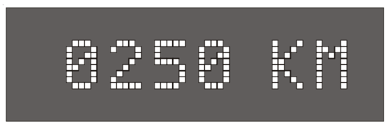



The following submenus are selectable (Set-button and Menu-key used as usual now):

## Menu DIST. o. T

The distance to the transmitter is entered in this menu for compensating the propagation delay of the received pseudo-random code. This setting should be done as exact as possible because the absolute precision of the time frame is influenced by this value.

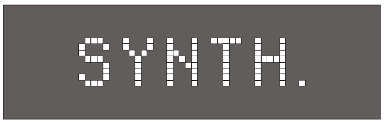


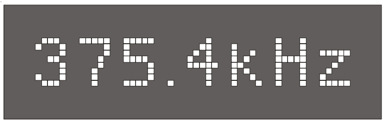



After pressing the Set-button a four digit kilometer-value is displayed. By pressing the Set-key again, the first position is selected (flashing digit). To choose a different digit, the Menu-key has to be pressed, to increment the current digit the Set-button must be used. If the value is entered, it will be stored by pressing the Menu-key until the display returns to the setup submenu. The km-value is stored in the internal EEPROM of the board.

## Menu SYNTH.

The output frequency of the internal synthesizer is selected in this menu. This can be done in the range of 1/3Hz to 9.999MHz.

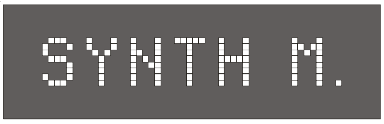


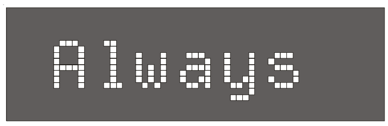



The frequency can be set here and the buttons are used the same way as for setting the DIST.o.T-value. In addition, the range of the frequency is defined and eiter xxx.xHz, x.xxxkHz, xx.xxkHz, xxx.xkHz or x.xxxMHz can be selected. In the first range (Hz) only the fractional digits 1/3Hz, 0.5Hz and 2/3Hz are accepted. After the frequency is entered the value becomes valid and is stored in the battery buffered RAM just after the Menu-button is pressed a longer time. Note: the sinewave output of the synthesizer provides an acceptable output signal not above 100kHz.

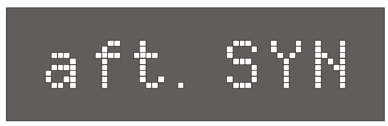
## Menu SYNTH M.

This menu configueres at which time after power-up the frequency generation of the synthesizer starts. The following settings are possible:Frequency-generation immediately after reset (allways),





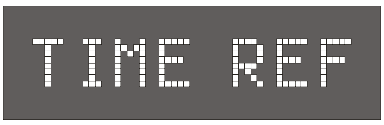

or the clock has to synchronize first before generation of the frequency starts (after synchronisation). Frequencies less than 10kHz are phase locked to the precise pulse per second at once.




Selection of the values happens like described.

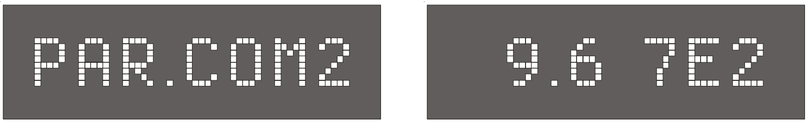
## Menu TIME REF

The displayed timezone can be set in this menu. Possible selections are:: UTC, MEZ/MESZ and MEZ (without daylight saving).



## Menu PAR.COMx

The three menus PAR.COM0 to PAR.COM2 allow the configuration of the serial RS232 ports COM0 to COM2.

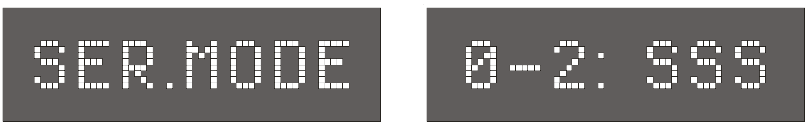



The following settings are possible:

Baudrate: 600, 1200, 2400, 4800, 9600 and 19200 Baud
Framing: 7N2, 7E1, 7E2, 8N1, 8N2, 8E1, 7O2 and 8O1

## Menu SER.MODE

The three serial ports COM0 to COM2 are able to send a time string in three different output modes. After the Set button is pressed the following is displayed:

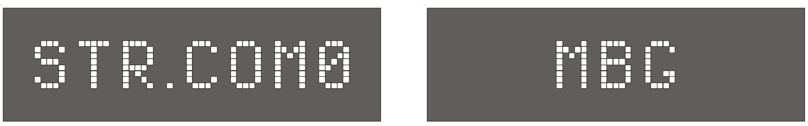



The three letters on the right side represent the output mode of the serial ports COM0, COM1 and COM2 (from the left to the right). With another brief push of the Set button the first letter starts to blink and can be set to one of the following values now:

'S' timestring starts with a new second
'M' timestring starts with a new minute
'R' timestring starts just after sending an ASCII '?' (3F hex) to the clock

## Menu STR.COMx

The three menus STR.COM0 to STR.COM2 allow the selection of the serial time strings for COM0, COM1 and COM2.

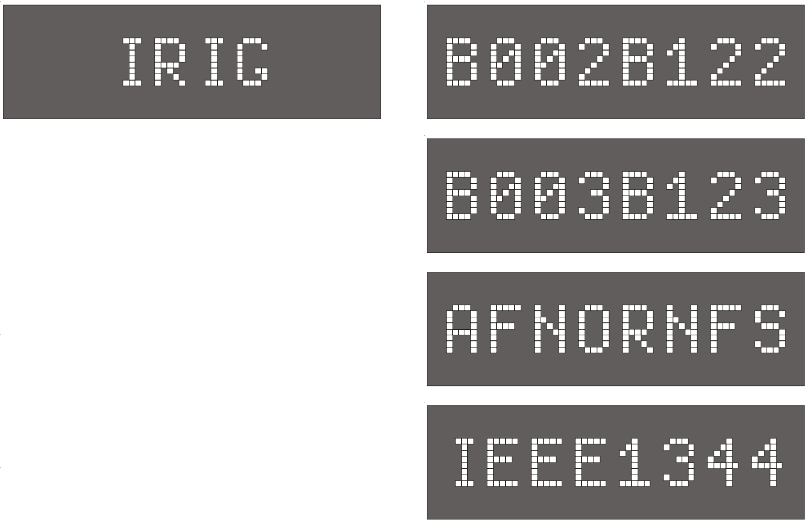



The following time strings can be selected:

- MBG - Meinberg Standard String
- Uni Erlangen String
- ATIS String

## Menu IRIG

This menu allows to select an IRIG, AFNOR or IEEE1344 timecode to be generated.




Besides the amplitude modulated sine wave signal, the PZF511 also provides an unmodulated DC-Level Shift TTL output in parallel. Thus six time codes are available.

a) B002: 100pps, PWM DC signal, no carrier
BCD time-of-year

b) B122: 100pps, AM sine wave signal, 1 kHz carrier frequency
BCD time-of-year

c) B003: 100pps, PWM DC signal, no carrier
BCD time-of-year, SBS time-of-day

d) B123: 100pps, AM sine wave signal, 1 kHz carrier frequency
BCD time-of-year, SBS time-of-day

e) AFNOR: Code according to NFS-87500, 100pps,
AM-Sine wave signal, 1kHz carrier frequency,
BCD time-of-year, complete date, SBS time-of-day,
Signal level according to NFS-87500

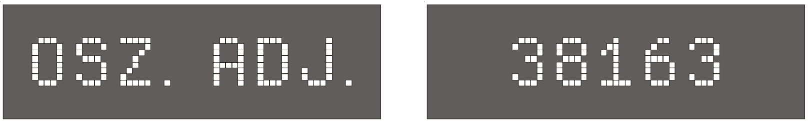
f) IEEE1344: Code according to IEEE1344-1995, 100pps,
AM sine wave signal, 1kHz carrier frequency,
BCD time-of-year, SBS time-of-day, IEEE1344
extensions for date, timezone, daylight-saving
and leap second in control functions (CF) segment.
*also see table 'Assignment of CF segment in IEEE1344 mode'*

## Menu IRIG REF

This menu lets the user select a timezone for the timecode generation.

## Menu OSZ.ADJ.

The standard version of the PZF511 includes a voltage controlled temperature compensated oszillator (TCXO). Its nominal frequency of 10MHz is adjusted by using two digital-to-analog converters (DACs). One of them is responsible for the coarse tuning and the other one for the fine adjustment of the oszillator.

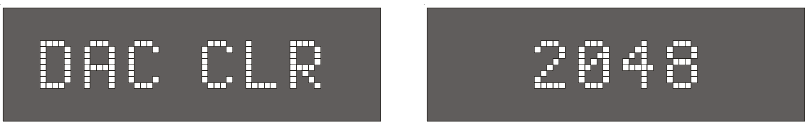



The value for the coarse-DAC is settable in this menu (range: 0...65535).

**Changes in this menu should be done by Meinberg, only, and not by the user!**

## Menu DAC CLR

The value of the fine DAC is displayed in this submenu.

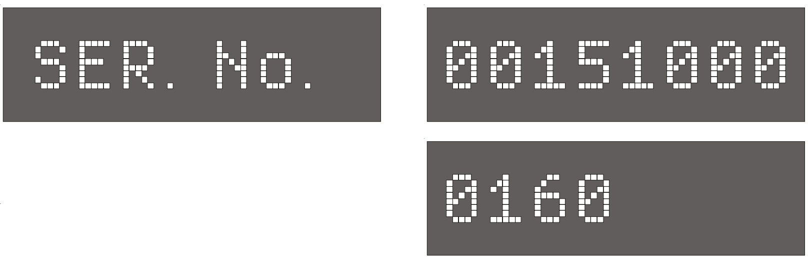



If the 'Set'-button is pressed for approximately two seconds, the DAC is set to its mid-scale value and the difference to its last value is added to the coarse DAC proportional. This process is released automatically if the value of the fine DAC exceeds its limits (0...4095).

**Therefore the setting of this value to mid-scale by hand is reserved for service purposes by Meinberg only.**

## Menu SER. No.

The 12-digit serial number of the PZF511 is displayed in this menu. This number may be helpful to know if the user asks Meinberg for support.




The most significant eight digits of the serial number are displayed first, after pressing the Set button the last four digits are shown.

## Asynchronous serial interfaces

Three independant serial RS232 interfaces are available at the rear connector of the clock PZF511. As set in menu SER.MODE, the serial ports can send the a time string either per second, per minute or on request by sending an ASCII '?' (3F hex) to the clock. Additional menus are used to set the framing and baudrate of these interfaces as well as the format of the time string. The structure of the strings are described in the chapter "Time Strings".

## Pulse outputs

TTL-low and TTL-high active pulses per minute and per second are generated by the PZF511, which are available at the VG-connector. TTL-high active pulses per 15 minutes (P_15MIN) are also available at the VG-connector.

Because the internal time frame of the clock has not yet been synchronized with the pseudo random sequence, no pulses are generated directly after reset. In case of normal receiption, the receiver needs about 12 seconds for coarse and another 5 seconds for fine synchronization. So, pulses are generated approximately 17 seconds after reset.

## Standard frequencies

The PZF511 provides four standard frequencies. The outputs 100kHz, 155kHz, 1MHz and 10MHz are derived from the main oszillator of the clock which is phase locked to the DCF-system by a digital PLL (phase locked loop). The temperature-dependant drift and the aging of the oszillator can be compensated by this procedure. Therefore the excellent short-term stability of the standard frequencies of +/- $5 \cdot 10^{-9}$ (standard version with TCXO) is achieved. The value for regulating the digital-to-analog converter of the PLL is avilable directly after reset because it is stored in the battery-backed RAM of the clock. If the DCF-transmitter fails, the oszillator is controled by this value also. The accuracy of the standard frequencies will not be worse than $1 \cdot 10^{-8}$ for one hour without receition therefore.

## Frequency synthesizer

The synthesizer of the PZF511 generates a frequency in the range of 1/3Hz up to 9.999MHz, which can be set in the menu SYNTH. The synthesizer-output is available with TTL-level, as a sinewave signal or an open drain output at the VG-connector. However, the sine wave output generates an acceptable output signal up to 100kHz, only.

The frequency to be generated can be adjusted by giving the four digits of highest-order, lower significant digits are set to zero. Only the fractions 1/3Hz, 0.5Hz and 2/3Hz are allowed in the Hertz-range, so frequencies of 1/3Hz or 2/3Hz lead to a periodic fraction, often used by ripple control systems.

Up to a value of 10kHz the synthesizer is phase-locked to the pulse per second. The accuracy of this frequency reaches the exactness of the standard frequencies therefore. Higher frequencies than 10kHz have a maximum error of +/- 2,35 mHz.

The behaviour of the synthesizer after power-up is selectable (see menu SYNTH. M), Frequency generation can start either directly after reset or after synchronization.

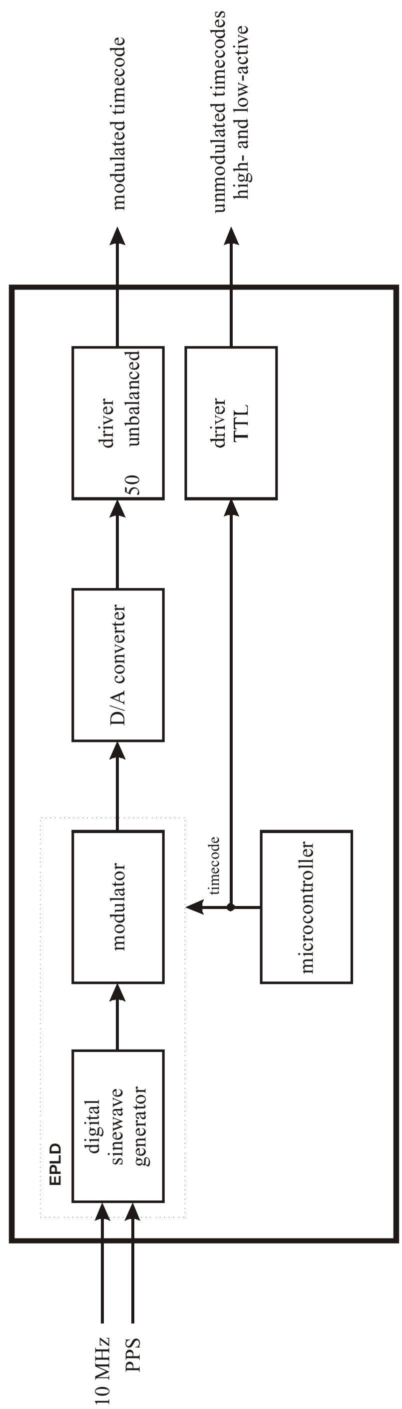
## Timecode

## Abstract

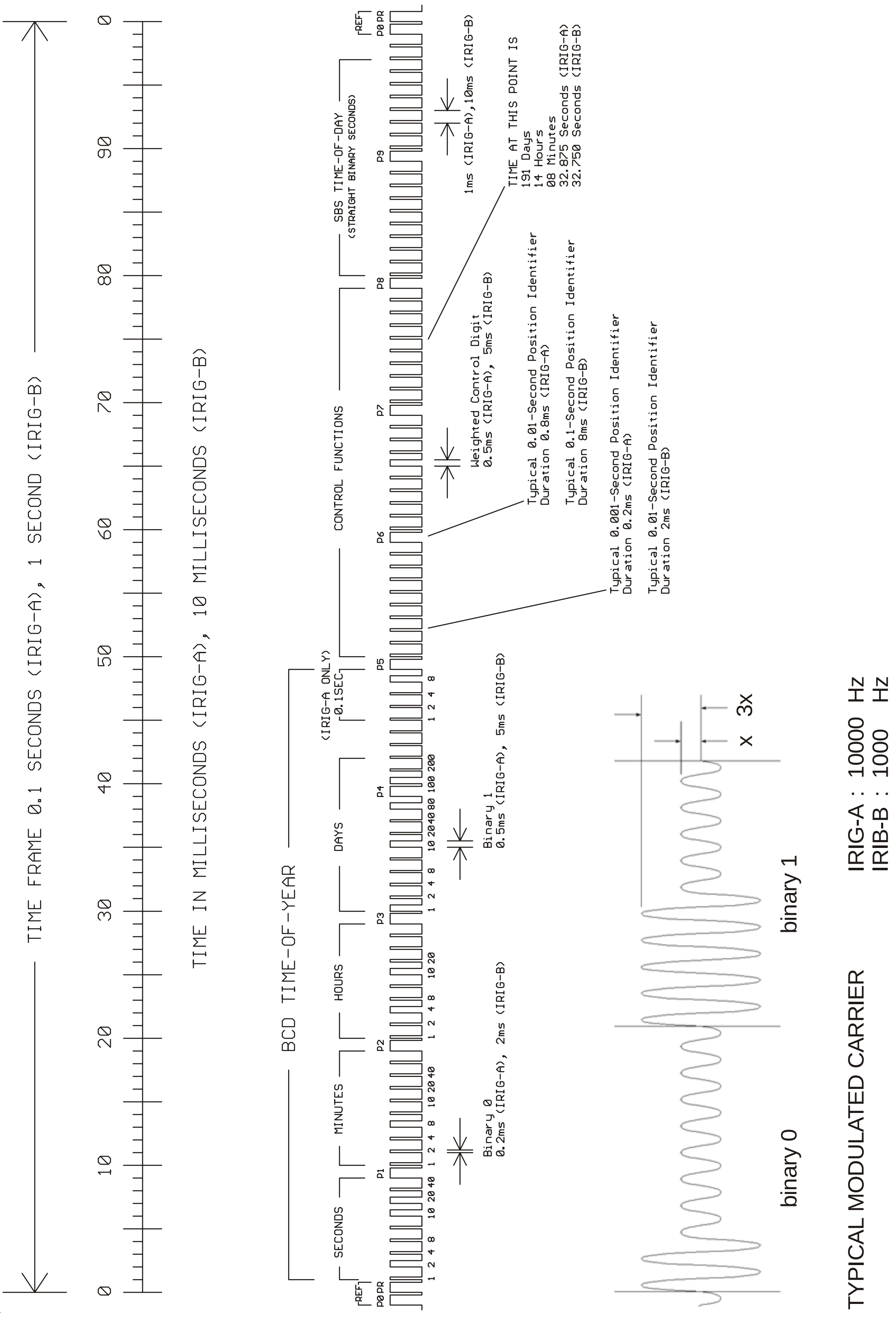
The transmission of coded timing signals began to take on widespread importance in the early 1950´s. Especially the US missile and space programs were the forces behind the development of these time codes, which were used for the correlation of data. The definition of time code formats was completely arbitrary and left to the individual ideas of each design engineer. Hundreds of different time codes were formed, some of which were standardized by the "Inter Range Instrumentation Group" (IRIG) in the early 60´s.

Except these "IRIG Time Codes", other formats like NASA36, XR3 or 2137 are still in use. The board PZF511 however generates the IRIG-B, AFNOR NFS 87-500 code as well as IEEE1344 code which is an IRIG-B123 code extended by information for time zone, leap second and date.

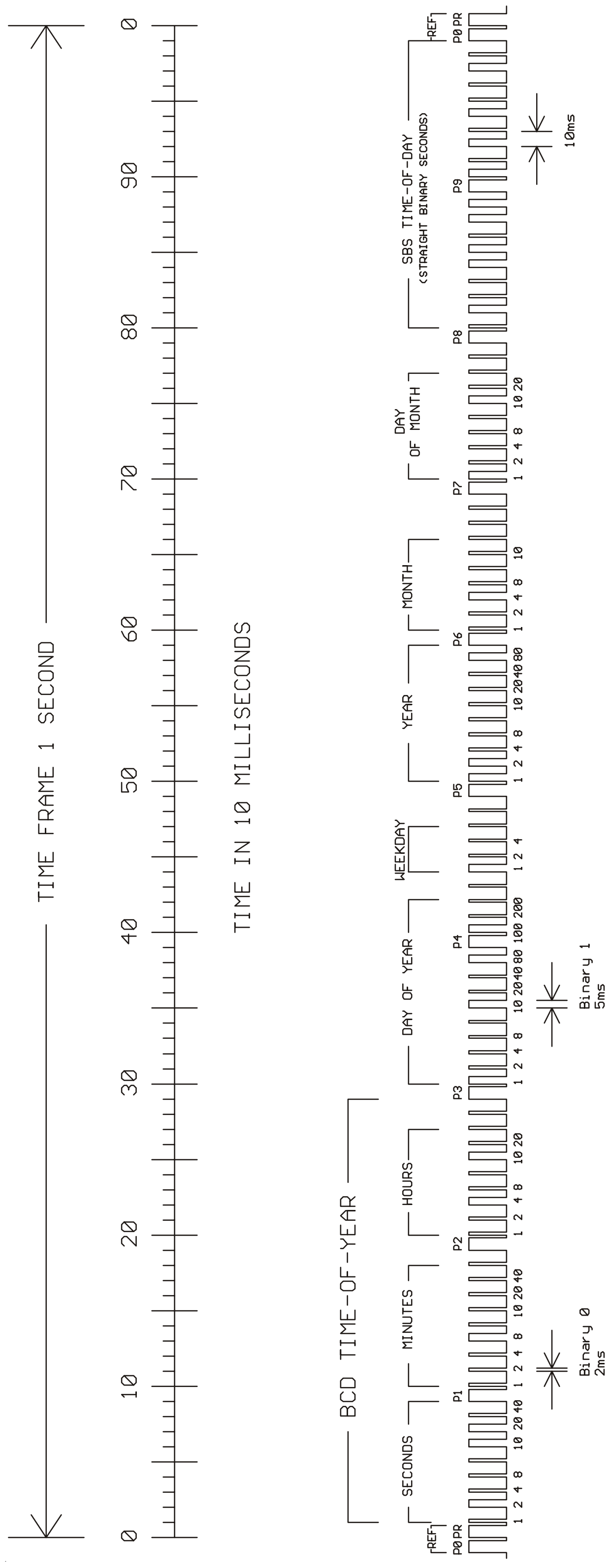
# Block Diagram Timecode



# IRIG Standard Format



# AFNOR Standard Format



## Assignment of CF Segment in IEEE1344 Code

| Bit Nr. | Bedeutung | Beschreibung |
|---|---|---|
| 49 | Position Identifier P5 | |
| 50 | Year BCD encoded 1 | unteres Nibble des BCD codierten Jahres |
| 51 | Year BCD encoded 2 | |
| 52 | Year BCD encoded 4 | |
| 53 | Year BCD encoded 8 | |
| 54 | empty, always zero | |
| 55 | Year BCD encoded 10 | oberes Nibble des BCD codierten Jahres |
| 56 | Year BCD encoded 20 | |
| 57 | Year BCD encoded 40 | |
| 58 | Year BCD encoded 80 | |
| 59 | Position Identifier P6 | |
| 60 | LSP - Leap Second Pending | bis zu 59s vor Schaltsekunde gesetzt |
| 61 | LS - Leap Second | 0 = LS einfügen, 1 = LS löschen [1.)] |
| 62 | DSP - Daylight Saving Pending | bis zu 59s vor SZ/WZ Umschaltung gesetzt |
| 63 | DST - Daylight Saving Time | gesetzt während Sommerzeit |
| 64 | Timezone Offset Sign | Vorzeichen des Zeitzonenoffsets 0 = '+', 1 = '-' |
| 65 | TZ Offset binary encoded 1 | Offset der IRIG Zeit gegenüber UTC<br>IRIG Zeit PLUS Zeitzonenoffset ( einschließlich Vorzeichen ) ergibt immer UTC |
| 66 | TZ Offset binary encoded 2 | |
| 67 | TZ Offset binary encoded 4 | |
| 68 | TZ Offset binary encoded 8 | |
| 69 | Position Identifier P7 | |
| 70 | TZ Offset 0.5 hour | gesetzt bei zusätzlichem halbstündigen Offset |
| 71 | TFOM Time figure of merit | TFOM gibt den ungefähren Fehler der Zeitquelle an [2.)]<br>0x00 = Uhr synchron<br>0x0F = Uhr im Freilauf |
| 72 | TFOM Time figure of merit | |
| 73 | TFOM Time figure of merit | |
| 74 | TFOM Time figure of merit | |
| 75 | PARITY | Parität aller vorangegangenen Bits |

[1.)] von der Firmware werden nur eingefügte Schaltsekunden ( 59->60->00 ) unterstützt !

[2.)] TFOM wird auf 0 gesetzt wenn die Uhr nach dem Einschalten einmal synchronisieren konnte, andere Codierungen werden von der Firmware nicht unterstüzt. *s.a. Auswahl des generierten Zeitcodes*.

## DC and AM Timecodes

DC-Level Shift Codes (PWM-signal) B00x and modulated sine wave carrier B12x are always generated simultaneously. Both signals are provided at the VG64-Connector, i.e. if code B132 is selected per menu, also code B002 is available. This applies for the codes AFNOR NFS 87-500 and IEEE1344 as well.

The TFOM field in IEEE1344 code is set dependent on the 'already sync'ed' character ('#') which is sent in the serial time telegram. This character is set, whenever the preconnected clock was not able to synchronize after power up reset. The 'time figure of merit' (TFOM) field is set as follows.

| | | |
|---|---|---|
| Clock synchronized once after power up | : | TFOM = 0000 |
| Clock not synchronized after power up | : | TFOM = 1111 |

## Sine Wave AM Output

The amplitude-modulated carrier is available at the VG-connector pin 14a. The carrier frequency is 1kHz (IRIG-B). The signal amplitude is $3V_{pp}$ (MARK) and $1V_{pp}$ (SPACE) into 50 Ω. The encoding is made by the number of MARK-amplitudes during ten carrier waves with the following agreements:

| | | | |
|---|---|---|---|
| a) | binary "0" | : | 2 MARK-amplitudes, 8 SPACE-amplitudes |
| b) | binary "1" | : | 5 MARK-amplitudes, 5 SPACE-amplitudes |
| c) | position-identifier | : | 8 MARK-amplitudes, 2 SPACE-amplitudes |

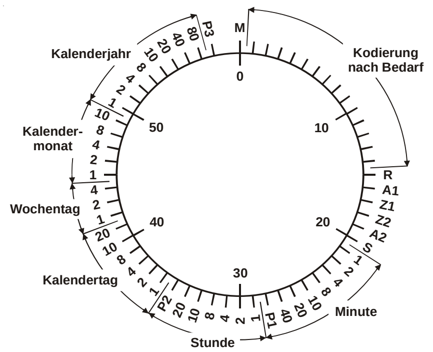
## PWM DC Output

The pulse width modulated DC signals shown in the diagramms "IRIG" and "AFNOR standard format" are coexistent to the modulated output and is available at the VG connector pin 13a with TTL level.

## DCF77 Emulation

The correlation receiver PZF511 generates TTL level time marks (active HIGH) which are compatible with the time marks spread by the German long wave transmitter DCF77. This long wave transmitter installed in Mainflingen near Frankfurt/Germany transmits the reference time of the Federal Republic of Germany: time of day, date of month and day of week in BCD coded second pulses. Once every minute the complete time information is transmitted. The PZF511 generates time marks representing always the

DCF-time including announcement of changes in daylight saving and announcement of leap seconds, changing the timezone in the setup menu has no effect on the generation. The coding sheme is given below:




| | |
|---|---|
| M | Minutenmarke (0.1 s) |
| R | Aussendung über Reserveantenne |
| A1 | Ankündigung Beginn/Ende der Sommerzeit |
| Z1, Z2 | Zonenzeitbits |
| | Z1, Z2 = 0, 1: Standardzeit (MEZ) |
| | Z1, Z2 = 1, 0: Sommerzeit (MESZ) |
| A2 | Ankündigung einer Schaltsekunde |
| S | Startbit der codierten Zeitinformation |
| P1, P2, P3 | gerade Paritätsbits |

Time marks start at the beginning of new second. If a binary "0" is to be transmitted, the length of the corresponding time mark is 100 msec, if a binary "1" is transmitted, the time mark has a length of 200 msec. The information on the current date and time as well as some parity and status bits can be decoded from the time marks of the 15th up to the 58th second every minute. The absence of any time mark at the 59th second of a minute signals that a new minute will begin with the next time mark. The DCF emulation output is enabled immediately after power-up.

## Realtime clock

The PZF511 includes a battery-backed realtime clock which runs crystal-precise in case of power failure. A relativ accurate time is present immediately after power-up this way. An additional RAM of the realtime clock is used to store important system parameters.

## TIME_SYN output

This output is set to TTL-high if the receiver is in synchronous state (LED 'Freil' switched off). The output level changes to TTL-low if the receiver is in asynchronous state for more than one hour. The TIME_SYN output is available at the VG-connector and can be used to release an alarm, for example.

## Firmware updates

Whenever the on-board software must be upgraded or modified, the new firmware can be downloaded to the internal flash memory via the serial port COM0. There is no need to remove the board to insert a new EPROM.

If the 'Menu' key on the front panel is pressed or the pin '/BOOT' at the blade-connector strip is held at TTL-low level while the system is powered up, a bootstrap-loader is actived and waits for instructions from the serial port COM0. The new firmware can be sent to PZF511 from any standard PC with serial interface. A loader program will be shipped together with the file containing the image of the new firmware.

The contents of the program memory will not be modified until the loader program has sent the command to erase the flash memory. So if the 'Menu' key is pressed unintentionally while the system is powered up, the firmware will not be changed accidentially. After the next power-up, the system will be ready to operate again.

## Replacing the lithium battery

The life time of the lithium battery on the board is at least 10 years. If the need arises to replace the battery, the following should be noted:

**ATTENTION!**

**Danger of explosion in case of inadequate replacement of the lithium battery. Only identical batteries or batteries recommended by the manufacturer must be used for replacement. The waste battery must be disposed as proposed by the manufacturer of the battery.**

## CE Label

This device conforms to the directive 2004/108/EG on the approximation of the laws of the Member States of the European Community relating to electromagnetc compatibility.

## Technical specifications

| | |
|---|---|
| RECEIVER: | Two seperate receiver channels for signal conversion and best aquisition and tracking of the DCF77 signal.<br>Reception via external ferrite antenna AW02. |
| CONTROL OF RECEPTION: | The DCF-signal is checked for minimum field strength by micro-processor. The result is indicated by LED.<br>In addition, the value of the digitized field strength is displayed in menu 'FIELD'. |
| BATTERY-BACKUP: | In case of power failure an internal realtime clock runs crystal-precise. Important parameters are stored in the system-RAM.<br>Life time of lithium battery: 10 years minimum<br>Option: backup capacitor for about 150 hours |
| DISPLAY: | Eight-digit alphanumeric display shows important time and status information. Digit-height 5mm. |
| INTERFACES: | Three independent RS232 ports |
| BAUD RATES: | 600, 1200, 2400, 4800, 9600 or 19200 Baud |
| FRAMING: | 7N2, 7E1, 7E2, 8N1, 8N2, 8E1, 7O2 or 8O1 |
| PULSE OUTPUTS: | Active-high and active-low pulses per minute and per second, TTL-level, pulse duration: 200ms<br>Active-high pulses per 15 minutes, TTL, pulse duration: 200ms |
| ACCURACY OF PULSES: | Time delay of two systems PZF511 with a maximum distance of 50km: typ. 20µs, max. 50µs<br>Time shifting of successive pulses: max. 1.5µs |
| PROPAGATION-TIME COMPENSATION: | The signal delay is compensated if the distance of the receiver to the transmitter is given. |

| | | | |
|---|---|---|---|
| STANDARD FREQUENCIES: | 100kHz, 155kHz, 1MHz and 10MHz are synchronized to DCF by a digital PLL.<br>For accuracy refer to table "Oscillator Types". | | |
| SYNTHESIZER: | Frequency range: | | 1/3Hz...9,999MHz |
| | Accuracy: | < 10kHz: | refer to table "Oscillator Types" |
| | | > 10kHz: | +/- 2,35mHz max. |
| | Phase jitter: | | max. 60ns |

| | | | |
|---|---|---|---|
| SYNTHESIZER-OUTPUTS: | F_SYNTH: | TTL-level | |
| | F_SYNTH_OD: | Open Drain | |
| | | Max. drain-source-voltage: | 100 V |
| | | Max. drain-current: | 100 mA |
| | | Dissipation power, 25° C: | < 360 mW |
| | F_SYNTH_SIN: | Sinewave | |
| | | Output voltage: | 1.5 V eff. |
| | | Output impedance: | 200 Ohm |

| | | |
|---|---|---|
| TIMECODE-OUTPUTS: | AM: | Unbalanced AM-sine wave-signal:<br>$3V_{PP}$ (MARK) / $1V_{PP}$ (SPACE) into 50Ω |
| | DC: | PWM signal, TTL, high active |

| | |
|---|---|
| TIME_SYN OUTPUT: | TTL-level, logical-high if receiver is synchronous |
| TERMINAL CONNECTION: | Blade-connector strip VG64, DIN 41612<br>Sub-miniatur coaxial HF-connector (SMB) |
| BOARD DIMENSIONS: | Eurocard size 100mm x 160mm, Epoxy 1,5mm<br>Front panel 12TE (61mm) |
| ANTENNA: | Ferrite antenna in plastic housing |
| HUMIDITY: | Relativ humidity 85% max. |
| TEMPERATURE RANGE: | 0 ... 50°C |
| POWER SUPPLY: | + 5V, 230mA |

## PZF511 with different oscillator options

The correlation receiver PZF511 can be equipped with several different oscillator types. Compared with the standard version (TCXO) the accuracy specifications are changed as given in the following table:

| | TCXO | OCXO LQ | OCXO MQ | OCXO HQ |
|---|---|---|---|---|
| short term stability<br>$\tau$ = 1 sec | 4 * 10 E-9 | 2 * 10 E-9 | 4 * 10 E-10 | 2 * 10 E-11 |
| accurracy free run<br>one day | +/- 1 * 10 E-7<br>+/- 1 Hz (Note 1) | +/- 2 * 10 E-8<br>+/- 0.2 Hz (Note 1) | +/- 1,5 * 10 E-9<br>+/- 15 mHz (Note 1) | +/- 5 * 10 E-10<br>+/- 5 mHz (Note 1) |
| accurracy free run<br>one year | +/- 1 * 10 E-6<br>+/- 10 Hz (Note 1) | +/- 4 * 10 E-7<br>+/- 4 Hz (Note 1) | +/- 1 * 10 E-7<br>+/- 1 Hz (Note 1) | +/- 5 * 10 E-8<br>+/- 0.5 Hz (Note 1) |
| phase noise | 1 Hz -60 dBc/Hz<br>10 Hz -90 dBc/Hz<br>100 Hz -120 dBc/Hz<br>1 kHz -130 dBc/Hz | 1 Hz -60 dBc/Hz<br>10 Hz -90 dBc/Hz<br>100 Hz -120 dBc/Hz<br>1 kHz -130 dBc/Hz | 1 Hz -75 dBc/Hz<br>10 Hz -110 dBc/Hz<br>100 Hz -130 dBc/Hz<br>1 kHz -140 dBc/Hz | 1 Hz -95 dBc/Hz<br>10 Hz -125 dBc/Hz<br>100 Hz -145 dBc/Hz<br>1 kHz -155 dBc/Hz |
| power supply at 25°C<br>steady state<br>warm up | +5V / 20 mA<br>N/A | +5V / 160 mA<br>+5V / 380 mA | +5V / 90 mA<br>+5V / 330 mA | +5V / 160 mA<br>+5V / 600 mA |
| temperature dependant drift<br>free run | +/- 1 * 10 E-6<br>(-20...70°C) | +/- 2 * 10 E-7<br>(0...60°C) | +/- 5 * 10 E-8<br>(-20...70°C) | +/- 1 * 10 E-8<br>(5...70°C) |

**Table1: Oscillator Types**

The accurracy in Hertz is based on the standard frequency of 10 MHz. For example:
Accurracy of TCXO (free run one day) is +/- 1 * 10 E-7 * 10 MHz = +/- 1 Hz

## Time Strings

## Format of the Meinberg Standard Time String

The Meinberg Standard Time String is a sequence of 32 ASCII characters starting with the STX (start-of-text) character and ending with the ETX (end-of-text) character. The format is:

**<STX>D:*dd.mm.yy*;T:*w*;U:*hh.mm.ss*;*uvxy*<ETX>**

The letters printed in *italics* are replaced by ASCII numbers whereas the other characters are part of the time string. The groups of characters as defined below:

<STX> Start-Of-Text (ASCII code 02h)

*dd.mm.yy* the current date:
- *dd* day of month (01..31)
- *mm* month (01..12)
- *yy* year of the century (00..99)

*w* the day of the week (1..7, 1 = Monday)

*hh.mm.ss* the current time:
- *hh* hours (00..23)
- *mm* minutes (00..59)
- *ss* seconds (00..59, or 60 while leap second)

*uv* clock status characters (depending on clock type):

*u*:
- '#' GPS: clock is running free (without exact synchr.)
  PZF: time frame not synchronized
  DCF77: clock has not synchronized after reset
- ' ' (space, 20h)
  GPS: clock is synchronous (base accuracy is reached)
  PZF: time frame is synchronized
  DCF77: clock has synchronized after reset

*v*:
- '*' GPS: receiver has not checked its position
  PZF/DCF77: clock currently runs on XTAL
- ' ' (space, 20h)
  GPS: receiver has determined its position
  PZF/DCF77: clock is syncronized with transmitter

*x* time zone indicator:
- 'U' UTC Universal Time Coordinated, formerly GMT
- ' ' MEZ European Standard Time, daylight saving disabled
- 'S' MESZ European Summertime, daylight saving enabled

*y* anouncement of discontinuity of time, enabled during last hour before discontinuity comes in effect:
- '!' announcement of start or end of daylight saving time
- 'A' announcement of leap second insertion
- ' ' (space, 20h) nothing announced

<ETX> End-Of-Text (ASCII code 03h)

## Format of the ATIS standard Time String

The ATIS standard Time String is a sequence of 23 ASCII characters terminated by a CR (Carriage Return) character. The format is:

**<GID><ABS><TSQ><CC><CS><ST>*yymmddhhmmsswcc*<GID><CR>**

The letters printed in *italics* are replaced by ASCII numbers whereas the other characters are part of the time string. The groups of characters as defined below:

| | | | |
|---|---|---|---|
| <GID> | Address of the receiver | | code 7Fh |
| <ABS> | Originator of message | ASCII '0' | code 30h |
| <TSQ> | Telegram number | ASCII '0' | code 30h |
| <CC> | Command code | ASCII 'S' for SET | code 53h |
| <CS> | Command code | ASCII 'A' for ALL | code 41h |
| <ST> | Time status | ASCII 'C' for valid time | code 43h |

| | | | |
|---|---|---|---|
| *yymmdd* | the current date: | | |
| | *yy* | year of the century | (00..99) |
| | *mm* | month | (01..12) |
| | *dd* | day of month | (01..31) |
| *hh:mm:ss* | the current time: | | |
| | *hh* | hours | (00..23) |
| | *mm* | minutes | (00..59) |
| | *ss* | seconds | (00..59, or 60 while leap second) |
| *w* | the day of the week | | (1..7, 1 = 31h = Monday) |
| *cc* | checksum in hex, built from all characters including GID, ABS, TSQ, CC, ST, ... | | |
| <CR> | Carriage Return, ASCII code 0Dh | | |

**Default RS232 Settings:**

Baudrate: 2400 Bd, Framing: 7E1

## Format of the Uni Erlangen String (NTP)

The time string Uni Erlangen (NTP) is a sequence of 66 ASCII characters starting with the STX (start-of-text) character and ending with the ETX (end-of-text) character. The format is:

***<STX>tt.mm.jj; w; hh:mm:ss; voo:oo; acdfg i;bbb.bbbbn lll.llle hhhh*m*<ETX>***

The letters printed in *italics* are replaced by ASCII numbers whereas the other characters are part of the time string. The groups of characters as defined below:

| | | | |
|---|---|---|---|
| <STX> | Start-Of-Text, ASCII Code 02h<br>sending with one bit occuracy at change of second | | |
| *dd.mm.yy* | the current date: | | |
| | *dd* | day of month | (01..31) |
| | *mm* | month | (01..12) |
| | *yy* | year of the century | (00..99) |
| *w* | the day of the week | | (1..7, 1 = Monday) |
| *hh.mm.ss* | the current time: | | |
| | *hh* | hours | (00..23) |
| | *mm* | minutes | (00..59) |
| | *ss* | seconds | (00..59, or 60 while leap second) |
| *v* | sign of the offset of local timezone related to UTC | | |
| *oo:oo* | offset of local timezone related to UTC in hours and minutes | | |
| *ac* | clock status characters: | | |
| | *a*: | ‘#’ | clock has not synchronized after reset |
| | | ‘ ‘ | (space, 20h) clock has synchronized after reset |
| | *c*: | ‘*’ | GPS receiver has not checked its position |
| | | ‘ ‘ | (space, 20h) GPS receiver has determined its position |
| *d* | time zone indicator: | | |
| | ‘S’ | MESZ | European Summertime, daylight saving enabled |
| | ‘ ‘ | MEZ | European Standard Time, daylight saving disabled |
| *f* | anouncement of discontinuity of time, enabled during last hour before discontinuity comes in effect: | | |
| | ‘!’ | announcement of start or end of daylight saving time | |
| | ‘ ‘ | (space, 20h) nothing announced | |

| | |
|---|---|
| *g* | anouncement of discontinuity of time, enabled during last hour before discontinuity comes in effect:<br>'A' announcement of leap second insertion<br>' ' (space, 20h) nothing announced |
| *i* | leap second insertion<br>'L' leap second is actually inserted (active only in 60th sec.)<br>' ' (space, 20h) no leap second is inserted |

***The following information regarding the receiver position is set to zero because receiver does not support this.***

---

| | |
|---|---|
| *bbb.bbbb* | latitude of receiver position in degrees<br>leading signs are replaced by a space character (20h) |
| *n* | latitude, the following characters are possible:<br>'N' north of equator<br>'S' south d. equator |
| *lll.llll* | longitude of receiver position in degrees<br>leading signs are replaced by a space character (20h) |
| *e* | longitude, the following characters are possible:<br>'E' east of Greenwich<br>'W' west of Greenwich |
| *hhhh* | altitude above sea level in meters<br>leading signs are replaced by a space character (20h) |

---

<ETX> End-Of-Text, ASCII Code 03h

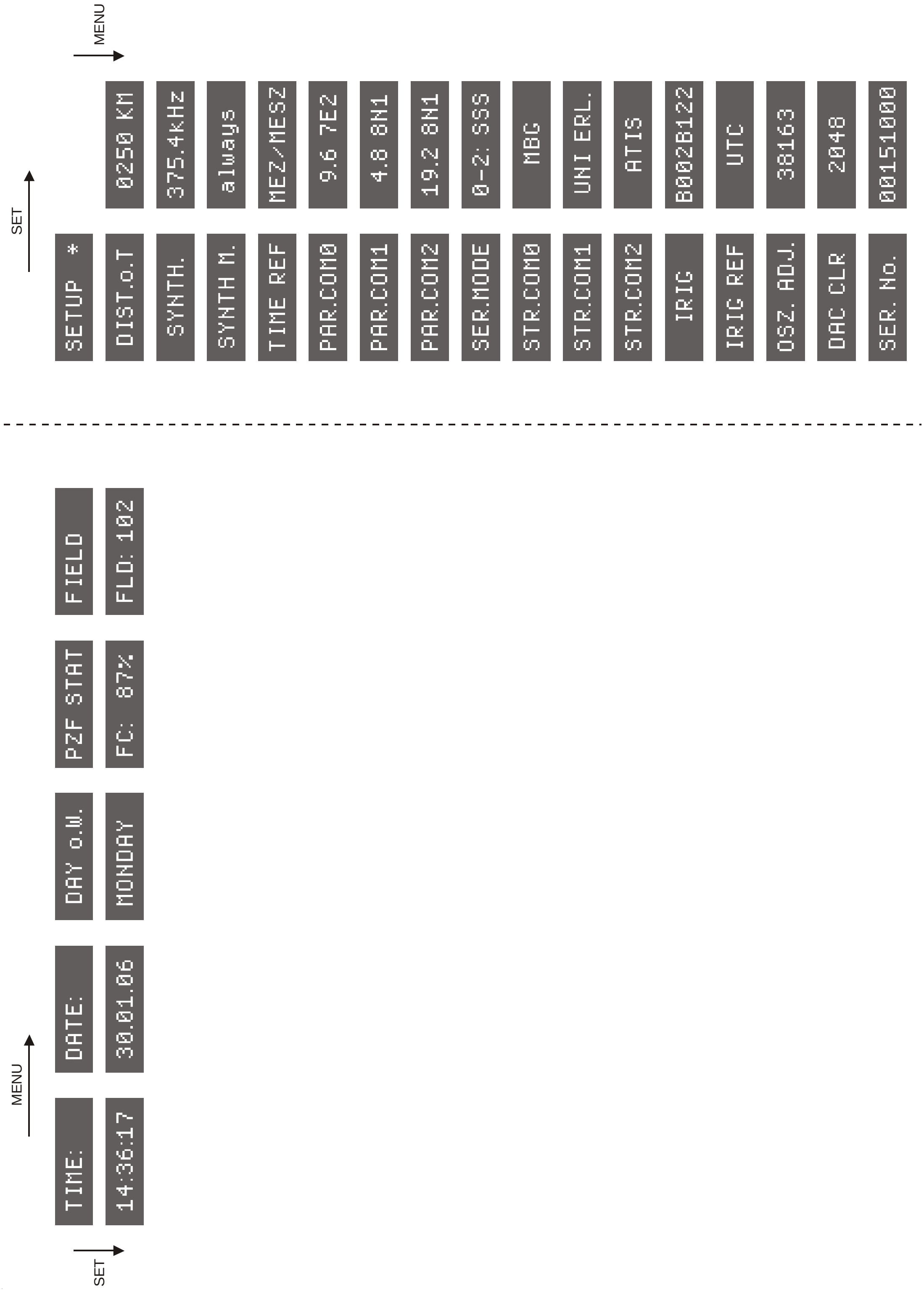
## Signal description PZF511

| Name | Pin | Function |
|---|---|---|
| GND | 32a+c | Reference potential |
| VCC in (+5V) | 1a+c | +5V power supply |
| VDD in (+12V) | 2a+c | +12V power supply, not used by standard |
| DCF_MARk out | 17c | DCF77 emulation, TTL, active high<br>pulse duration: 100ms or 200ms |
| P_15MIN out | 4c | Pulse per 15 minutes, TTL-level, active high |
| P_SEC out | 6c | Pulse per second, TTL-level, active high |
| /P_SEC out | 6a | Pulse per second, TTL-level, active low |
| P_MIN out | 8c | Pulse per minute, TTL-level, active high |
| /P_MIN out | 8a | Pulse per minute, TTL-level, active low |
| 100kHz out | 10a | 100kHz frequency output, TTL-level |
| 155kHz out | 11c | 155kHz frequency output, TTL-level |
| 1MHz out | 11a | 1MHz frequency output, TTL-level |
| 10MHz out | 12a | 10MHz frequency output, TTL-level |
| F_SYNTH out | 21c | Synthesizer frequency, TTL-level |
| F_SYNTH_OD out | 22c | Synthesizer frequency, open-drain |
| F_SYNTH_SIN out | 23c | Synthesizer frequency, sinewave |
| Timecode_AM | 14a | Timecode, amplitude modulated 1kHz sinewave carrier |
| Timecode_DC | 13a | Timecode, TTTL-level, active high |
| COM0 TxD out | 26c | COM0 RS-232 output |
| COM0 RxD in | 30c | COM0 RS-232 input |
| COM1 TxD out | 24c | COM1 RS-232 output |
| COM1 RxD in | 29c | COM1 RS-232 input |
| COM2 TxD out | 16a | COM2 RS-232 output |
| COM2 RxD in | 15a | COM2 RS-232 input |
| /BOOT in | 4a | Input for activating the bootstrap-loader |
| TIME_SYN out | 19c | Status output, TTL-level, high if synchronous |
| /RESET in | 9c | Input for external RESET |
| reserved | | Reserved for future expansions, do not connect |

## Rear Connector Pin assignment

| | a | c |
|---|---|---|
| 1 | VCC in (+5V) | VCC in (+5V) |
| 2 | VDD in (+12V) | VDD in (+12V) |
| 3 | | |
| 4 | /BOOT in | P_15MIN out |
| 5 | | reserved |
| 6 | /P_SEC out | P_SEC out |
| 7 | | |
| 8 | /P_MIN out | P_MIN out |
| 9 | | /RESET in/out |
| 10 | 100 kHz out | |
| 11 | 1 MHz out | 155 kHz out |
| 12 | 10 MHz out | |
| 13 | Timecode_DC | PPS_IN (optional) |
| 14 | Timecode_AM | |
| 15 | COM2 RxD in | |
| 16 | COM2 TxD out | |
| 17 | | DCF_MARK out |
| 18 | | |
| 19 | | TIME_SYN out |
| 20 | | |
| 21 | | F_SYNTH out |
| 22 | | F_SYNTH_OD out |
| 23 | | F_SYNTH_SIN out |
| 24 | | COM1 TxD out |
| 25 | | |
| 26 | | COM0 TxD out |
| 27 | | Capture1 (optional) |
| 28 | | Capture0 (optional) |
| 29 | | COM1 RxD in |
| 30 | | COM0 RxD in |
| 31 | | |
| 32 | GND | GND |

# Menüstruktur  PZF511



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