Technical Information

Operating Instructions

PZF600

Impressum

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Table of contents

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 PZF600

The PZF600 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 PZF600 and synchronizes the internal realtime clock.

By evaluating the pseudorandom phase noise, the PZF600 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 PZF600 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.

Compared to the former PZF511 the new PZF600 provides the capability to evaluate the high-precision pseudorandom phase noise as well as the common amplitude modulated AM signal. If the PZF signal is disturbed an cannot be received, the PZF600 automatically switches over to decode the AM signal, if available, and ensures synchronisation.

The PZF600 generates an IRIG timecode that is available at the rear VG-connector both as a modulated AM and as an unmodulated DCoutput. Furthermore, the receiver provides active-low and active-high TTL pulses per minute and per second. To spread time, date and status information, four independent serial interfaces (RS232 COM ports) are used which are configurable in a setup menu.

The PZF600 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 PZF600 from its application (field programmable).

Installation PZF600

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 antenna should be installed with a minimum distance of 30cm to all metal objects and, if possible, to any microcomputers and the PZF600 itself as well. A distance of several meters to TV- or computermonitors must be kept.

With help of the menu 'FIELD' the adjustment of the antenna can be done easily. 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° into 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 LEDs

The **Field**-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.
Whenever the reception of the pseudorandom PZF signal is not possible but the AM signal is available, the 'Field'-LED starts to blink once per second with a pulse duration of 100 or 200ms, corresponding to the demodulated DCF pulses.

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. Furthermore, this LED is switched on whenever the receiver is using the AM signal instead of the PZF signal for synchronisation, no matter if the clock is sync'ed or not.

If the **Free**-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 PZF600, because two DCF-telegrams are checked for plausibility before the data is taken over. Short disturbance of receiption can cause this state too.
This LED is switched off when the receiver is synchronous, this applies for PZF reception as well as for AM reception.

Display

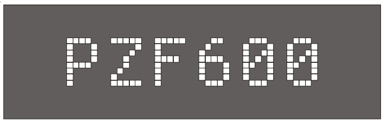
The eight digit alphanumeric display shows important information concerning status and time. The setting of system parameters is also done with the help of the display.

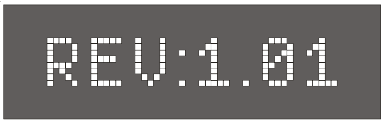
Control keys

It is possible to change the displayed information (time, date or status information) by two keys. Pushing *Menu* selects one of the available menus. After presing *Set* the corresponding 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 PZF600 switches to time-display automatically:

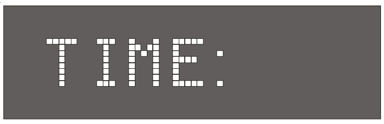




The handling of any queries will be simplified if the software revision can be given by the user. The following menus are available then:

Menu TIME

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



Menu DATE

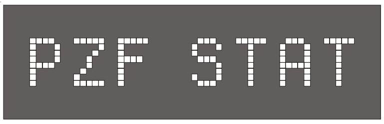
After *Set* is pressed, the actual date appears on the display.

Menu DAY o.W.

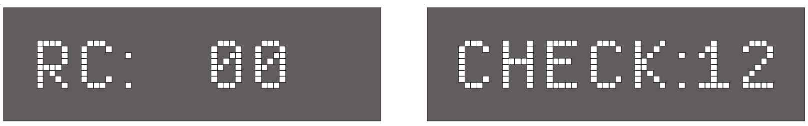
The day of the week will be displayed in this menu.

Menu PZF STAT

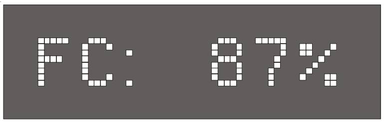
Information on the decoding of the pseudo-random sequence is available in this menu.



The following content may be displayed:



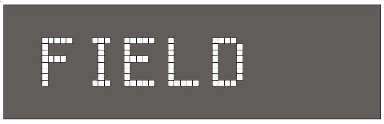
This message indicates that the system tries to achieve a coarse synchronisation. This procedure starts after power-up or worse receiption for more than ten seconds. If the coarse synchronisation was successfull, the receiver enters the state of fine-correlation. The system tries to lock the received 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.

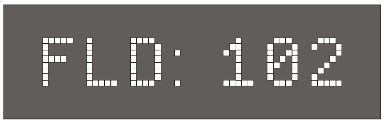


The essential part of the tracking is completed five seconds after "FC: xx%" appeared. Tracking steps of three microseconds are possible each second until the internal realtime clock is synchronized (two minutes max.). Afterwards, corrections of the time frame are executed per minute only. The direction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

Menu FIELD

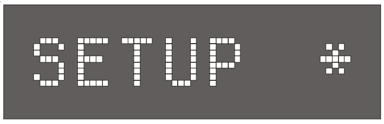
The digitized field strength is displayed in this menu. There is a logarithmic relation between this value and the field strength. This menu is useful for mounting the antenna, like described in chapter 'Assembly of antenna'.





Menu SETUP

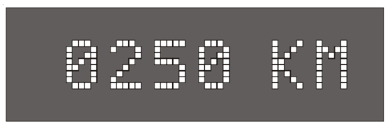
The user-specific parameters of the PZF600 are set in this menu. To avoid the erroneous change of these parameters, it is not possible to enter the submenus just by pressing *Set*. The first submenu can be entered not before the *Set* button is pressed until the character '*' is displayed behind the text SETUP (> 2sec.) and the *Menu* key is pressed thereafter.



The following submenus are selectable (*Set* and *Menu* are used as usual):

Menu DIST. o. T

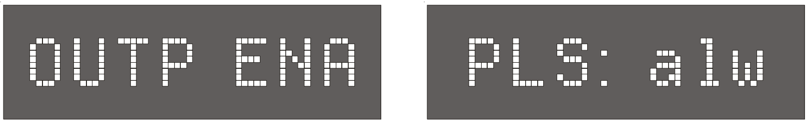
The distance to the transmitter is entered in this menu for compensating the propagation delay of the received pseudo-random code. This setting should be done as exact as possible because the absolute precision of the time frame is influenced by this value.



After pressing *Set* a four digit value is displayed (kilometers). By pressing *Set* again, the first position is selected (flashing digit). To select the next digit, the *Menu* must be pressed, to increment the current digit, *Set* must be used. When the value is entered completely, it is stored by pressing *Menu* until the display returns to the setup submenu. The km-value is stored in the internal EEPROM of the board.

Menu OUTP ENA

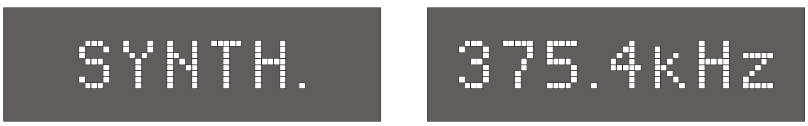
This menu defines when the output signals are enabled after powering up the system. The following settings are possible: output signal generation starts immediately after reset (**alw**ays), or the clock has to synchronize first before the signals are enabled (**a**fter **sy**nc). This selection can be done separately for the pulse outputs (**PLS**), the serial interfaces (**SER**) and the programmable synthesizer (**SYN**). After pressing *Set* the following content is displayed:



Pushing *Set* again, the option on the right side starts blinking. Selection of the available options (**alw** and **asy**) is made with *Set* as well. To make this selection also for the other output signals, *Menu* must be pushed once. When this enabling is defined for all output signals, the configuration ist stored by keeping *Set* pressed for a while. The sub menu is displayed again.

Menu SYNTH.

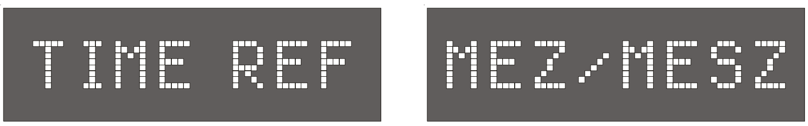
The output frequency of the internal synthesizer is selected in this menu. This can be done in the range of 1/3Hz to 9.999MHz.



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.

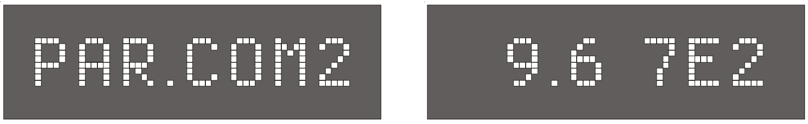
Menu TIME REF

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



Menu PAR.COMx

The four menus PAR.COM0 to PAR.COM3 allow the configuration of the serial RS232 ports COM0 to COM3.

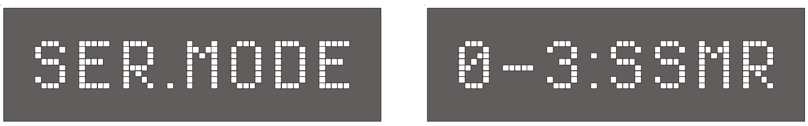


The following settings are possible:

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

Menu SER.MODE

The four serial ports COM0 to COM3 are able to send out time strings in three different output modes. After the Set button is pressed the following content is displayed:

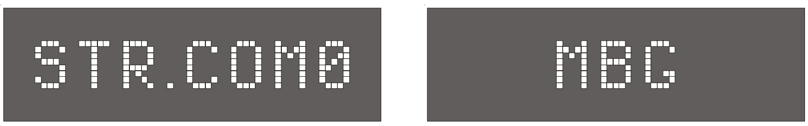


The four letters on the right side represent the output mode of the serial ports COM0, COM1, COM2 and COM3 (from the left to the right). With another brief push of the *Set* button the first letter starts to blink and can be set to one of the following options now:

'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 four menus STR.COM0 to STR.COM3 allow the selection of the serial time string formats for COM0, COM1, COM2 and COM3.



The following time strings can be selected:

- MBG - Meinberg Standard String
- Uni Erlangen String
- ATIS String
- Sysplex String
- SAT String
- SPA String
- CompuTime String

Menu IRIG

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

IRIG → B002B122

B003B123

AFNORNFS

IEEE1344

Besides the amplitude modulated sine wave signal, the PZF600 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'

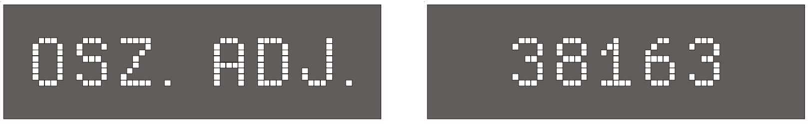
Menu IRIG REF

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

IRIG REF → UTC

Menu OSZ.ADJ.

The standard version of the PZF600 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.

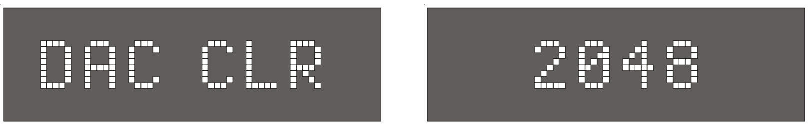


The value for the coarse-DAC is settable in this menu (range: 0...65535).

Changes in this menu should be done by *MEINBERG*, only!

Menu DAC CLR

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

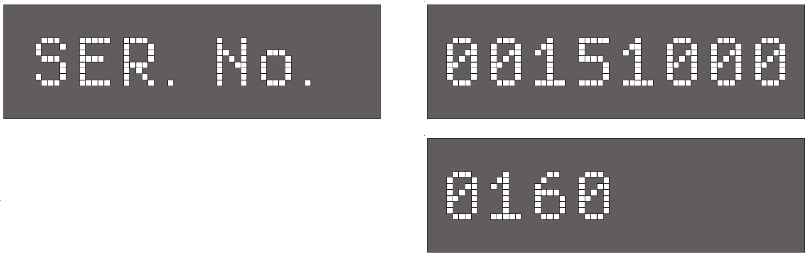


If the *Set* button is pressed for approximately two seconds, the DAC is set to its mid-scale value and the difference to its last value is added to the coarse DAC proportional. This process is released automatically if the value of the fine DAC exceeds its limits (0...4095).

This action is reserved for service purposes by *MEINBERG*, only!

Menu SER. No.

The 12-digit serial number of the PZF600 is displayed in this menu. This number is 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

Four independant serial RS232 interfaces are available at the rear connector of the PZF600. As set in menu SER.MODE, the serial ports can send a time string either once per second, once per minute or on request only 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 PZF600, which are available at the VG-connector.

Corresponding to the settings made in the menu OUTP ENA, the pulses are generated either immediately after power up or not until the first synchronisation of the receiver occurs.

Standard frequencies

The PZF600 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 PZF600 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 10kHz the synthesizer is phase-locked to the pulse per second. The accuracy of this frequency reaches the accuracy of the standard frequencies therefore. Higher frequencies than 10kHz have a maximum error of +/- 2,35 mHz.

Corresponding to the settings made in the menu OUTP ENA, the synthesizer frequency is generated either immediately after power up or not until the first synchronisation of the receiver occurs.

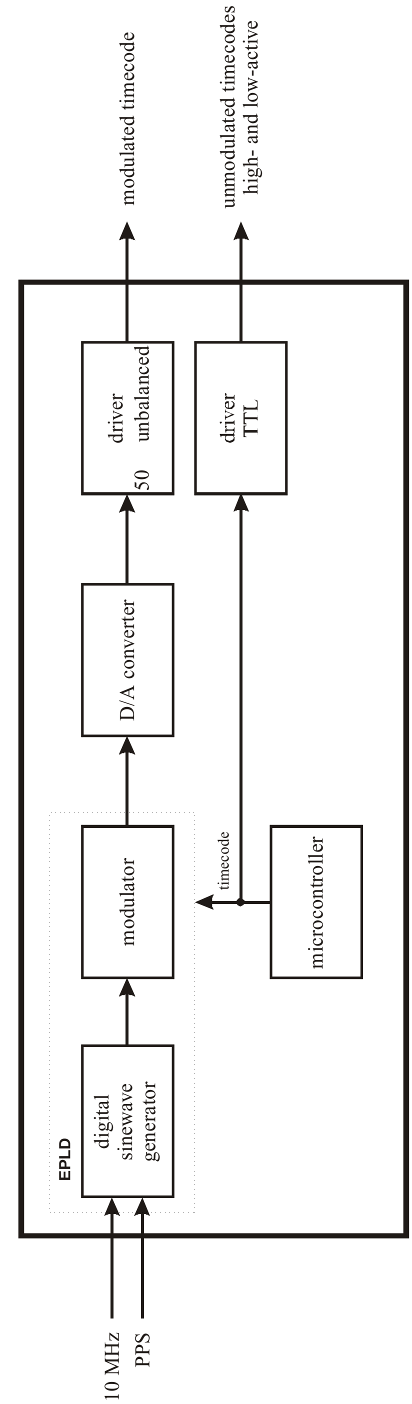
Timecode

Abstract

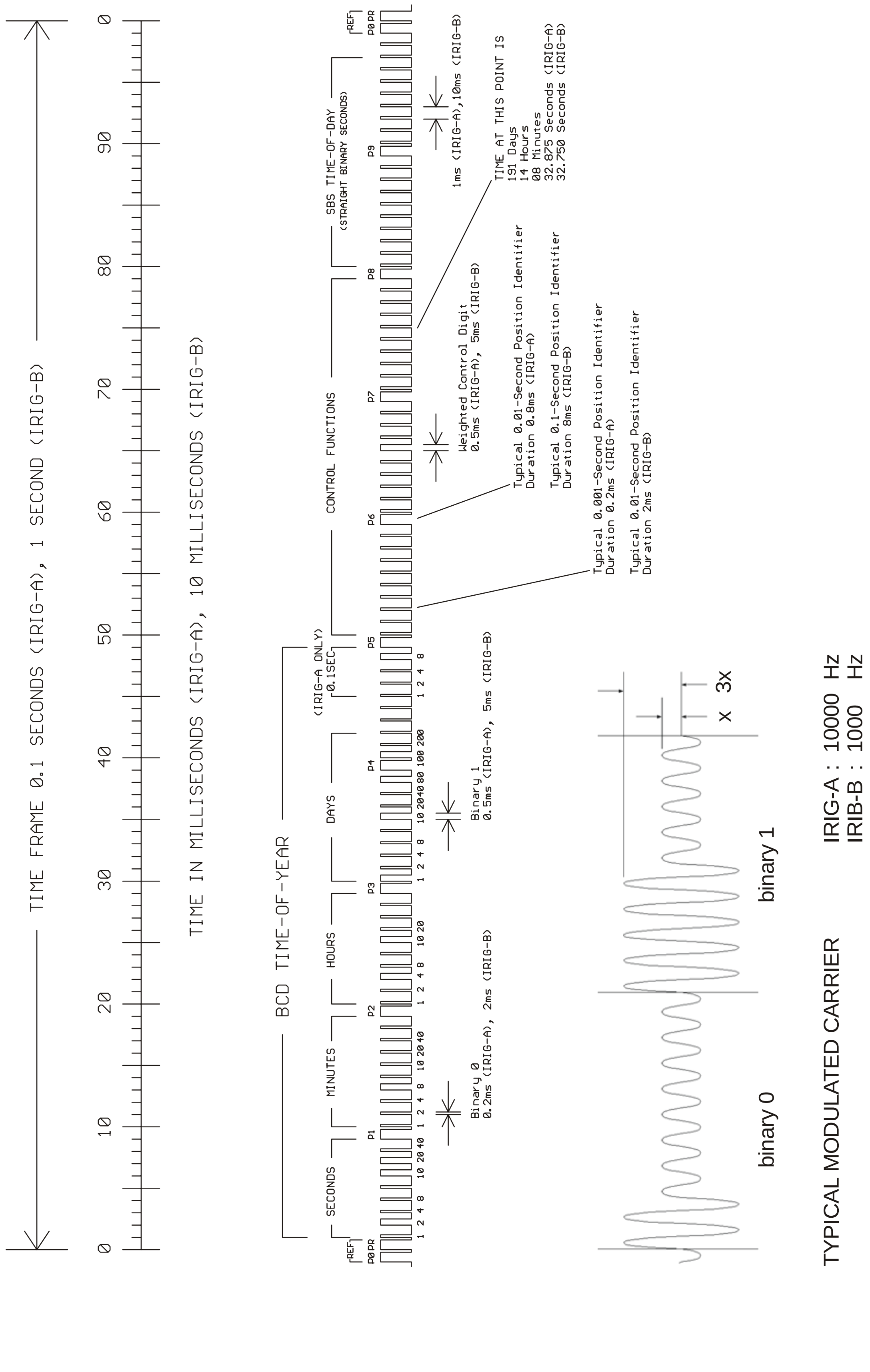
The transmission of coded timing signals began to take on widespread importance in the early 1950´s. Especially the US missile and space programs were the forces behind the development of these time codes, which were used for the correlation of data. The definition of time code formats was completely 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 PZF600 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.

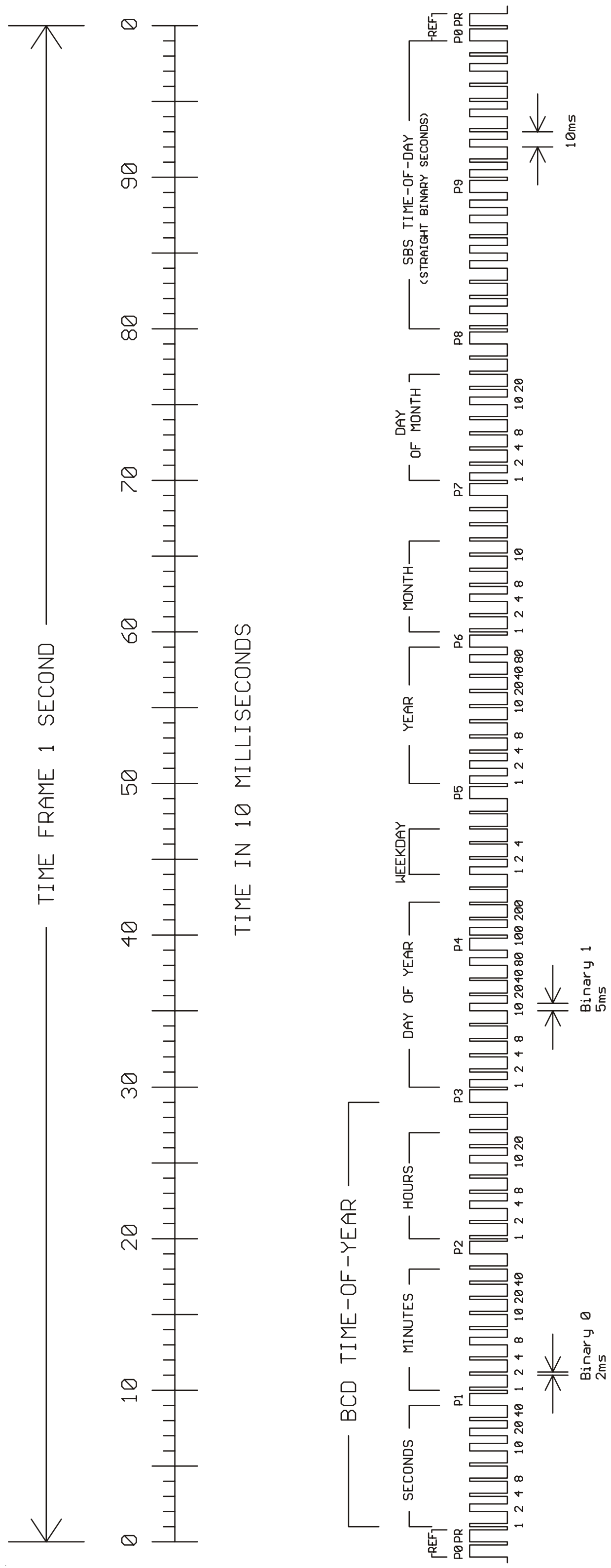
Block Diagram Timecode



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 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.)] 0x00 = Uhr synchron 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 unterstützt. *s.a. Auswahl des generierten Zeitcode*s.

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

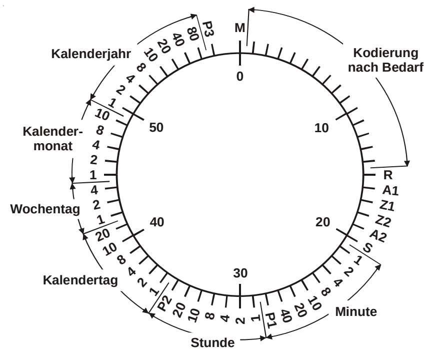
PWM DC Output

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 PZF600 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 PZF600 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 PZF600 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 'Free' 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 both buttons *Menu* **and** *Set* in the front panel are pressed concurrently 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 PZF600 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 process is independently from the content of the program memory, therefore it is possible to start this action again in case of a failure.

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. 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. 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. Life time of lithium battery: 10 years minimum Option: backup capacitor for about 150 hours
DISPLAY:	Eight-digit alphanumeric display shows important time and status information. Digit-height 5mm.
INTERFACES:	Four independent RS232 ports
BAUD RATES:	600, 1200, 2400, 4800, 9600 or 19200 Baud
FRAMING:	7N2, 7E1, 7E2, 8N1, 8N2, 8E1, 7O1, 7O2 or 8O1
PULSE OUTPUTS:	Active-high and active-low pulses per minute and per second, TTL-level, pulse duration: 200ms
ACCURACY OF PULSES:	Time delay of two systems PZF600 with a maximum distance of 50km: typ. 20µs, max. 50µs 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. 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: $3V_{PP}$ (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 Sub-miniatur coaxial HF-connector (SMB)
BOARD DIMENSIONS:	Eurocard size 100mm x 160mm, Epoxy 1,5mm Front panel 12TE (61mm)
ANTENNA:	Ferrite antenna in plastic housing (AW02)
HUMIDITY:	Relativ humidity 85% max.
TEMPERATURE RANGE:	0 ... 50°C
POWER SUPPLY:	+ 5V, 230mA

PZF600 with different oscillator options

The correlation receiver PZF600 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 τ = 1 sec	4 * 10 E-9	2 * 10 E-9	4 * 10 E-10	2 * 10 E-11
accurracy free run one day	+/- 1 * 10 E-7 +/- 1 Hz (Note 1)	+/- 2 * 10 E-8 +/- 0.2 Hz (Note 1)	+/- 1,5 * 10 E-9 +/- 15 mHz (Note 1)	+/- 5 * 10 E-10 +/- 5 mHz (Note 1)
accurracy free run one year	+/- 1 * 10 E-6 +/- 10 Hz (Note 1)	+/- 4 * 10 E-7 +/- 4 Hz (Note 1)	+/- 1 * 10 E-7 +/- 1 Hz (Note 1)	+/- 5 * 10 E-8 +/- 0.5 Hz (Note 1)
phase noise	1 Hz -60 dBc/Hz 10 Hz -90 dBc/Hz 100 Hz -120 dBc/Hz 1 kHz -130 dBc/Hz	1 Hz -60 dBc/Hz 10 Hz -90 dBc/Hz 100 Hz -120 dBc/Hz 1 kHz -130 dBc/Hz	1 Hz -75 dBc/Hz 10 Hz -110 dBc/Hz 100 Hz -130 dBc/Hz 1 kHz -140 dBc/Hz	1 Hz -95 dBc/Hz 10 Hz -125 dBc/Hz 100 Hz -145 dBc/Hz 1 kHz -155 dBc/Hz
power supply at 25°C steady state warm up	+5V / 20 mA N/A	+5V / 160 mA +5V / 380 mA	+5V / 90 mA +5V / 330 mA	+5V / 160 mA +5V / 600 mA
temperature dependant drift free run	+/- 1 * 10 E-6 (-20...70°C)	+/- 2 * 10 E-7 (0...60°C)	+/- 5 * 10 E-8 (-20...70°C)	+/- 1 * 10 E-8 (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.)
DCF77: clock has not synchronized after reset
‘ ‘ (space, 20h)
GPS: clock is synchronous (base accuracy is reached)
DCF77: clock has synchronized after reset

v: ‘*’ GPS: receiver has not checked its position
DCF77: clock currently runs on XTAL
‘ ‘ (space, 20h)
GPS: receiver has determined its position
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 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.lllle 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
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:

‘A’ announcement of leap second insertion
‘ ‘ (space, 20h) nothing announced

i	leap second insertion 'L' leap second is actually inserted (active only in 60th sec.) ' ' (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 leading signs are replaced by a space character (20h)
n	latitude, the following characters are possible: 'N' north of equator 'S' south d. equator
lll.llll	longitude of receiver position in degrees leading signs are replaced by a space character (20h)
e	longitude, the following characters are possible: 'E' east of Greenwich 'W' west of Greenwich
hhhh	altitude above sea level in meters leading signs are replaced by a space character (20h)

<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 SYSPLEX-1 Time String

The SYSPLEX1 time string is a sequence of 16 ASCII characters starting with the SOH (Start of Header) ASCII controll character character and ending with the LF (line feed, ASCII Code 0Ah) character. The format is:

<SOH>*ddd*:*hh*:*mm*:*ssq*<CR><LF>

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:

<SOH>	Start of Header (ASCII control character)	
ddd	day of year (001..366)	
hh:mm:ss	the current time:	
	hh hours	(00..23)
	mm minutes	(00..59)
	ss seconds	(00..59, or 60 while leap second)
q	Quality indicator	(space) Time Sync (GPS lock) (?) no Time Sync (GPS fail)
<CR>	Carriage-return (ASCII code 0Dh) The start bit of carriage-return is transmitted synchronous with the rising edge of the PPS pulse.	
<LF>	Line-feed (ASCII code 0Ah)	

Format of the SAT Time String

The SAT Time String is a sequence of 29 ASCII characters starting with the STX (start-of-text) character and ending with the ETX (end-of-text) character. The format is:

<STX>*dd.mm.yy/w/hh:mm:ssxxxxuv<CR><LF>*<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
sending with one bit accuracy 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)

xxxx time zone indicator:
‘UTC‘ Universal Time Coordinated, formerly GMT
‘MEZ‘ European Standard Time, daylight saving disabled
‘MESZ’ European Summertime, daylight saving enabled

u clock status characters:
‘#’ clock has not synchronized after reset
‘ ‘ (space, 20h) clock has synchronized after reset

v announcement 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

<CR> Carriage Return, ASCII Code 0Dh

<LF> Line Feed, ASCII Code 0Ah

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

Format of the SPA Time String

The SPA Time String is a sequence of 32 ASCII characters starting with the characters ">900WD" and ending with the <CR> (Carriage Return) character. The format is:

>900WD:*yy-mm-tt_hh.mm;ss.fff*:*cc*<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:

yy-mm-tt	the current date:		
	yy	year of the century	(00..99)
	mm	month	(01..12)
	dd	day of month	(01..31)
_	Space (ASCII code 20h)		
hh.mm;ss.fff	the current time:		
	hh	hours	(00..23)
	mm	minutes	(00..59)
	ss	seconds	(00..59, or 60 while leap second)
	fff	milliseconds	(000..999)
cc	Check sum: Exclusive-Or result of all previous characters, displayed as a HEX byte (2 ASCII characters 0..9 or A..F)		
<CR>	Carriage Return, ASCII Code 0Dh		

Format of the Computime Time String

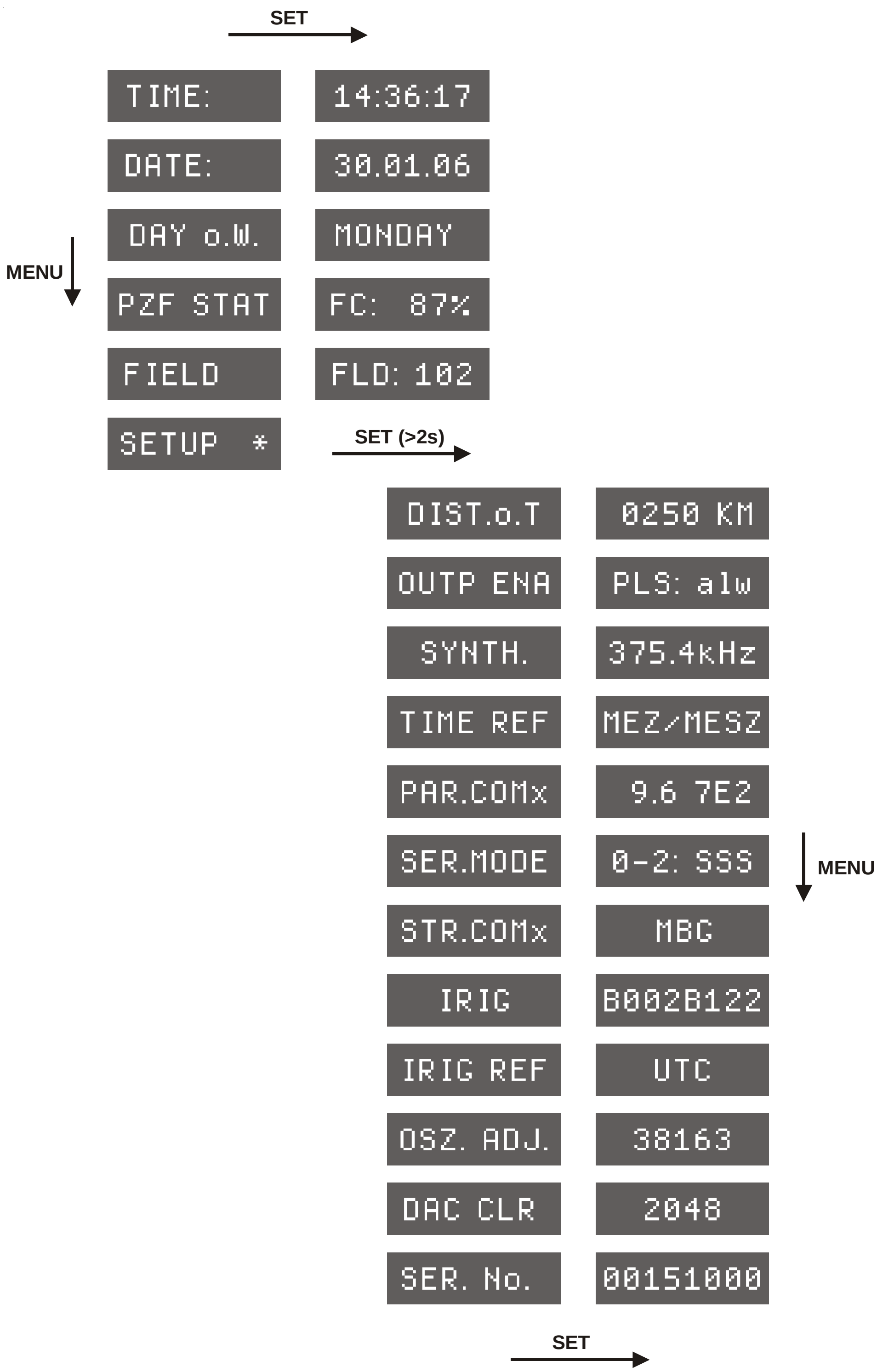
The Computime time string is a sequence of 24 ASCII characters starting with the T character and ending with the LF (line feed, ASCII Code 0Ah) character. The format is:

T:*yy*:*mm*:*dd*:*ww*:*hh*:*mm*:*ss*<CR><LF>

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:

T	Start character sending with one bit accuracy at change of second		
yy:mm:dd	the current date:		
	yy	year of the century	(00..99)
	mm	month	(01..12)
	dd	day of month	(01..31)
ww	the day of the week		(01..07, 01 = monday)
hh:mm:ss	the current time:		
	hh	hours	(00..23)
	mm	minutes	(00..59)
	ss	seconds	(00..59, or 60 while leap second)
<CR>	Carriage Return, ASCII Code 0Dh		
<LF>	Line Feed, ASCII Code 0Ah		

Menu Quick Reference PZF600



Signal description PZF600

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 pulse duration: 100ms or 200ms
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
COM3 TxD out	18a	COM3 RS-232 output
COM3 RxD in	17a	COM3 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	/BSL in	reserved
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	COM3 RxD in	DCF_MARK out
18	COM3 TxD out	
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

PZF600-PZF600-E-19.04.11