

**ZZG 2**  
Time Signal Generator - **MANUAL**

Manual for the  
TIME SIGNAL GENERATOR – ZZG 2



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## 1 Short description

The ZZG2 is a battery powered LCD-clock which is able to display hours : minutes : seconds and the date. As a special feature the clock can simulate codes of different time-signals and can transmit these generated signals with a special internal ferrit antenna. Additionally the ZZG2 is able to communicate with microcontroller modules of type MCM RS232.

According to these features the ZZG2 can be used as:

- support of RF-clocks in showrooms where you can't receive the original time-signal
- support of RF-clocks outside the receiving area of original transmitter
- to convert the time-signal (support of RF-clocks through other transmitters)
- table clock

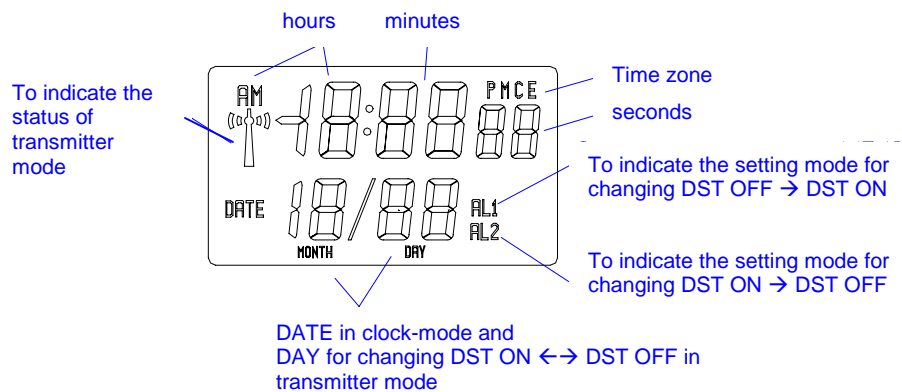
## 2 Type of products

In function of the requested code of time-signal and of its transmitting- (carrier-) frequency the ZZG2 can be offered in the following versions:

Description	code of time-signal / carrier frequency
Simulator USA	WWVB / 60 kHz
Simulator DCF	DCF / 77.5 kHz
Simulator MSF	MSF / 60 kHz

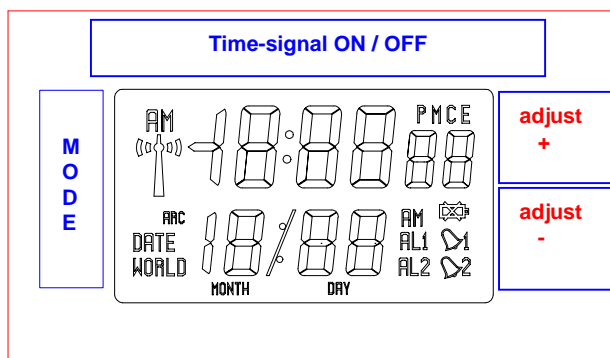
## 3 Construction

### 3.1 LCD



### 3.2 Operation keys

Time-signal ON/OFF	to switch the transmitter mode ON/OFF
MODE	to change the display-mode and the operation-mode
adjust +	to enlarge the display value in the adjust- (setting-) mode
adjust -	to reduce the display value in the adjust- (setting-) mode



### 3.3 Transmitter

#### 3.3.1 Code

In function of the selected ZZG2-version there can be simulated the time signals of the following transmitting stations:

- ◆ DCF
- ◆ MSF
- ◆ WWVB

##### 3.3.1.1 DCF

The simulated DCF-signal includes the complete time-, check- and status-information like the original German time signal transmitter DCF77. The content of bit-positions of the 15<sup>th</sup> to the 20<sup>th</sup> second are fixed as follows:

Second	content
15	always 0
16	announcement for the coming change: summer-time (DST ON) $\leftrightarrow$ winter-time (DST OFF) bit "A1"
17	=0 for MEZ; =1 for MESZ bit "Z1"
18	=1 for MEZ; =0 for MESZ bit "Z2"
19	always 0
20	always 1

The change from winter- (DST OFF; MEZ) to summer-time (DST ON; MESZ) and reverse will be done automatically at that time specified before in the corresponding setting mode. The corresponding bit-positions which belong to this information will be changed accordingly. Please also refer to the attached application hints (chapter 6).

##### 3.3.1.2 MSF

The simulated MSF-signal includes all time-information and check-bits like the original British time signal transmitter MSF. The Fast-Code wouldn't be simulated. Special data bits are coded as follows:

Second	content
1 ÷ 16	always 0 (double impulse)
53	announcement for the coming change to summer-time (DST ON)
58	=1; if standard time (DST OFF) bit "BST" =0; if summer-time (DST ON)

The change from winter- (DST OFF) to summer-time (DST ON) and reverse will be done automatically at that time specified before in the corresponding setting mode. The corresponding bit-positions which belong to this information will be changed accordingly. Please also refer to the attached application hints (chapter 6).

##### 3.3.1.3 WWVB

The simulated WWVB-Signal works like the original US time-signal respecting the fact that some of the included bits are always constant.

Second	content
35, 36, 37	UT1 all bits = 0
41 ÷ 44	UT1 Set all bits = 0
56	Leap Second = 0

The change from winter- (DST OFF) to summer-time (DST ON) and reverse will be done automatically at that time specified before in the corresponding setting mode. The corresponding bit-positions which belong to this information will be changed accordingly.

### 3.3.2 Transmitter parameters

#### Modulation

The AM-modulation (amplitude modulation) of the carrier frequency of all stations (DCF, MSF, WWVB) is different.

#### Accuracy

The accuracy of the clock is internally tuned by a trimmable capacitor in order to guarantee a tolerance of  $\leq 1$  sec. per day ( $T=20^{\circ}\text{C}$ ; constant). There is used a crystal for the time base. The temperature dependence of that crystal should be taken into account. Depending on the requirement we recommend to check the accuracy of internal time base in constant intervals.

The difference between consecutive second impulses is  $< 5\text{ms}$ . The long term precision of the generated carrier frequency is about  $\pm 100\text{ppm}$  ( $T=20^{\circ}\text{C}$ ; constant). It isn't necessary to calibrate the carrier frequency.

### 3.3.3 Transmitter Mode

The power supply of the transmitter part can be realized or by the internal system battery or by a separate, external plug-in power supply. In order to get a longer life time of the internal system battery the ZZG2 offers different operation modes of the transmitter:

#### ■ temporary operation

Once the ZZG2 is in its main clock-display mode, a short push of the button „TIME SIGNAL ON/OFF“ starts the transmitter for 10 minutes. A flashing tower-icon appears in the LCD (left upper corner). After 10 min. the ZZG2 automatically stops the transmission of time-signal and returns to the clock-mode.

#### ■ permanent operation (about 10 hours operation time only if powered exclusive by system-battery)

Once the ZZG2 is in its main clock-display mode, a long push ( $> 3$  sec.) of the button „TIME SIGNAL ON/OFF“ starts the transmitter to work permanently. The tower-icon is statical shown in the LCD (left upper corner). The time-signal is continuously transmitted.

In both operation modes the active mode of transmitter can be switched OFF by a short push of the button „TIME SIGNAL ON/OFF“.

### 3.3.4 Power supply

The ZZG2 can be powered or by the internal system battery (2\*LR6; AA-size) or by a separate, external plug-in power supply. Using batteries, the ZZG2 can run in its clock-mode for about 1 year (Transmitter switched OFF!).

To extend the operation-time of the ZZG2 we recommend the use of an external power supply which has to be connected to the provided DC-socket. By this way can be increased also the power of the transmitted time signal (transmitter ON). It will be about 70% higher than in battery-supply mode.

Technical specification of external power supply:

Voltage:	9V $\pm$ 12V DC		
Current:	$\geq 150\text{mA}$		
Connector:	chinch (GND outside)		
	inside dimension:	2.1 mm	
	outside dimension:	5.5 mm	
	length:	11 mm	

## 3.4 Serial Interface

### 3.4.1 Transmitting parameters

Baud rate:	300 baud
Data bits:	8
Stop bits:	2
Parity:	not considered
Content of data-bits:	please refer to the description of serial protocol of the MCM RS232 module

### 3.4.2 Functions

By use of the serial interface the ZZG2-clock can be synchronized by another radio-controlled clock (for example MCM RS232) supporting the same serial interface and data protocol. The supplied time-information (included in the serial data protocol) will be tooked over once the ZZG2 is powered ON, at each full hour and after each manual setting of the ZZG2-clock. Applying this regular and automatic time synchronization the tolerance between the original time-signal and the generated time-signal (ZZG2 transmitter) can be kept <100ms.

## 4 Handling

### 4.1 Function of operation keys

button	Clock Mode		Setting Mode	
	short push of the button	long push of the button (>3 sec.)	short push of the button	long push of the button (>3 sec.)
<b>Adjust +</b>			Increments (+1) the selected value or moves it forward in the listing (step by step)	Continuous Increment of the selected value
<b>Adjust -</b>			decrements (-1) the selected value or moves it backward in the listing (step by step)	Continuous decrement of the selected value
<b>MODE</b>	to switch between display-modes: a) system time (internal time base) and b) transmitter data	If pressed in display-mode a): • to enter the <b>setting mode</b> ; an active transmitter is automatically switched OFF  If pressed in display-mode b): • to switch between operation modes: b1) display of transmitter data and b2) generation and display of a test-pattern	to select the next parameter	
<b>Time Signal ON/OFF</b>	• to switch ON the transmitter for 10 min (temporary operation) • to switch OFF the transmitter in all modes if it was active before	• to switch ON the transmitter (permanent operation)	• to leave the <b>setting mode</b> ; • the transmitter is automatically switched ON for 10 minutes (temporary operation)	• to leave the <b>setting mode</b> ; • the transmitter is automatically switched ON (permanent operation)

### 4.2 LCD Display

General display information:

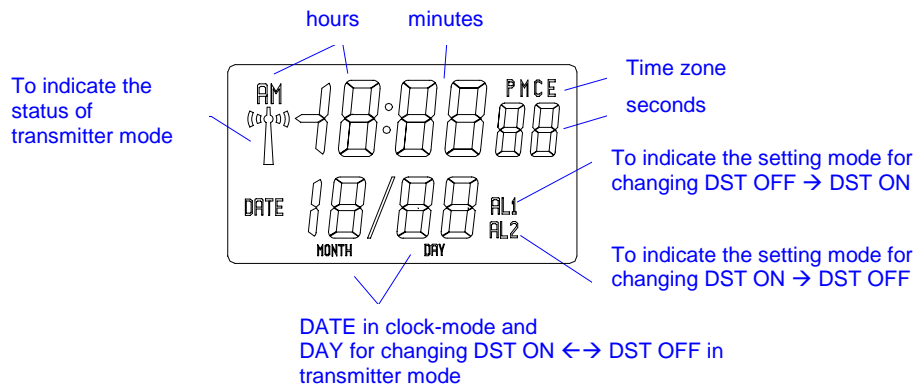
Upper digit-line: hours, minutes, seconds  
 Lower digit-line: date  
 Special symbols: AM, PM symbols to decide hours before noon (AM) and after noon (PM) in 12h time-display  
 P,M,C,E time zones for the USA (Pacific, Mountain, Central, Eastern)  
 radio tower shows the transmitter-status:  
 OFF = transmitter is switched OFF  
 ON = transmitter is switched ON (permanent operation)  
 flashing = transmitter is switched ON for 10min. (temporary operation)  
 MONTH active if the date is shown  
 DAY active if the date is shown

Display during setting mode:

Selected datas which can be modified by the keys "Adjust +" and/or "Adjust -" will be displayed flashing.

Special symbols:

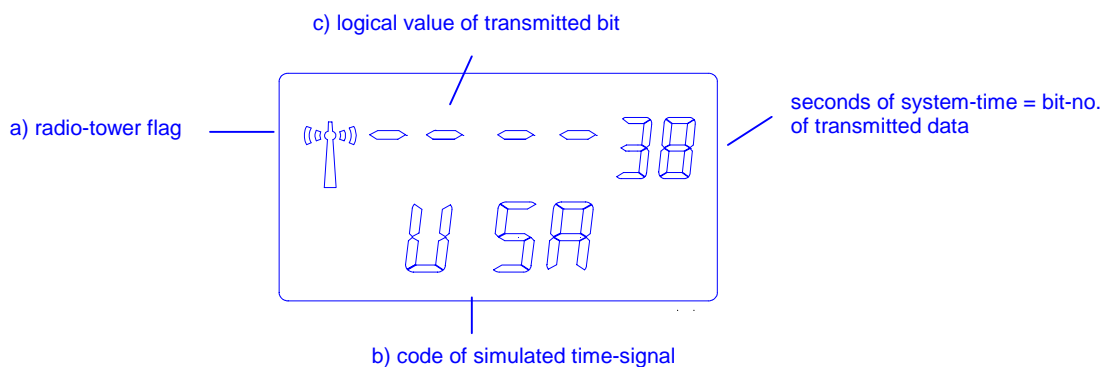
- AL1 indicates the setting mode for datas specifying the change DST OFF (winter time) → DST ON (summer time)
- AL2 indicates the setting mode for datas specifying the change DST ON (summer time) → DST OFF (winter time)



Display mode of transmitter datas:

Once the system-time is shown in the clock-mode the display-mode can be switched to transmitter-datas by a short push of the MODE-button.

The digits in the lower LCD-line will indicate the type of simulated time-signal in function of the ZZG2-version.



- to a) radio-tower flag shows the transmitter-status:  
 OFF = transmitter is switched OFF  
 ON = transmitter is switched ON (permanent operation)  
 flashing = transmitter is switched ON for 10min. (temporary operation)

to b):

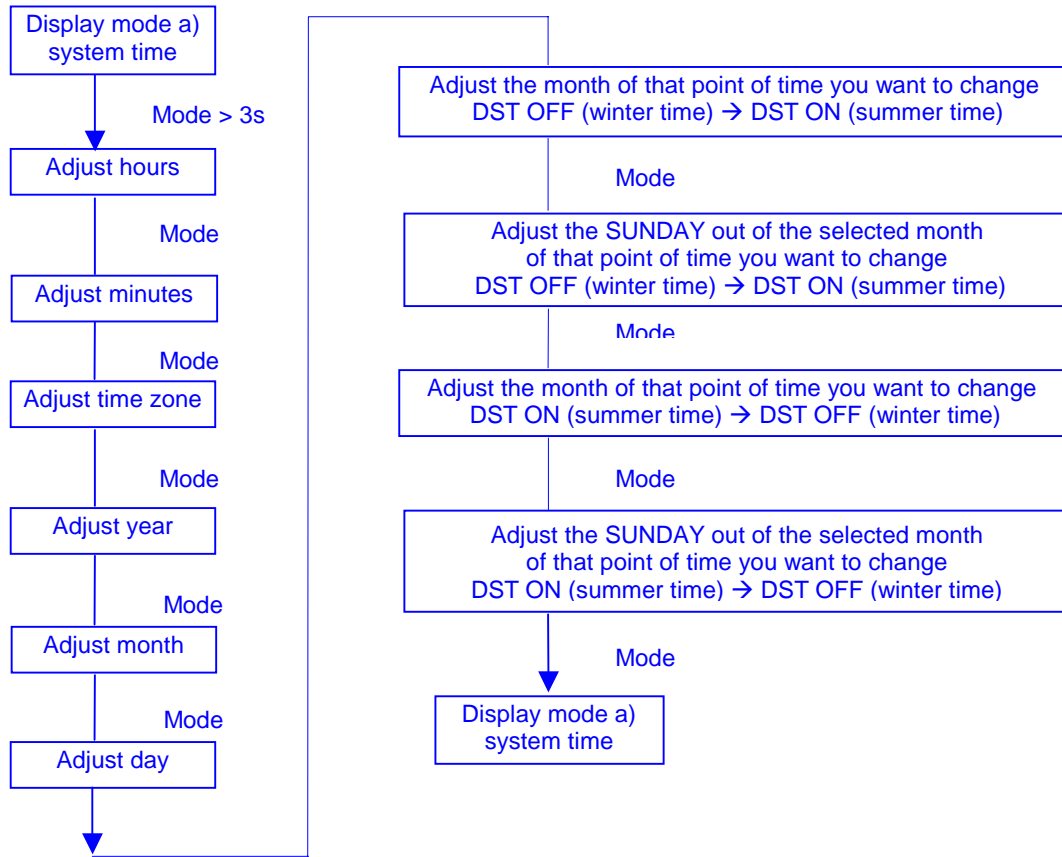
Code of simulated time-signal	Display indicator
WWVB	USA
MSF	MSF
DCF	DCF

- to c) Each transmitted bit (second) having the logical value "1" is indicated by a short line. Bits of logical value "0" wouldn't be shown. Their position will be kept free. Each new second-bit appears beside the tower-flag and moves then from left to right in 1 Hz rhythm.

### 4.3 Manual settings – setting mode

You can enter the setting-mode by pressing the MODE-button >3s if the ZZG2 works in display-mode a) of the clock-mode. An active transmitter is automatically switched OFF. During the setting mode it wouldn't be transmitted any signal!

All possible setting steps are shown in the following scheme:



#### NOTES:

- You can leave the setting mode at any time by pressing the button "Time Signal ON/OFF". In the same time the transmitter is automatically switched ON.
- Once the minutes will be adjusted manually the seconds will be set to "00". The clock will be re-started exactly once the „MODE“ -key is pressed afterwards.
- The points of time for changing DST ON (summer time) → DST OFF (winter time) and reverse are predefined by the software. It is possible to change these datas manually inside of the setting mode. You will have access to these DST- parameters once all settings for the system-time were done.
- The point of time for DST-changings is always defined by the corresponding month and the corresponding Sunday out of the selected month. The setting range for the change "DST OFF (winter time) → DST ON (summer time)" allows the values March (3) .... Mai (5). The setting range for the change "DST ON (summer time) → DSTOFF (winter time)" allows the values Sept. (9) ... Nov. (11). For each of these months can be selected the first, second, third, fourth or the last Sunday of the month.
- For each direction of DST-changing has to be specified one set of parameters. Two LCD-flags are used to indicate to which direction the current data belongs:
 

AL1	indicates datas which specify the change "DST OFF (winter time)→ DST ON (summer time)
AL2	indicates datas which specify the change "DST ON (summer time)→ DST OFF (winter time)
- Manually adjusted parameters for DST-changings will be lost by each POWER ON Reset !

#### 4.4 Automatical setting / synchronization of the system time

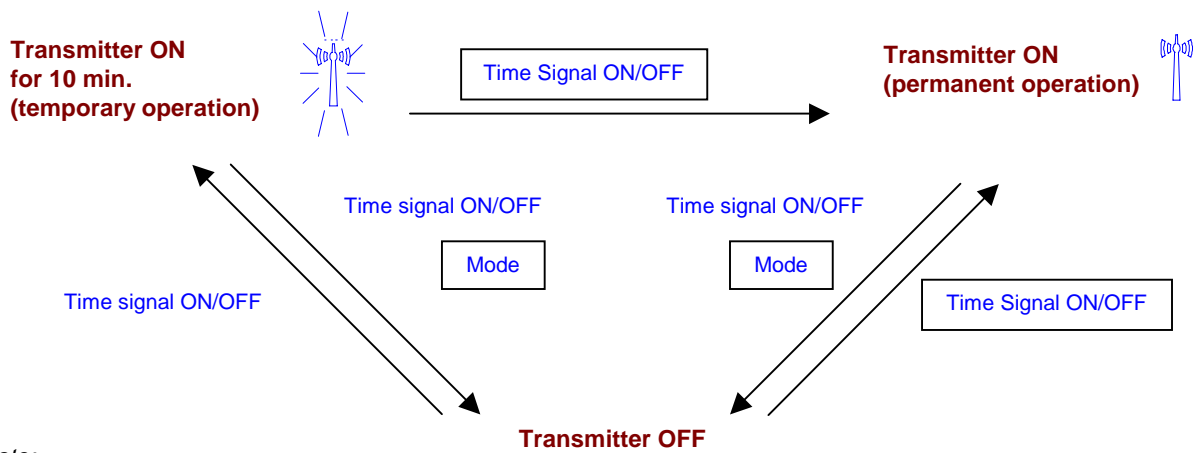
By use of the serial interface the ZZG2 can be connected to another radio-controlled clock supporting the same serial interface and data protocol. By this way the system time of the ZZG2 can be automatically synchronized to the time and date of the connected radio-controlled clock. Supposing that both units are connected to each other by a corresponding interface-cable, the supplied time-information (included in the serial data protocol) will be read in by the ZZG2 in the following situations:

- once the ZZG2 is powered ON
- at each full hour and
- after each manual setting of the ZZG2-clock.

Applying this regular and automatic time synchronization the tolerance between the original time-signal and the generated time-signal (ZZG2 transmitter) can be kept <100ms.

Note: HKW offers a special type of radio controlled digital clock supporting the ZZG2-interface.

#### 4.5 Application of the transmitter mode (time signal generator)

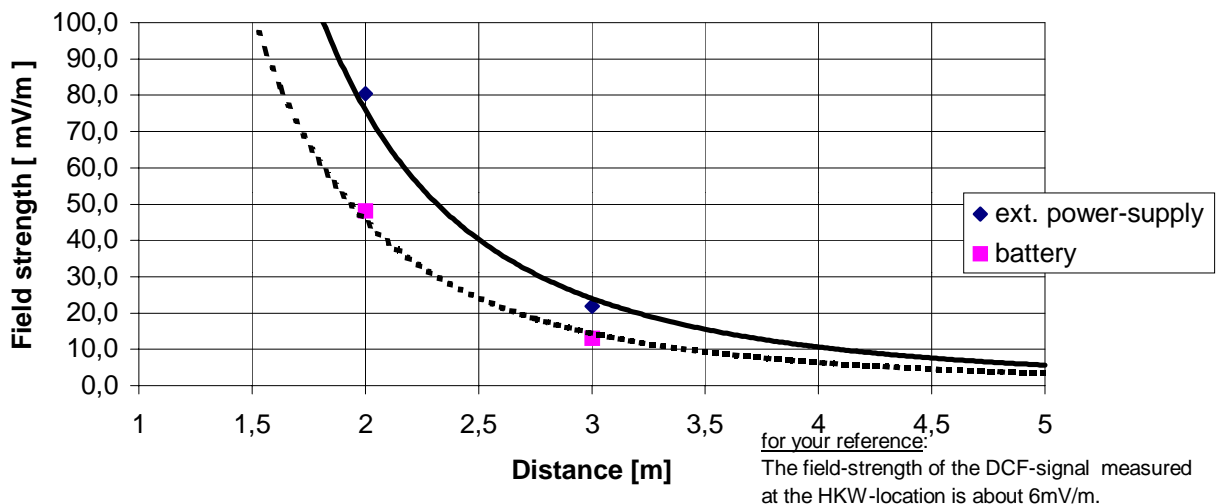


Note:

symbol of used button	operation needed
button	short push of "button"
button	press "button" > 3 sec.

The power of the ZZG2-transmitter is strong enough to allow other radio controlled clocks/watches to receive the generated signal in a distance of up to 1... 5m around the transmitting unit.

#### Transmitter-Power



For a successful application of the ZZG2 please respect the following points:

- The diagram shown above demonstrates the dependence of measured field strength in function of the distance to the ZZG2-transmitter. This diagram represents the correct situation as long as the receiving antenna is in a parallel position to the transmitting antenna of the ZZG2-transmitter. If the antennas are in another position to each other then the field strength found by the receiving unit will be more weak.
- Radio controlled clocks/watches (units under test) which has to receive the time-signal transmitted by the ZZG2-transmitter have to be placed in a minimum distance to the ZZG2. The field strength found by the "unit under test" has to be  $\leq 100$  mV/m. If the field strength is too strong then the receiver can't process the signal due to its overmodulation.
- To find the max. allowed distance between ZZG2 and the "unit under test" please put the receiving antenna into a parallel position to the transmitting antenna. There should be avoided any kind of electro-magnetical disturbances. They should be kept away in especially from the receiving unit.
- In case that more than one "unit under test" shall receive the transmitted signal in the same time then they should keep a minimum distance of about 20cm to each other (supposing a 2-dimensional placement).
- The operation distance (the transmitting and receiving range) will be reduced once the ZZG2 and/or the units under test will be placed on a metallic surface.
- If more than one ZZG2-transmitters are used in the same time and inside their transmitting range, then their transmitted signals will influence each other. It wouldn't be possible to receive any accurate signal.

**Important:**

We recommend to switch ON the ZZG2-transmitter only as long as it is needed for the corresponding application. Otherwise there can appear overlapping problems with other signal-sources (for example on exhibitions).

## 5 Technical parameters

power supply:	battery 2 x 1.5V, LR06, 2000mAh or battery 2 x 1.5V ,R06 zinc-coal, 1000mAh
external power supply:	
Voltage:	9V $\pm$ 12V DC
Current:	$\geq 150$ mA
Connector:	chinch (GND outside)
	inside dimension: 2.1 mm
	outside dimension: 5.5 mm
	length: 11 mm
current consumption:	
clock	about 150...200 $\mu$ A
transmitter:	about 100mA
life time (battery-supply):	
clock only	about. 1 year (transmitter OFF)
transmitting mode	about. 10 hours; transmitter ON (permanent operation)
transmitting range:	about. 5 m
time accuracy:	$\pm 50$ ppm (T = 20°C; constant)
short time tolerance of transmitted signal:	$\pm 3$ ms (V1.4; measured at the emulator)
carrier frequency of transmitted signal:	77500Hz or 60000Hz
tolerance of carrier frequency:	$\pm 100$ ppm
modulation:	WWVB -10dB DCF 25% MSF 0%
Connector for the serial interface:	modular jack / top entry / 6/6-poli
	<u>Pin-configuration:</u> 1: GND 2: RS232-OUT 3: GND 4: RS232-IN

## 6 Application hints

The comportation of the simulated bits A1, Z1, Z2 (DCF77-protocol) and of the “announcement bit” and BST-bit (MSF-protocol) isn’t 100% compatible to the corresponding original time-code!

Bit-status of original DCF77- (MSF-) time-code:

	Notation	No. of second	Summer time DST ON	Winter time DST OFF
A1 ( ... )	announcement bit	16 (53)	0	0
Z1	summer time bit 1	17	1	0
Z2 (BST)	summer time bit 2	18 (58)	0	1

Real situation of simulated DCF77- (MSF-) time-code:

- At the day of time-change “summer time  $\leftrightarrow$  winter time” the announcement bit A1 is transmitted with the logical value “1” starting with the protocol of the first minute.
- The announcement bit A1 will be set back (deleted) after the time-change “**winter time  $\rightarrow$  summer time**” at 3:00 o'clock.

Example:

Date	Time	A1 ( ... )	Z1	Z2 (BST)	Status / comment
1. April 2000	23:59	0	0	1	Winter-time
2. April 2000	00:00	1	0	1	Day of time-change to summer-time
	01:58	1	0	1	
	01:59	1	0	1	Last minute of winter-time
	03:00	0	1	0	First minute of summer-time

- During the time-change “**summer time  $\rightarrow$  winter time**” the corresponding bits wouldn’t be automatically set back to “winter-time”. The corresponding bits will be updated only once the manually setting-mode was entered or sometimes by switching ON/OFF the transmitter-signal.

Example:

Date	Time	A1 ( ... )	Z1	Z2 (BST)	Status / comment
30. Sept. 2000	23:59	0	1	0	Summer-time
01. Oct. 2000	00:00	1	1	0	Summer-time
	01:59	1	1	0	Summer-time
	02:00	1	1	0	Summer-time
	02:59	1	1	0	Summer-time
	02:00	1	1	0	Winter-time
	02:59	1	1	0	Winter-time
	03:00	1	1	0	Winter-time
					Winter-time
	06:06	0	0	1	(bit-setting after starting the manually setting mode)

Note: correct setting of the ZZG2 to simulate the time-change “summer time  $\rightarrow$  winter time”:

To simulate the time-change “summer time  $\rightarrow$  winter time” the corresponding point of time can be manually set only in this way: 00:00 .... 2:59 o'clock summer time  
03:00 .... and later winter time

To repeat the simulation of this time-change don’t use the decrement-function of the setting mode! You cannot re-install the summer-time settings by changing hours backwards. Please change hours only forward by use of the increment function.