MEINBERG
FUNKUHREN

Technical Data

Operating Instructions

TCR510

Incl. Software TCRMON

Impressum

Werner Meinberg
Auf der Landwehr 22
D-31812 Bad Pyrmont

Telefon: 0 52 81 / 9309-0
Telefax: 0 52 81 / 9309-30

Internet: **http://www.meinberg.de**
Email: **info@meinberg.de**

November, 11, 2005

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Introduction

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 Instrumantation 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 TCR510 however only decodes IRIG-A, IRIG-B or AFNOR NFS 87-500 formats. The AFNOR code is a variant of the IRIG-B format. Within this code the complete date is transmitted instead of the ‘Control Functions’ of the IRIG-telegram.

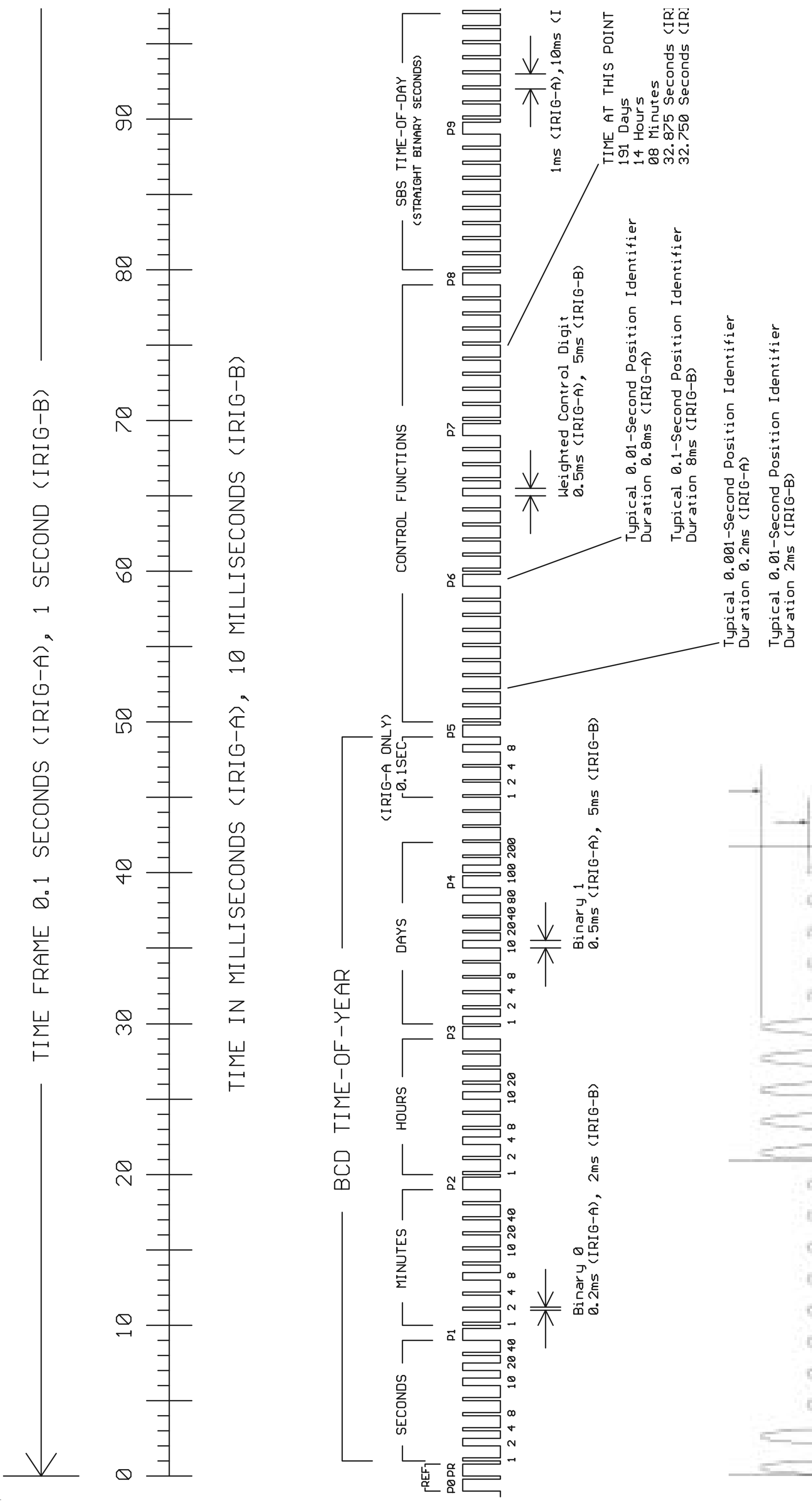
Description of IRIG-Codes

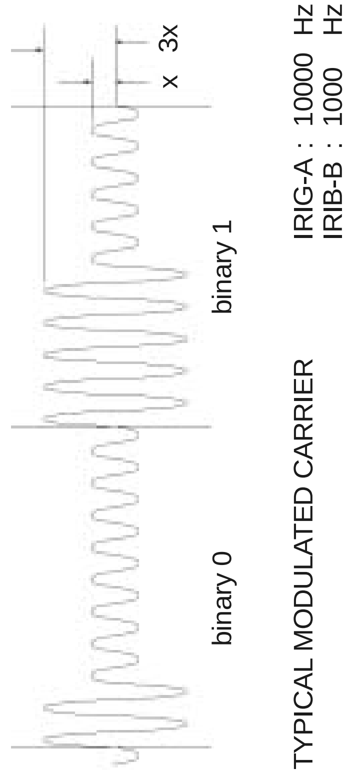
The specification of individual IRIG time code formats is defined in IRIG Standard 200-98. They are described by an alphabetical character followed by a three-digit number sequence. The following identification is taken from the IRIG Standard 200-98 (only the codes relevant to TCR510 are listed):

character	bit rate designation	A	1000 pps
		B	100 pps
1st digit	form designation	0	DC Level Shift width coded
		1	sine wave carrier amplitude modulated
2nd digit	carrier resolution	0	no carrier (DC Level Shift)
		1	100 Hz, 10 msec resolution
		2	1 kHz, 1 msec resolution
		3	10 kHz, 100 µsec resolution
3rd digit	coded expressions	0	BCD, CF, SBS
		1	BCD, CF
		2	BCD
		3	BCD, SBS

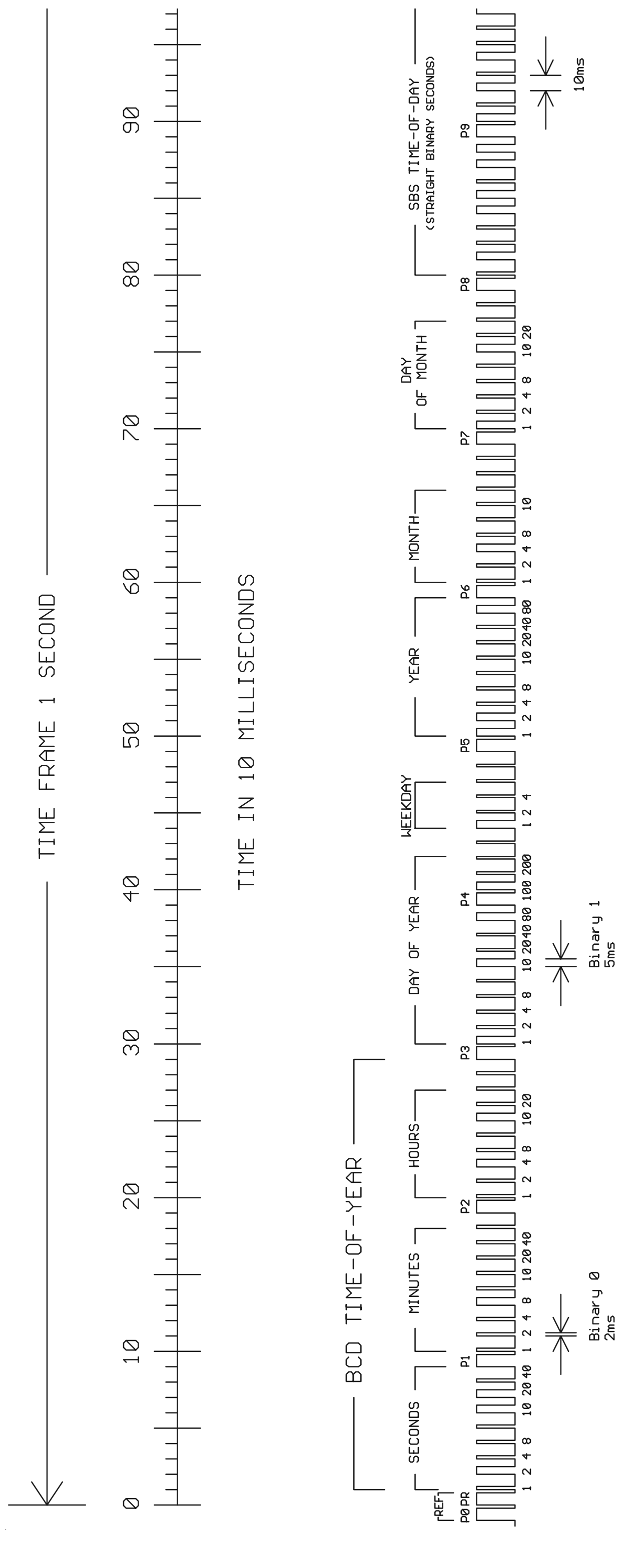
BCD: time of year, BCD-coded
CF: Control-Functions (user defined)
SBS: seconds of day since midnight (binary)

IRIG-Standard format





AFNOR-Standard format



Overview

The Board TCR510 was designed for the decoding of unmodulated and modulated IRIG- and AFNOR time codes. Modulated codes transport the time information by modulating a sinusoidal carrier signals amplitude whereas unmodulated signals employ a pulse width modulated DC signal.

The receivers automatic gain control allows the reception of signals within a range from abt. 600mVpp up to 8Vpp. The potential free input can be jumper selectable terminated in either 50Ω, 600Ω or 5kΩ. Modulated codes are applied to the board via an on board SMB connector.

The unmodulated or 'DC Level Shift' time codes are applied via pins 21c and 22c of the 64pin VG connector. Galvanic insulation of this input is obtained by an opto coupler device.

TCR510 provides two configurable serial ports (RS232 or 1xRS485 option), a pulse per minute and per second (PPS / PPM) as well as a DCF Simulation port at TTL Level. Further three fixed frequency outputs at 100kHz, 1MHz and 10MHz at TTL Level are available

The boards micro controller provides a Bootstrap-Loader that allows updating the firmware stored in Flash-Memory via serial port COM0 by using the program mbgflash.exe.

Function principle

After the received IRIG code has passed a consistency check, the software clock and the battery backed real time clock of TCR510 are synchronized to the external time reference. If an error in the IRIG telegram is detected, the boards system clock switches into holdover mode.

Apart from the codes AFNOR NFS 87-500 and IEEE1344, IRIG codes do not carry a complete date but the number of the day within the current year (1...366). Hence the date that is output in the serial telegram must be completed by the date stored in the buffered real time clock. The day within the current year calculated from the RTCs date is compared with the day number from the IRIG code every minute. When a mismatch between these two day numbers is detected the board signalizes freewheeling mode, however the systems time base will continue to synchronize with the IRIG signal. The DCF-Simulation is suppressed in this case.

Time and date of the real time clock can be set by a Meinberg Standard Telegram via serial port COM0. Received IRIG-Time can be re-calculated into UTC provided that no time zone changeovers such as daylight saving appear in the received IRIG telegrams. For more information please see chapter 'UTC-Offset' in the online documentation of the enclosed software TCRMON.

IRIG telegrams don’t include announcers for the change of time zone (daylight saving on/off) or for the insertion of a leap second. Hence the clock will switch into freewheeling mode in case of such event, and resynchronize afterwards.

The board TCR510 decodes the following formats:

A133:	1000pps, amplitude modulated sine wave signal, 10 kHz carrier frequency BCD time of year, SBS time of day
A132:	1000pps, amplitude modulated sine wave signal, 10 kHz carrier frequency BCD time of year
A003:	1000pps, DC Level Shift pulse width coded, no carrier BCD time of year, SBS time of day
A002:	1000pps, DC Level Shift pulse width coded, no carrier BCD time of year
B123:	100pps, amplitude modulated sine wave signal, 1 kHz carrier frequency BCD time of year, SBS time of day
B122:	100pps, amplitude modulated sine wave signal, 1 kHz carrier frequency BCD time of year
B003:	100pps,DC Level Shift pulse width coded, no carrier BCD time of year, SBS time of day
B002:	100pps, DC Level Shift pulse width coded, no carrier BCD time of year
AFNOR NFS 87-500:	100pps, amplitude modulated sine wave signal, 1 kHz carrier frequency BCD time of year, complete date, SBS time of day

Setting into operation

To ensure proper operation, please pay attention to the following points.

Supply Voltage

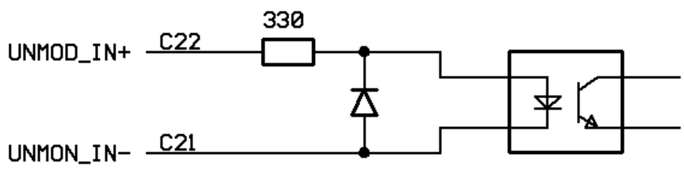
The boards microprocessor system needs a supply voltage of +5V / 200mA. Additionally the Oscillator supply voltage (+5V or +12V depends on type) must be applied via 64pin VG connector. The voltage feed shall be low impendance and for each of the voltages pins a + c at VG connector shall be used.

Input Signals

Modulated IRIG or AFNOR-Codes are applied via the on board SMB connector. The lead should be shielded. Unmodulated codes are applied at Pins 21c ad 22c of the 64pin VG connector. Voltages applied to this input shall not exceed 12V. The IRIG-Code to be used must be set at the DIP Switch.

Input for unmodulated codes

Unmodulated IRIG-Codes, often referred to as pulse with coded or DC-Level Shift Codes (DCLS), are fed into the board via pins C21 and C22 off the 64pin VG connector. Insulation of this input is done by a opto coupler device. The input circuitry is shown below.



Input for modulated codes

Modulated codes must be applied to the on board SMB Connector. An automatic gain control allows decoding of codes within an amplitude range from abt. 600mVpp up to 8Vpp. To allow adaptation of different time code generators, the boards input impedance can be selected by an on board jumper.

Input impedance

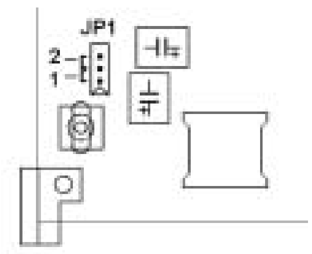
The IRIG-specification doesn't define values for the output impedance of generators or the input impedance of receivers. This fact led to incompatibility of some modules, because the manufacturers could choose the impedances freely. For example: if the output impedance of the generator is high and the input impedance of the receiver low, the signal level at the receiver input might be too low for correct decoding. Therefore the board TCR510 provides a jumper to select the impedance (50 Ω, 600 Ω or 5 kΩ) of the input for modulated codes (SMB) to comply with the requirements of several systems.

Meinberg IRIG-generators have an output impedance of **50 Ω**, to build a matched transmission system when using a coaxial cable. If such a generator is used to synchronize TCR510, the input impedance has to be set to 50 Ω accordingly (default on delivery).

In addition to the telegram, the **AFNOR-code** defines the input/output impedances also. If TCR510 is synchronized by this code, an input impedance **600 Ω** of must be set.

The setting „5 kΩ" may be necessary if the generator has a high output impedance (see specifications of manufacturer). The driver software shows a bar chart for evaluation of the signal level at the receiver input.

The following detail of the place plan of TCR510 shows the possible jumper setting with the related input impedance:



JP1 in position 1 - 50 Ω
JP1 in position 2 - 600 Ω
JP1 open - abt. 5k Ω

Pulse and frequency outputs

The board provides pulses on second and minute changeover (P_SEC, P_MIN). Additionally fixed frequencies at 100kHz, 1MHz and 10MHz are derived from the master oscillator. Each of these signals is available at TTL Level on the rear panel 64pin connector.

TIME_SYN-Output

This TTL output can be used to monitor the synchronization state of the board. The TIME_SYN signal is in high state whenever the clock is synchronized with the applied IRIG-Code. It shows low state when the applied code cannot be read, the consistency check fails or a system failure like brown-out or watchdog reset occurs.

Serial Ports

The board provides two indepentently configurable serial ports at RS232 level. Optionally, the port COM1 is available as RS485 version. Both serial ports output the Standard Meinberg telegram. Telegrams can either be output automatically on second changeover or on request (ASCII char '?' received). Serial port COM0 can additionally be used to communicate with the enclosed monitor software. A firmware update using mbgflash.exe is done via this channel as well.

Status LEDs

The boards state is signalized by two front panel leds. The red FAIL led indicates the free wheeling mode. It is activated when the board has switched into freewheling mode, and turned off when the clock is synchronized. The green LOCK led shows the state of the internal time. LOCK is turned on when the timebase regulation has settled.

Configuration of the board

Configuration of the IRIG format to be used as well as the serial ports can be done by an on board DIP-Switch.

Selecting the IRIG format

The IRIG or AFNOR format to be used can be selected by switches SW1-7 to SW1-10. Please note that modulated and unmodulated code formats are applied to the board at separate inputs.

Code	SW1-7	SW1-8	SW1-9	SW1-10
B122/B123	Off	Off	Off	Off
A132/A133	On	Off	Off	Off
B002/B003	Off	On	Off	Off
A002/A003	On	On	Off	Off
AFNOR NFS 87-500	Off	Off	On	Off
AFNOR NFS 87-500 (DC)	On	Off	On	Off

The code AFNOR NFS 87-500 (DC) is the unmodulated version of the AFNOR code. This unmodulated code is not standardized. The standard AFNOR-NFS 87-500 confines to the modulated signal.

Baudrate and framing of the serial ports

Baudrate and framing can be configured independently for each serial port by two DIP-switches.

SW1-1	Baudrate COM0
off	19200
on	9600

Baudrate of COM0

SW1-2	Framing COM0
off	8N1
on	7E2

Framing of COM0

SW1-4	Baudrate COM1
off	19200
on	9600

Baudrate of COM1

SW1-5	Framing COM1
off	8N1
on	7E2

Framing of COM1

Output mode of the serial ports

Two diffrent modes are configurable for each of the serial ports. Mode 'per second' causes the port to output a timestring automatically on second changeover. In 'on request' mode the timestring is output on the next second changeover after a serial char '?' (ASCII Code 3Fh) has been received.

SW1-3	Mode COM0
off	on request '?'
on	per second

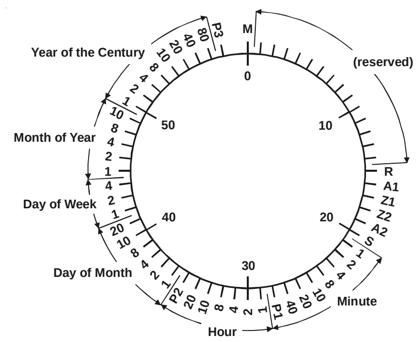
Mode of serial port COM0

SW1-6	Mode COM1
off	on request '?'
on	per second

Mode of serial port COM1

DCF Simulation

The DCF_MARK output (TTL) produces a time mark signal similar to the signals transmitted by the german VLF time code transmitter DCF77. Within one minute a complete time code frame is transmitted. Since there are no timezone and leap second announcements in the IRIG time code, these announcement flags (daylight saving flag, leap second flag) are neglected. The generated DCF telegram always contains the time information which is derived from the IRIG Signal and the system clock. When receiving a time code telegram containing a leap second (field sec. is 60) the DCF simulation is turned off for a minute. By this the re-synchronization of all clocks connected to the simulation outputs is enforced. The issued DCF time code frame contains a date information which is derived from the system clock. The validity of the system clock date is ensured by a 'day of year' comparison. In case of an invalid system clock date the DCF simulation is turned off. System clocks initial date can be set via COM0. In case of brown out or power failure a lithium battery guarantees the system clocks operation for at least ten years.



M	Start of Minute (0.1 s)	
R	RF Transmission via secondary antenna	
A1	Announcement of a change in daylight saving	
Z1, Z2	Time zone identification	
	Z1, Z2 = 0, 1:	Daylight saving disabled
	Z1, Z2 = 1, 0:	Daylight saving enabled
A2	Announcement of a leap second	
S	Start of time code information	
P1, P2, P3	Even parity bits	

Updating the Firmware

Whenever it is necessarry to upgrade the on-board software, the new firmware can be downloaded using the serial port COM0.

If the /BOOT input, which is available on the 64 Pin VG-Connector, is pulled low during at power up reset or the on board boot key is pressed, an internal bootstrap-loader is activated and waits for instructions from the serial port COM0. A loader program will be shipped together with the file containing the image of the new firmware. The current fimware is retained in the flash memory until the download program sends a command to erase the flash. So if the boot sequence was initiated erroneously, the program memory is not deleted accidently. The system is ready to go after the next power up.

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.

Technical Specifications TCR510

RECEIVER INPUT:	<u>AM INPUT (SMB-Connector) :</u> insulated by transformer impedance : 50 Ω, 600 Ω , 5 kΩ selectable by jumper input signal : abt.600mVpp to 8V (Mark) other ranges on request <u>DC-Level Shift Input (VG-Connector)</u> insulated by opto-coupler device internal series resistor : 330Ω max. input current: 25mA diode forward voltage : 1.0V...1.3V
DECODING:	decoding of the following codes possible : IRIG-A133/A132/A003/A002 IRIG-B123/B122/B003/B002 AFNOR NFS 87-500
ACCURACY OF TIME BASE :	+/- 10us compared to IRIG reference marker
REQUIRED ACCURACY OF TIME CODE SOURCE :	+/- 100ppm
HOLDOVER MODE:	automatic switching to crystal time base, accuracy : see. accuracy of Oscillator
BACKUP BATTERY :	onboard realtime clock keeps time and date in case of power supply failure. System parameters are stored in battery buffered ram lifetime of Lithium battery at least 10 years
RELIABILITY OF OPERATION:	microprocessor supervisory circuit generates reset in case of brown-out, software watchdog generates reset in case of improper program execution
INITIALIZATION:	initial time and date can be set by standard meinberg telegram via serial port COM0
PULSE OUTPUTS:	pulse per second PPS, TTL-Level pulse, active high, 200ms pulse width pulse per minute PPM, TTL-Level pulse, active high, 200ms pulse width

FREQUENCY OUTPUTS:	10MHz TTL-Level 1MHz TTL-Level 100kHz TTL-Level
RELATIVE ACCURACY OF FREQUENCIES COMPARED TO IRIG SOURCE:	+/- 1e-8 with TCXO-HQ option +/- 5e-9 with OCXO-LQ option
STATUS OUTPUT:	TIME_SYN, TTL LEVEL, active high when clock is synchronuos
SERIAL PORTS:	two independent RS232 ports
BAUDRATES:	9600Bd, 19200Bd
FRAMINGS:	7E2, 8N1
OUTPUT CYCLE:	per second or per minute
SERIAL TELEGRAM:	Meinberg Standard Telegram
REAR EDGE CONNECTOR:	according to DIN41612, type C 64, rows a+c (male)
POWER CONSUMPTION:	VCC +5V, abt. 300mA VDD +5V, abt. 50mA with TCXO-HQ option max. 500mA OCXO-LQ/MQ
PHYSICAL DIMENSIONS:	Eurocard 100mm x 160 mm, 1,5mm Epoxy
AMBIENT TEMPERATURE:	0...50°C
HUMIDITY:	max. 85%

CE-Label

This device conforms to the directive 89/336/EWG on the approximation of the laws of the Member States of the European Community relating to electromagnetc compatibility.

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)

Signals at Rear Connector

Signal	Pin	Description
VCC in (+5V)	1a+c	+5V Voltage Supply
VDD in	3a+c	Supply Voltage Oscillator
GND	32a+c 31a+c 19a, 20a, 21a, 22a, 23a, 24a, 25a, 26a, 27a, 28a, 29a, 30a	Ground
P_SEC	6c	pulse per second, TTL-Level
P_MIN	8c	pulse per minute, TTL-Level
RESERVE	10c	Reserved
DCF_MARK	17c	DCF-Simulation, TTL-Level
TIME_SYN	19c	Status Output, TTL-Level
10MHz	12a	Freq. Output10MHz, TTL-Level
1MHz	11a	Freq. Output1MHz, TTL-Level
100kHz	10a	Freq. Output 100kHz, TTL-Level
UNMOD_IN+	21c	+Input unmodulated IRIG Code
UNMOD_IN-	22c	-Input unmodulated IRIG Code
COM0 RxD	26c	COM0 RS-232 Input
COM0 TxD	30c	COM0 RS-232 Output
COM1 RxD	29c	COM1 RS-232 Input
COM1 TxD	24c	COM1 RS-232 Output
/BOOT	4a	Boot-Input, starts bootstrap loader if hold low during power up reset

Rear Connector Pin Assignements

	a	c
1	VCC in (+5V)	VCC in (+5V)
2		
3	VDD in (OSC)	VDD in (OSC)
4	/BOOT	
5		
6		P_SEC
7		
8		P_MIN
9		
10	100kHz	RESERVE
11	1MHz	
12	10MHz	
13		
14		
15		
16		
17		DCF_MARK
18		
19	GND	TIME_SYN
20	GND	
21	GND	UNMOD_IN-
22	GND	UNMOD_IN+
23	GND	
24	GND	COM1 TxD
25	GND	
26	GND	COM0 TxD
27	GND	
28	GND	
29	GND	COM1 RxD
30	GND	COM0 RxD
31	GND	GND
32	GND	GND

Conncetor acc. DIN41612, type C 64, rows a + c (male)

Diskette with Windows Software TCRMON

The program TCRMON

The program TCRMON can be used to program the time offset from UTC and the initial time of Meinberg IRIG-Receivers. The Software is executable under Win9x/2k/NT. To install TCRMON just run Setup.exe from the included diskette and follow the instructions of the setup program

To obtain a serial connection from IRIG receiver to PC, serial port **COM0** of TCR must be connected to a free serial port of the PC. The host PCs serial port as well as baudrate and framing can be selected on tab sheet **‚PC-Comport'**. The selected serial parameters of the PC must match to those of the TCR (see DIP Switches). Further, serial mode of the TCR must be set to **STRING_PER_SECOND**.

Online Help

The online help can be started by clicking the menu item 'Help' in menu Help. In every program tab a direct access to a related help topic can be obtained by pressing F1. The help language can be selected by clicking the menu items Deutsch/Englisch in the Help Menu.