Technical Data

Operating Instructions

TCR510

Incl. Software TCRMON
Impressum

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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 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 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):

<table>
<thead>
<tr>
<th>character</th>
<th>bit rate designation</th>
<th>A</th>
<th>B</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>1000 pps</td>
<td>100 pps</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>1st digit</th>
<th>form designation</th>
<th>0</th>
<th>DC Level Shift</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>width coded</td>
<td>1</td>
<td>sine wave carrier</td>
</tr>
<tr>
<td></td>
<td>amplitude modulated</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>2nd digit</th>
<th>carrier resolution</th>
<th>0</th>
<th>no carrier (DC Level Shift)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>100 Hz, 10 msec resolution</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1 kHz, 1 msec resolution</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>10 kHz, 100 µsec resolution</td>
<td>3</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>3rd digit</th>
<th>coded expressions</th>
<th>0</th>
<th>BCD, CF, SBS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1 BCD, CF</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>2 BCD</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>3 BCD, SBS</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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

TIME FRAME 0.1 SECONDS (IRIG-A), 1 SECOND (IRIG-B)

0 10 20 30 40 50 60 70 80 90

TIME IN MILLISECONDS (IRIG-A), 10 MILLISECONDS (IRIG-B)

BCD TIME-OF-YEAR

SECONDS | MINUTES | HOURS | DAYS | (IRIG-A ONLY) | B. SEC | CONTROL FUNCTIONS | SBS TIME-OF-DAY

Binary 0
0.2ms (IRIG-A), 2ms (IRIG-B)

Binary 1
0.5ms (IRIG-A), 5ms (IRIG-B)

TYPICAL MODULATED CARRIER
IRIG-A: 10000 Hz
IRIG-B: 1000 Hz

binary 0
binary 1

x 3x
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**: 1000ppps, amplitude modulated sine wave signal, 10 kHz carrier frequency
  - BCD time of year
  - SBS time of day
- **A132**: 1000ppps, amplitude modulated sine wave signal, 10 kHz carrier frequency
  - BCD time of year
- **A003**: 1000ppps, DC Level Shift pulse width coded, no carrier
  - BCD time of year
  - SBS time of day
- **A002**: 1000ppps, DC Level Shift pulse width coded, no carrier
  - BCD time of year
- **B123**: 100ppps, amplitude modulated sine wave signal, 1 kHz carrier frequency
  - BCD time of year
  - SBS time of day
- **B122**: 100ppps, amplitude modulated sine wave signal, 1 kHz carrier frequency
  - BCD time of year
- **B003**: 100ppps, DC Level Shift pulse width coded, no carrier
  - BCD time of year
  - SBS time of day
- **B002**: 100ppps, DC Level Shift pulse width coded, no carrier
  - BCD time of year
- **AFNOR NFS 87-500**: 100ppps, 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 board’s 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 impedance 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 board’s 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 64-pin 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 independently 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 board's state is signaled by two front panel LEDs. The red FAIL LED indicates the free wheeling mode. It is activated when the board has switched into freewheeling 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.

<table>
<thead>
<tr>
<th>Code</th>
<th>SW1-7</th>
<th>SW1-8</th>
<th>SW1-9</th>
<th>SW1-10</th>
</tr>
</thead>
<tbody>
<tr>
<td>B122/B123</td>
<td>Off</td>
<td>Off</td>
<td>Off</td>
<td>Off</td>
</tr>
<tr>
<td>A132/A133</td>
<td>On</td>
<td>Off</td>
<td>Off</td>
<td>Off</td>
</tr>
<tr>
<td>B002/B003</td>
<td>Off</td>
<td>On</td>
<td>Off</td>
<td>Off</td>
</tr>
<tr>
<td>A002/A003</td>
<td>On</td>
<td>On</td>
<td>Off</td>
<td>Off</td>
</tr>
<tr>
<td>AFNOR NFS 87-500</td>
<td>Off</td>
<td>Off</td>
<td>On</td>
<td>Off</td>
</tr>
<tr>
<td>AFNOR NFS 87-500 ( DC )</td>
<td>On</td>
<td>Off</td>
<td>On</td>
<td>Off</td>
</tr>
</tbody>
</table>

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.

<table>
<thead>
<tr>
<th>SW1-1</th>
<th>Baudrate COM0</th>
</tr>
</thead>
<tbody>
<tr>
<td>off</td>
<td>19200</td>
</tr>
<tr>
<td>on</td>
<td>9600</td>
</tr>
</tbody>
</table>

Baudrate of COM0

<table>
<thead>
<tr>
<th>SW1-2</th>
<th>Framing COM0</th>
</tr>
</thead>
<tbody>
<tr>
<td>off</td>
<td>8N1</td>
</tr>
<tr>
<td>on</td>
<td>7E2</td>
</tr>
</tbody>
</table>

Framing of COM0

<table>
<thead>
<tr>
<th>SW1-4</th>
<th>Baudrate COM1</th>
</tr>
</thead>
<tbody>
<tr>
<td>off</td>
<td>19200</td>
</tr>
<tr>
<td>on</td>
<td>9600</td>
</tr>
</tbody>
</table>

Baudrate of COM1

<table>
<thead>
<tr>
<th>SW1-5</th>
<th>Framing COM1</th>
</tr>
</thead>
<tbody>
<tr>
<td>off</td>
<td>8N1</td>
</tr>
<tr>
<td>on</td>
<td>7E2</td>
</tr>
</tbody>
</table>

Framing of COM1
Output mode of the serial ports

Two different 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.

<table>
<thead>
<tr>
<th>SW1-3</th>
<th>Mode COM0</th>
</tr>
</thead>
<tbody>
<tr>
<td>off</td>
<td>on request '?'</td>
</tr>
<tr>
<td>on</td>
<td>per second</td>
</tr>
</tbody>
</table>

Mode of serial port COM0

<table>
<thead>
<tr>
<th>SW1-6</th>
<th>Mode COM1</th>
</tr>
</thead>
<tbody>
<tr>
<td>off</td>
<td>on request '?'</td>
</tr>
<tr>
<td>on</td>
<td>per second</td>
</tr>
</tbody>
</table>

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.
**Updating the Firmware**

Whenever it is necessary 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 firmware 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:**
- **AM INPUT (SMB-Connector):** insulated by transformer
- **Impedance:** 50 Ω, 600 Ω, 5 kΩ, selectable by jumper
- **Input signal:** abt.600mVpp to 8V (Mark), other ranges on request

**DC-Level Shift Input (VG-Connector):**
- 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 synchronous

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 electromagnetic 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:

\(<\text{STX}>\text{D}:\text{dd.mm.yy};\text{T}:\text{w};\text{U}:\text{hh.mm.ss};\text{uv}\text{xy}<\text{ETX}>\)

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:

\(<\text{STX}>\quad\text{Start-Of-Text (ASCII code 02h)}\)

\(\text{dd.mm.yy}\) the current date:

\(\text{dd}\) day of month (01..31)
\(\text{mm}\) month (01..12)
\(\text{yy}\) year of the century (00..99)

\(\text{w}\) the day of the week (1..7, 1 = Monday)

\(\text{hh.mm.ss}\) the current time:

\(\text{hh}\) hours (00..23)
\(\text{mm}\) minutes (00..59)
\(\text{ss}\) seconds (00..59, or 60 while leap second)

\(\text{uv}\) clock status characters (depending on clock type):

\(\text{u}\) “#” GPS: clock is running free (without exact synchr.)
PZF: time frame not synchronized
DCF77: clock has not synchronized after reset

(white space, 20h)

GPS: clock is synchronous (base accuracy is reached)
PZF: time frame is synchronized
DCF77: clock has synchronized after reset

\(\text{v}\) “*” GPS: receiver has not checked its position

PZF/DCF77: clock currently runs on XTAL

(white space, 20h)

GPS: receiver has determined its position

PZF/DCF77: clock is synchronized with transmitter

\(\text{x}\) time zone indicator:

‘U’ UTC Universal Time Coordinated, formerly GMT

‘\ ‘ MEZ European Standard Time, daylight saving disabled

‘S’ MESZ European Summertime, daylight saving enabled

\(\text{y}\) announcement 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

(white space, 20h) nothing announced

\(<\text{ETX}>\quad\text{End-Of-Text (ASCII code 03h)}\)
### Signals at Rear Connector

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

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<tr>
<td>3</td>
<td>VDD in (OSC)</td>
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Connector 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_PERSECOND.
**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.